Factors in the identification and treatment of stuttering

Stephen Roger Davis

Thesis submitted for PhD
University College London
December 2001
This thesis is dedicated to Pete Howell for showing me the path and to Dawn for her constant encouragement to walk it. It is also dedicated to those people, too numerous to name individually, who, when the light became dim and the path was unclear, helped to light my way...
## CONTENTS

Abstract 1
Acknowledgements 2

**Chapter 1. Introduction and review of the literature** 5
History of stuttering 5
Demographic features of stuttering 5
Preliminaries on definition of the disorder 8
Factors that are considered to aid diagnosis 9
Defining stuttering events for the purpose of diagnosis 22
Critique of diagnostic research using the multifactor approach 25
Methods of defining recovery 26
Review of retrospective studies 26
Critique of retrospective studies 28
Review of prospective or longitudinal studies 29
Critique of prospective or longitudinal studies 30
Yairi's work on factors predicting recovery 31
Prospects for a multifactor examination of the causes of stuttering 32
Conclusion 33

**Chapter 2. The EXPLAN model of fluency failure** 34

**Chapter 3. Sociodynamic relationships between CWS and their non-stuttering classmates** 50
Abstract 50
Introduction 50
Method 57
Results 59
Discussion 71
Chapter 4. Assessment of cerebellar performance in children who stutter and controls

Abstract 81
Introduction 82
Method 91
Results 96
Discussion 108

Chapter 5. Diagnosing stuttering using linguistic analysis of dysfluent speech

Abstract 112
Introduction 112
Method 119
Results 122
Discussion 127

Chapter 6. General discussion

Summary of results and implications for diagnosis 134
The identification and treatment of stuttering 137
The treatment of children who stutter 138
Future directions 145
Concluding summary 151

Appendices

Appendix A. The report of the initial stages of the development and validation of a communication attitude assessment instrument for use with young children. 134
Appendix B. Chapter 1 – Survey documents 178
Appendix C. Chapter 3 – Location and details of schools 180
Appendix D. Chapter 3 – Information regarding individual children who stutter, together with composition of peer groups 181
Appendices (continued)
Appendix E. Chapter 3 – Sample parental information letter 189
Appendix F. Chapter 3 – Behavioural categories 190
Appendix G. Chapter 3 – SBS Questionnaire 191
Appendix H. Chapter 4 – Scores on the Dow and Moruzzi Battery 193

References 196
ABSTRACT

A large number of children with a diagnosis of stuttering will recover, often without formal treatment. This recovery pattern highlights the importance of a clear, early diagnosis and has implications for therapeutic practice. This thesis investigated three factors that could assist speech and language therapists in their diagnosis and treatment of children who stutter (CWS). Those factors were social, motor and speech skills. A pilot study investigating a fourth factor, communication attitude, is reported as an appendix. All factors were investigated from the perspective of the EXPLAN model of fluency failure. EXPLAN suggests that a combination of speech timing and phonological difficulty is an important source of fluency failures. The investigation into the social skills of CWS indicated that there is a trend for CWS to hold a lower social position to that of age matched controls. CWS were more likely to be bullied at school than their peers. The relationship between stuttering severity and social status was not significant. The motor skills study, using a battery of tests of cerebellar function (Dow & Moruzzi, 1958), indicated that CWS showed a deficit in performance on balance/posture tests at a young age and on complex movement tasks at teenage when compared to age matched controls. These differences are discussed with relation to auditory and cerebellar function. The fluency of a group of CWS was examined using phonological word analysis (Au-Yeung & Howell, 1998). Five children were producing predominantly part-word repetitions at initial assessment. Four of these children had persisted in their stutter when followed up three years later. Results suggest that information regarding motor skills and linguistic analysis of speech may be useful in the diagnosis and treatment of CWS. The results of the experimental work are discussed with relation to their theoretical and clinical significance.
ACKNOWLEDGEMENTS

The wide ranging investigation into the factors that may aid the diagnosis of children who stutter that was carried out for this thesis necessitated the assistance of several members of the Speech Research Group at University College London. It is important to acknowledge their contribution. I am indebted to Professor Peter Howell for the amount of time and effort he has contributed to this thesis, often above and beyond the call of duty. The thesis examines socialisation problems in children who stutter, their attitude to communication, speech-language indices and how they change through development and assesses whether children who stutter have cerebellar deficits. Norah Fredrickson was my second supervisor and I am extremely grateful for her positive input and enthusiasm throughout. Her advice on the measurement of socialisation and attitude in children was particularly valuable. Dr Richard Baker wrote the computer program for the communication attitude assessment. Students working with the Speech Research Group carried out the preliminary work on the collection of data for the socialisation and communication attitude studies. I am grateful to Charlotte Dawson, Anna Killick and Gemma Simons for their help. I have drawn on the experience of Dr James Au-Yeung for language analysis and for advice on the assessment of cerebellar function. Isabel Vallejo Gomez has carried out the majority of the transcriptions necessary for language analysis. It makes sense to employ these techniques to obtain data for the multivariate analysis of diagnosis that will be the culmination of my work so it is better informed with speech-language and motor skills measures. At the same time, it is necessary to clearly identify my role. In the speech-language data, I have been principally responsible for making the recordings and I am fully conversant with the transcription and analysis procedures (though not competent to develop them). Included in Chapter 5 is a report of the methods I employed in collection of the data and a description of the analysis procedures Au-Yeung and Vallejo Gomez have performed on them. I collected and analysed all the data for the cerebellar assessments. Similarly, I was responsible for the collection and analysis
of the data from the socialisation and communication attitude studies. Stevie Sackin has provided invaluable assistance with database management.

Outside of the Speech Research Group I am indebted to the Speech and Language Therapists at The Michael Palin Centre for Stammering Children and at the Department of Clinical Communications, City University for their support during the course of this thesis. They have allowed me to work with the children who stutter who are in their care and have shown a positive interest in my research. Finally, my thanks go to the schools and to all the parents and children who have participated in this work. Without their involvement and co-operation this thesis would not have been possible. The schools (who are listed separately), despite the pressures of the current education system, have been helpful and accommodating. The parents of the children who participated have given generously of their time to complete numerous questionnaires and to accompany their offspring on their visits to the speech laboratory at UCL. The children have cheerfully submitted to even more questionnaires, assessments and tests, my deepest thanks go to all of them.

The following schools have given freely of their time and resources to assist in the research featured in thesis. I am indebted to the staff and students involved.

Ashford High School, Ashford, Middlesex
Aveland School, Billingborough, Lincolnshire
Cherry Orchard Primary School, Worcester
Chiswick Community School, Chiswick, London W4
Fawbert and Barnard School, Harlow, Essex
Feltonfleet School, Cobham, Surrey
Goodrich School, Dulwich, London SE22
Heathlands School, Hounslow, Middlesex
Holy Trinity School, Dobcross, Lancashire
Leiston Middle School, Leiston, Suffolk
Little Pandon Junior School, Harlow, Essex
Manor Junior School, Barking, Essex
Marlborough Primary School, Isleworth, Middlesex
Marshland High School, Wisbech, Cambridgeshire
Merchant Taylors School, Northwood, Middlesex
Sacred Heart School, Redcar, Cleveland
Saint Johns School, Rotherhithe, London SE16
Saint Patricks School, Southampton
Chapter 1.  
Introduction and review of the literature

History of Stuttering
The Chinese poet Laotze made the first known record of stuttering over 2,500 years ago. It is also documented in the Judaeo-Christian bible (circa 1,200 BC). The Ancient Greeks often wrote of stuttering. For instance, Aristotle suggested “stuttering is due to a weak tongue that acts too sluggishly to keep up with the conceptions of the mind.” In Roman times, Claudius was probably the most famous person who stutters and in the ninth century a Frankish king was given the name “Ludwig the stutterer”.

There are also historical recommendations about the treatment of stuttering. In the 1580’s, for example, Doctor Mercuralis prescribed “calm life, regular bowels and vigorous exercise” for those that stutter. Francis Bacon in the 1620’s stated, “that in those that stutter, if they drink wine moderately, they stutter less, because it healeth.”

Demographic features of Stuttering
Stuttering is a widespread disorder. The onset of dysfluency usually occurs between the ages of 3 and 5 (Dalton and Hardcastle, 1977) and affects approximately 5% of the population (Conture, 1996 – USA; Mansson, 2000 – Denmark). Figures indicate that 80% of young children who are diagnosed as stuttering recover to normal fluency (Starkweather, 1983; Yairi and Ambrose, 1999), leaving an incidence of one in hundred in the adult population (Andrews and Harris, 1964; Bloodstein, 1987). Indeed, 40% of children recover without formal intervention (Sheehan and Martyn, 1970) and this is comparable with the proportion that recovers with intervention (Martin and Lindamood, 1986).

Attention has been focussed on the onset of stuttering as catching a disorder at onset offers better potential for treatment. A leading figure who has investigated this area is Ehud Yairi from Illinois. Yairi (1993) has put the onset of the disorder at around three and a half years. Other studies have even suggested an earlier onset than this (Bernstein Ratner, 2000). There is also documentation indicating what happens in subsequent childhood years. In a retrospective study, Morley (1957) investigated four hundred
clinical cases and found that in 50% reported onset prior to aged five, 90% before eight, and 99% before 13 years. The onset of stuttering in adulthood is rare and is normally associated with a traumatic event rather than arising in children who develop normally in areas other than their speech. Morley (1957) cited research that showed adult males began stuttering while in active service during World War I and during World War II (Peacher and Harris, 1946).

The prevalence of the disorder differs between the sexes. The British Stammering Association states that the ratio of males to females is 3:1 at onset, and increases to 6:1 in adulthood. Theories have attempted to explain why there is this difference between genders. For instance, Mills and Streit (1942) suggested that although male development of speech is slower than that of females, society pressurises males to be more concerned about attaining fluent speech. If they are unable to achieve this goal, anxiety results that, in turn, leads to stuttering. West, Nelson and Berry (1939) proposed the hypothesis that females have a greater resistance to hereditary factors that can lead to stuttering. A genetic predisposition for stuttering has been supported by research that shows between half and two-thirds of CWS have a parent who has reported to have stuttered at some time in their lives. The topic of genetic predisposition has been of interest since the 1970's (Bloodstein, 1977; Sheehan and Costley, 1977) and is still currently receiving considerable attention. Felsenfield (1996) and Kidd (1980, 1984) have presented evidence which indicates that stuttering does run in families and is at least partially governed by genetic factors. They also concede that other, unspecified environmental factors which also contribute to the etiology of the disorder. The significant number of sufferers who recover from the disorder (see above) has also been of interest to researchers investigating the family history of stuttering. Cox and Kidd (1983) explored the possibility that recovery from stuttering was a genetically transmitted milder form of stuttering. Their findings indicated that although there was no evidence that recovery had any relationship with the transmission of stuttering, the possibility could not be ruled out. Later research (Ambrose, Cox and Yairi, 1997) found evidence that persistent stuttering and recovered stuttering were genetically transmitted and that persistence was also due to
additional genetic factors. They found no evidence that recovery from stuttering was a genetically milder form of stuttering.

Researchers have also considered the question whether stuttering is universal (i.e. ubiquitous to languages and cultures). There is no agreed point of view about this. The research that concluded stuttering is not universal used evidence that there are societies and cultures that did not have a word for stuttering. Stewart (1960) cites Johnson (1944), Snedicor (1947) and Stewart (1959) who worked respectively with the Utes, Bannock and Shoshone American Indian tribes. The research procedure used was for the researcher to imitate stuttering to members of these tribes and ask them to indicate if any tribe members spoke or had spoken in this way. This research method seems flawed as it can not be guaranteed that the researcher demonstrated all characteristics of stuttering. Stewart (1960) found that the Colorado Utah tribes could not identify any member who stuttered. However, his criteria for diagnosis included negative perceptions as well as individual stuttering characteristics. So if this cultural population was tolerant of stuttering, the absent of negative reactions may have prevented sufferers of the disorder being identified.

Specific subgroups with other speech disorders have been investigated with the intention of identifying what leads to the disorder in question. The widespread reported improvement in fluency control when the sound of a speaker who stutter’s voice is altered has suggested that auditory processes may be instrumental in leading to the speech control problems. If auditory processes are involved, then there should be a low incidence in hearing impaired populations. Montgomery and Fitch (1988) found that this appeared to be the case. In a survey of nearly 10,000 students in schools for the hearing impaired only 12 (0.12%) students who stutter were reported.

To summarise the demographic characteristics of stuttering, it is clear that the disorder is widespread, a lot of sufferers get better whether they receive treatment or not. From the outset of this review, then, the importance of having a clearcut early diagnosis is vital and this has ramifications for treatment and recovery that are the underlying
themes of this thesis. The next section continues on the theme of diagnosis starting by looking at the ways stuttering has been defined.

**Preliminaries on Definition of the disorder**

For most people stuttering would seem to be a self-evident problem. The lay person generally perceives it as a series of part word repetitions (for example K-K-Katy) accompanied by unsuitable facial grimaces and the avoidance of feared words. This stereotype of stuttering behaviour was classically illustrated by Ronnie Barker’s portrayal of the grocer, Arkwright, in Roy Clarke’s BBC television series "Open All Hours".

However, a wide-ranging survey conducted by Ham (1990) found that generally people could not apply a consistent definition or description of stuttering. Clinically, a definition of stuttering is also regarded as being difficult, and it is often easier to describe the overt symptoms (Starkweather, 1987). Sheehan (1970) proposed that stuttering was not a unitary disorder and there may be a different definition and description for every person that stutters. The World Health Organisation (1977) classifies stuttering as “disorders in the rhythm of speech, in which the individual knows precisely what they want to say, but at the same time is unable to say it because of an involuntary, repetitive prolongation or cessation of a sound” (p.202). In 1982, Van Riper stated that stuttering was principally a disorder of the temporal aspects of speech, not of the articulatory, phonatory or symbolic processes. Van Riper (1982) agreed with Sheehan in that he suggested that a process of differential diagnosis identifies stuttering.

Van Riper (1982) provided an inventory of the core or basic behaviours of stuttering, again this comprised mainly a list of different types of stuttering (repetitions, prolongations, blocks), although escape and avoidance behaviours were included. However all the items on van Riper’s (1982) inventory were speech related, as were those on Cooper’s Chronicity Check List and Wingate’s (1964) wide ranging multipart definition. Some definitions of stuttering have attempted to include non-speech items. These often comprise lists of symptoms that are sub-grouped into core and secondary behaviours. The core behaviours are usually a list of speech symptoms and the secondary behaviours contain items such as feelings and emotions (Shames and Florence, 1980).
Perhaps researchers and clinicians are reticent to include non-speech factors into their definitions of stuttering because they are aware of the problems inherent in obtaining reliable measures of factors such as anxiety, attitude or socialisation in young children.

It is evident from the brief review above that the majority of the definitions of stuttering that have been provided by the research and clinical literature focus on overt speech symptoms. A problem with simply listing symptoms related to speech performance as a method of defining stuttering, particularly with children, is that many children go through a transient period often referred to as normal non-fluency (NNF) where they tend to repeat whole words (as listed above) easily and effortlessly. This type of speech behaviour is described as “normal” in the leaflet *Does your young child stammer?* published by The British Stammering Association. Certainly some adults may also be non-fluent at times of stress or anxiety without calling their behaviour ‘stuttering’. The issue is important because of the continuum between this, transient stuttering (discussed under the label ‘function word stuttering’ in this project) and persistent stuttering (content word stuttering). Stuttering, like some other disorders, can be put onto a continuum with one end being normal non-fluency and the opposite end severe or pathological stuttering (Bloodstein, 1975).

This similarity between NNF speech and stuttering makes definition extremely difficult. Consequent on this lack of an agreed definition, diagnosis of stuttering also becomes a problem - a condition cannot be diagnosed if it cannot be defined. How researchers and clinicians have addressed the problems associated with the diagnosis of stuttering are reviewed in the next section.

Factors that are considered to aid Diagnosis
A knock-on effect of the lack of a robust definition is that scientific analysis becomes problematic. Because of this, stuttering theories have often been promulgated with little or no recourse to scientific data, with theories being built upon intuitive ideas that could not be scientifically measured. Often the focus was only to explain the nature of stuttering, while the problems of a definitive diagnosis or prediction of therapy outcome were not addressed. The defining characteristic of these global theories was the attempt to
answer the one big question - What is stuttering? Alternatively many research projects have focussed on a single factor, for example genetics or parental attitude, and have concentrated on the finite measurement of that factor to the exclusion of all others. Whereas the global theories were too "big" these studies are too "narrow". Big theories cannot address diagnosis or therapy outcome until they get it more or less right, while narrow studies cannot address the role of anything but the factor selected for investigation. This research project is the first stage of a wider research programme that will adopt a multifactorial strategy toward an accurate diagnosis of stuttering. That is, which factors will predict the fluency of a child or the persistence of stuttering. The programme will also take the same position with regard to the prediction of therapy outcome, that is which child will recover spontaneously or respond positively to therapy.

The initial phase of this thesis was concerned with identifying what background information could be obtained during initial assessments of children who were thought to be stuttering that could aid diagnosis. A major consideration was that the information needed to be obtained in a systematic way given the limited time available in speech and language therapy clinics for these activities. A comprehensive review of the literature indicated ten factors. Those factors were; social skills, attitude to speech, motor skills, speech scores, family history of stuttering (genetics), cerebral dominance/handedness, language development, parental attitude, general health and auditory skills. Although a great deal of time and consideration had been expended on the identification of the factors that may be important for diagnosis and for the outcome of treatment in stuttering it cannot be categorically stated that all these items are relevant. Authors of journal articles consulted during literature searches may have been incorrect in some of their assumptions, and the distillation of what was considered to be the key properties of each topic may not have acquired those which are salient.

In order to minimise this possibility, a survey of speech therapists, researchers and pathologists in the UK and abroad was conducted regarding the relative importance and completeness of the factors. Ninety-eight therapists, researchers and speech pathologists were contacted using e-mail, standard mail and personal contact and were requested to
respond by whichever means they found convenient. The survey document is included as Appendix B.

The survey generated a limited number of responses, however there was evidence to indicate that the respondents considered the ten factors exhaustive. In order that the respondents should have the best possible indication of the research intentions it was decided to include in the survey not only the 10 factors but also the means by which it was intended to measure them. Respondents were asked to rank the factors in terms of importance separately for both diagnosis and prognosis. They were also requested to indicate and rank any factors they considered important that had not been included.

Analysis was undertaken on the data obtained from the 43 responses received. In order to ascertain the scale of agreement between the respondents regarding the relative importance of the factors the data was analysed using Kendalls coefficient of concordance (W). Results show significant levels of agreement regarding the relative importance of the factors for both diagnosis and prognosis.

When using Kendalls coefficient of concordance when ranked items exceed seven the obtained W is converted to a chi-square numeric (degrees of freedom = ranked items minus 1) to assess significance. With regard to diagnosis the following result was obtained;

\[ \chi^2 (9) = 57.17; \text{significant, } p< .001 \]

A similar result was recorded for prognosis;

\[ \chi^2 (9) = 80.33; \text{significant, } p< .001 \]

Further evidence of agreement amongst the respondents is demonstrated by the fact that 30 out of the 43 respondents (69.8%) ranked Client Attitude as one of the two most important factors with regard to diagnosis. Fifty-three per cent of respondents include both Client Attitude and Parental Attitude in the three factors they considered most important to diagnosis. A family history of stuttering was consistently regarded as being relevant to the diagnosis of stuttering, 58.8% of respondents considered it as one of
the 3 most important factors. Similar conclusions can be drawn from inspection of the ranking of the factors that predict outcome of therapy, 32 respondents (74.4%) ranked Client Attitude in the top 2 most important and 25 (58.1%) attached the same importance to Parental Attitude. More than 50% of the respondents viewed Client Attitude and Parental Attitude as the two most important factors with regard to prognosis.

Only two respondents indicated additional factors that were considered important for diagnosis and prognosis that had not been included in our survey, this would signify that majority of respondents viewed the factors identified as comprehensive. The ten factors together with their importance as rated by the respondents are listed below in tables 1 (diagnosis) and 2 (prognosis).

Table 1. Relative importance of each of the 10 factors with respect to diagnosis as rated by respondents

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>% OF NOMINATIONS AS MOST IMPORTANT</th>
<th>% OF NOMINATIONS IN FIRST 3 MOST IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client Attitude</td>
<td>37</td>
<td>81</td>
</tr>
<tr>
<td>Parents Attitude</td>
<td>28</td>
<td>63</td>
</tr>
<tr>
<td>Family History</td>
<td>18</td>
<td>59</td>
</tr>
<tr>
<td>Speech Scores</td>
<td>7</td>
<td>49</td>
</tr>
<tr>
<td>Social Skills</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Motor Skills</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Cerebral Dominance</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Language Development</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Auditory Skill</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>General Health</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

In summary, analysis of the data obtained from the response to the survey indicate significant levels of agreement with regard to the relative importance of the factors identified, both for diagnosis and predicting therapy outcome. There is also evidence that the respondents consider the 10 factors identified as exhaustive.
Table 2. Relative importance of each of the 10 factors with respect to prognosis as rated by respondents

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>% OF NOMINATIONS AS MOST IMPORTANT</th>
<th>% OF NOMINATIONS IN FIRST 3 MOST IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client Attitude</td>
<td>40</td>
<td>88</td>
</tr>
<tr>
<td>Parents Attitude</td>
<td>35</td>
<td>70</td>
</tr>
<tr>
<td>Family History</td>
<td>12</td>
<td>35</td>
</tr>
<tr>
<td>Speech Scores</td>
<td>3</td>
<td>49</td>
</tr>
<tr>
<td>Social Skills</td>
<td>3</td>
<td>32</td>
</tr>
<tr>
<td>Motor Skills</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Cerebral Dominance</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Language Development</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Auditory Skill</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>General Health</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>

In the experimental work in the thesis, three representative factors are considered. These are socialisation (studied in a school environment), child attitude, motor and speech performance. The remainder of the review looks at all ten factors. There are some extra details about the selected factors that are given in the introduction to the respective experimental chapters. The reasons why the remaining six factors were not investigated in this thesis are given below.

1. Socialization

An extensive literature search has not revealed any evidence of a diagnostic role for Social Skills. Therapists and sufferers report that children who are better positioned in their educational situation respond better to treatment. However the acquisition of appropriate social behaviour could be particularly difficult for children whose interactions are hampered by dysfluency. Rustin and Kuhr (1989) have acknowledged this problem by devising a social skills training program for the speech and language impaired. What would be required to assess the social status of a child referred to a specialist speech and language therapist a general picture of the child’s performance in and out of school. As there is very little work in this area, it was selected for investigation in chapter 3 and a full review of previous research is given in the introduction to that chapter.
2. Attitude to speech

Studies have shown that CWS show a significantly more negative attitude toward speech than non-stutterers (e.g. Vanryckegham and Brutten, 1992). Guitar (1976) states that the likelihood of therapeutic success depends on whether the speaker has a positive attitude to speech. There are assessments of speech attitudes that have been validated (for example The Inventory of Communication Attitudes; Watson, 1987) but these are only for adults. The preliminary work undertaken in an attempt to devise a test of communication attitudes for children is reported in Appendix A.

3. Motor skills

Nicolson and Fawcett of Sheffield University have developed a battery of simple tests to assess motor skill performance in dyslexic children. Fawcett and Nicolson (1992) demonstrated that dyslexic children make a high proportion of balance errors (wobbles) when required to stand on a beam and perform a secondary task (counting backwards) compared with when no secondary task is involved. There is widespread interest in motor involvement in stuttering (see the reports of the Nijmegen series of conferences –Peters and Hulstijn, 1987; Peters, Hulstijn and Starkweather, 1991; Hulstijn, Peters and van Lieshout, 1997). In addition a theoretical framework that implicates the cerebellum in particular, the EXPLAN model of fluency failure, has been proposed. The EXPLAN model provides the basis of this thesis and is fully described and compared to other theories of stuttering in Chapter 2. Performance by stuttering and control subjects on a battery of cerebellar tasks is reported in chapter 4.

4. Speech analysis

The simplest method of using speech scores to diagnose stuttering is to measure of the incidence of occasions, or frequency, of stuttering. A child who stutters would be expected to exhibit a higher proportion of stuttering instances than one who does not. However, the problems of identifying stutterings (already discussed above) and its specific application to diagnosis are discussed further below. The approach taken in this thesis builds on one of Conture's (1990) guidelines concerning changes in the proportion
of repetitions to prolongations (he suggests, based on clinical observation, that the emergence of prolongations is a danger sign). Further research with CWS proposes that a change from repetition of function words to stuttering on content words is an indication of stuttering (Au-Yeung, Howell and Pilgrim, 1998). The EXPLAN model attempts to give an account of this (see Chapter 2 for a full explanation). A report of the linguistic analysis of stuttered speech based on the EXPLAN model of fluency failure is given in chapter 5.

The next six factors are not investigated in the thesis for reasons given in the respective section.

5. Family history/genetics

In many disorders a positive family history (FHP) has been identified as a factor that initiates, or affects the progress, of the problem. For example, levels of cholesterol are a major influence on the susceptibility to heart disease and a person’s cholesterol level is influenced by genetics mediated by apolipoprotein structural genes and receptors. Note though, that levels of cholesterol are also influenced by environmental factors such as diet and exercise. So many people suffer from heart disease without having an FHP of this problem.

Studies of how stuttering runs in families reported in the past 50 years, have shown that around one third of people who stutter have other sufferers in their families, indicating that FHP may be a contributory factor in the onset of stuttering. The Yale Family Study of Stuttering (Kidd, 1980; Kidd, 1984; Kidd, Heimbuch and Records, 1981) investigated nearly 600 people who stutter and over 2000 of their first-degree relatives (parents, and full siblings). Approximately 15% of the first-degree relatives were reported to have stuttered at some time in their lives - five times more than the 3% in the general population. Nearly half of the affected first-degree relatives were considered to be chronic, persistent stutterers. Ambrose, Yairi and Cox (1993) collected information on all available relatives of 69 CWSed. The results of segregation analyses suggested a major genetic locus that increases the liability to stuttering best accounts for the transmission of stuttering. A study by Howie (1981) investigated 17 sets of identical
twins and 13 sets of fraternal twins where each pair contained at least one child who stuttered. The study found support for the hereditability of stuttering with a concordance of 77% for identical twins and 32% for fraternal twins. In a review of the remaining literature Mellon, Umar and Hanson (1993) state that family, twin and segregation studies all indicate that stuttering has a large genetic component in its etiology. This would seem to promote the case for the investigation of a positive family history as a diagnostic criterion when assessing children thought to be stuttering. The reason it was not included is now discussed.

There are two accepted techniques for establishing the incidences of any given disorder in the family of the proband (person under investigation) - family history method and family study method. If the family history method is used, probands (or parent(s) of probands in the case of children) are requested to recall incidences of the disorder within their immediate and extended family. From this information a biological family tree is generated and the family members reported to be exhibiting the target condition are identified. In its most basic form (e.g. the Yale Family Study of Stuttering, Kidd, 1984) informant probands were not interviewed in person, they were requested to respond via a questionnaire mailed to them. Most studies employ variants of the questionnaire and interview format. For example parents/probands could be asked to complete a questionnaire at interview and are then would be given time to verify any missing or doubtful data. An alternative method is to send questionnaires to parents/probands and follow them up with an interview when the requested information has been returned. There are several drawbacks to the family history method. The reliance on self-report undermines the accuracy of information about the onset of stuttering. As trained clinicians and therapists have problems defining and diagnosing stuttering (see above), it is unlikely that untrained parents/probands will be accurate in their identification of the disorder. In many incidences this problem will be exacerbated by the time elapsed since the last contact with the relative concerned.

The family study method initially uses the same procedure as the family history method but it differs in that each reported individual with the disorder is followed up and
checked by researchers, either by directly interviewing the affected relative (where possible) or by checking medical records. If neither of these options is possible, other relatives are interviewed in an attempt to verify the report. In a variant of the family study method involves establishing the biological family tree of the proband that then enables trained researchers to interview every available family member. This method requires a big investment in time and training for the follow up and interviewing of relatives identified as suffering from the disorder under investigation. Those involved in the interviews need to be trained and experienced in the identification and diagnosis of stuttering.

Investigations of the two types of study in psychiatric illnesses, such as depression (Orvaschel, Thompson, Belanger, Prusoff, and Kidd, 1982) and other affective illnesses (Mendlewicz, Fleiss, Cataldo, and Rainer, 1975), have consistently found the family history method underestimates the prevalence of the disorder in relatives as determined by direct interview. In a study examining the pedigrees of families of stuttering children. Hedges, Umar, Mellon, Herrick, Hanson and Wahl (1995) confirmed the advantages of personal interview as compared with the family history method. The authors also reported that the family history method is too imprecise to be used in studies attempting to establish a definitive genetic component. However the same study concluded that although some instances of stuttering went undetected by the family history method those that were reported were, in a significant number of cases, correctly identified as stuttering.

In light of these findings the family study method would be the preferred method of investigating the usefulness of a FHP as diagnostic criteria. A method that involves interviewing all relatives of the proband overcomes many of the problems associated with the reliability of the information but would be both a lengthy and costly process. A study involving 50 probands would entail, at a rough estimate, over 1000 interviews - well beyond the range of most research projects and certainly of this thesis.
6. Cerebral Dominance/Handedness

The idea that handedness is related to developmental disorders has been around for at least 60 years and has enjoyed a recent revival in popularity. However, paediatricians and therapists often assess the handedness of children referred to them, but remain uncertain how to utilise their findings. The Orton-Travis theory of cerebral dominance and stuttering dates from 1931 and guided most of the research into stuttering and (to a lesser extent) influences the therapy that was offered at that time. “Laterality therapy” prescribed that left-handed people who stutter should have their left arm immobilised, their left eye covered and were to hop around on the right leg only. This attempted to establish “normal” cerebral dominance. Cerebral dominance theory declined in impact throughout the 1950’s and 1960’s but still has a place in stuttering research. In 1978 Travis concluded that cerebral dominance reinforcement in therapy was still valid and that more research was needed. Even more recently, Webster (1993) postulated that stutterers have hemispheric lateralization dysfunction. If these theories are correct then a measure of hemispheric lateralization should aid diagnosis.

Hugdahl (2000) used MRI to study the lateralisation of the cognitive processes in the brain, but where PET or MRI scanning is impractical, other measures can often be used to determine level of lateralization. For example, dichotic listening procedures have been used to assess laterality in children with dyslexia (Alejandro-Martinez and Sanchez, 1999; Helland and Asbjornsen, 2001). Although useful as a research tool, the equipment and training required to implement dichotic listening procedures makes them impractical for use in speech therapy clinics (see also audiometric assessments below). Self-report questionnaires of handedness, such as the Edinburgh Handedness Inventory (Oldfield, 1971) and the Waterloo Handedness Questionnaire (Bryden, 1977), are more practical. However, although the direction of handedness appears to be more or less fixed by the age of 3 years, the degree of handedness increases at least over the range 3-7 years, and, although more slowly, possibly even up to 7 to 9 years (McManus, Sik, Cole and Mellon, 1988). As this thesis is primarily concerned with developing diagnostic criteria for use with children this factor was not included for investigation as handedness does not appear
to be firmly established until after the onset age of most stuttering – between 3 and 5 years (Dalton and Hardcastle, 1977).

7. Language Development

Berry (1938) first reported a relationship between stuttering in children and speech and language delay. Andrews, Craig, Feyer, Hoddinott, Howie and Neilsen (1983) demonstrated that people who stutter are approximately six months late in their speech milestones. It has also been suggested that children with other language disorders are at risk of fluency breakdown (Dill, 1995). Language delay does not appear to predict the course of the disorder. However, in a study looking at recovery from stuttering Yairi, Ambrose, Paden, Throneburg (1996) indicated that scores on Language Comprehension and Language Expression Tests were significantly lower for persistent stutterers than for recovered stutterers.

Speech and Language Therapists have recognized the importance of language development and many therapists obtain a measure of language ability in their initial assessment of children who are referred to them. Several standardised and validated tests of language development are available. The Test of Oral Language Development (TOLD; Newcomer and Hammill, 1988) consists of five subtests (Picture Vocabulary, Oral Vocabulary, Grammatic Completion, Grammatic Understanding and Sentence Completion). The test is comprehensive but too long for use in clinic where time is limited. One-Word tests of receptive language are more appropriate and the Peabody Picture Vocabulary Test - Revised (PPVT-R; Dunn and Dunn, 1981) and the Expressive One Word Picture Vocabulary Test - Revised (EOWPVT-R; Gardner, 1990) would be suitable. However, because it is designed as a test specifically for the UK, the British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton and Pintilie, 1982) would appear most appropriate. The BPVS is a British adaptation of the PPVT-R and may be seen as measuring the same attribute as the PPVT-R but in a British context. The short version of the BPVS involves the presentation of up to 32 sets of four images and takes around 10 minutes to complete. Each set of images is accompanied by a spoken stimulus word, from which the child under assessment has to identify the correct picture. The child can do this
by pointing or indicating the number of the picture. Because the responses can be gestural
the BPVS is appropriate even for more seriously speech impaired children. Because of
the ready availability of validated assessments and the inclusion of language development
measures in most therapeutic assessments it was decided not to include this factor for
investigation in this thesis.

8. Parental Attitude

Interest in the role of the attitude of parents to their child’s speech stems from Johnson’s
(1959) diagnosogenic theory. Johnson and his associates proposed that the onset of
stuttering was a direct result of parental attitude. He suggested that parents who
misconstrued their child’s normal hesitations and dysfluencies as abnormal called them
stuttering, and thereby created a problem that did not actually exist. Johnson’s theory is
encapsulated in his statement that stuttering generally begins “not in the child’s mouth but
in the parents ear”. There has been little scientific research that supports Johnson’s claim.
Bloodstein (1975) also put forward the view that attitudes of the parent toward stuttering
are a significant factor in its onset and development. With regard to treatment outcome
Van Riper (1973) and Caron and Ladouceur (1989) have indicated that parental attitudes
to speech are important components in the efficacy of therapeutic intervention with CWS.

The dearth of research in this area probably accounts for why a review of the
literature revealed only one instrument specifically designed to obtain a measure of
parental attitude - the University of Alabama Parental Attitude Toward Stuttering (PATS)
Inventory (Crowe and Cooper, 1977). The PATS Inventory comprises 45 statements
intended to elicit this measure. The statements in the inventory were selected from a
review of the literature and from accumulated samples of attitude statements submitted
by speech clinicians. Preliminary interviews conducted for this thesis indicated that
parents of CWS and speech and language therapists were uneasy about the PATS
Inventory. They felt that statements in the inventory such as “Stuttering is in many ways
worse than blindness”, “Spanking a child for stuttering may be useful in decreasing the
frequency of stuttering” and “Stuttering could often be seen as a sign of an inherent
character weakness” were not appropriate. Given these reactions and the fact that there
was no evidence that the inventory was validated, it was decided not to pursue parental attitude to speech.

9. General Health

When a child is referred to a speech and language therapist from a primary health care worker, details of the child’s general health are often sent with the referral documents. Where this is not the case, details of the child’s general health are usually obtained from the parent/carer at the clinical assessment. However these details do not appear to be used in any systematic fashion to assist diagnosis or predict treatment outcome with children being assessed for stuttering. Although it seems likely that health could be a relevant factor, particularly for assessing possible response to treatment, research in this area is sparse. Anecdotal evidence gained from parental report during work with clinicians on other research projects indicated that children who have good general health respond well to treatment. There is no widely used general health questionnaire designed specifically to assess CWS. A questionnaire is being developed at the Institute of Hearing Research (IHR) at Nottingham, devised for children with hearing problems. A version of this questionnaire, modified so that questions were more pertinent to speech, rather than hearing, was considered for inclusion in this thesis. However preliminary discussions with parents revealed their reluctance to divulge details of their child’s health for research purposes.

10. Auditory Skills

Research has indicated that a measurement of auditory processing skills could be an important factor in the assessment of a child believed to be at risk for stuttering. Howell, El-Yaniv and Powell (1987) considered auditory monitoring to be involved in all speech control and stuttering in particular. The relevance of auditory processing is also shown by the remarkable effect of altered auditory feedback on the speech of people who stutter (Hargrave, Kalinowski, Stuart, Armson, Jones, 1994; Zimmerman, Kalinowski, Stuart, Ratstatter, 1997). When the speech of person who stutters is relayed back to them (via headphones) slightly delayed (DAF) or at a different pitch (FSF, Howell et al., 1987), in the majority of cases speech becomes fluent. The effect is transient and dysfluent speech
returns almost immediately after the altered feedback is removed. As it is known that these alterations to auditory feedback have dramatic effects on speech control in people who stutter, auditory processes may be implicated in stuttering that the alteration “corrects” (e.g. a time delay with DAF). Early investigations by the UCL group have failed to find peripheral processing problems (Howell and Powell, 1984). Research seems to indicate that the processes concerned with the effects of altered auditory feedback are central rather than peripheral (Howell, El-Yaniv and Powell, 1987; Howell and Powell, 1984). Sophisticated techniques, beyond the scope of this thesis, would be needed to properly assess central auditory processing.

The aim of the thesis is to identify factors that may aid speech and language therapists in their assessment of CWS. The time and resources available to speech and language therapists for such assessments are limited and it is unlikely that the equipment and training required to undertake a full audiometric assessment would be available. Therefore the measurement of auditory processing skills was not included in the investigations carried out in this thesis for entirely practical reasons.

Defining stuttering events for the purpose of diagnosis
As was said earlier, A condition cannot be diagnosed if the nature of the condition is not defined. The lack of agreement amongst clinicians and researchers as to what constitutes stuttering behaviour and whether and how to include the factors reviewed shows why it is difficult to successfully diagnose stuttering.

The majority of previous research has focused on speech assessment. Conventional ways of making speech assessments for the purpose of diagnosis are to count the occurrences of stuttered instances such as those proposed by Johnson et al (1959) and to express them as proportion of all the words in a passage. A related method is to use the amount of time taken to produce the stuttered instances as a proportion of the duration of the entire passage. Culp (1984), for example, proposed taking samples from five different speaking situations - Monologue, Dialogue, Telling a Story, Play and Pressure (speaking under time constraints) - and then counting the number and types of dysfluency in line with
the Johnson et al (1959) definitions. There are two main difficulties associated with making such counts; first, they are time consuming and second, there is poor inter-judge agreement on counts made on the same material. This is clearly demonstrated in a study by Kully and Boberg (1988). They sent a copy of the same tape (containing several different speech samples) to different clinics for assessment, without any instructions how judges were to undertake their assessments. Subsequently a section of speech that contained a part word repetition and phrase revision, for example “the girl c.c.caught, the girl threw” could be correctly considered as either, or both types, of dysfluency, this not only leads to poor inter-judge agreement but the number of words considered dysfluent is also affected. This potentially affects claims regarding recovery and whether or not a child should be diagnosed as stuttering. The main implication of the Kully and Boberg (1988) study is that it emphasizes the need for improvement of assessment methods.

One approach at improving assessment could be to see what the speaker is doing as well as hear the speech. In 1973 MacDonald and Martin reported a study in which observers viewed videotape samples of stutterers speech. They were asked to identify dysfluencies (other than stuttering behaviour) and stuttering by marking them on typed transcriptions of the speech. MacDonald and Martin found that judgments of stuttering and dysfluency were usually assigned to different behavioural categories so they concluded that stuttering and dysfluency can be reliably differentiated by listeners. However when Curlee (1981) extended the MacDonald and Martin to include better control of the independence between listener’s judgments of stuttering and their judgments of dysfluencies he found that judges were unable to distinguish stuttering and dysfluencies as two reliable and unambiguous response classes. Curlee had seen a flaw in MacDonald and Martin’s methodology, in their experiment the judges marked stuttering and dysfluency successively on the same typed transcript, making it impossible to identify a speech behaviour as both dysfluent and as stuttering. Observers in the Curlee study made judgments on stuttering and dysfluency independently, using separate transcripts, under these conditions it was clear that perceptual distinctions between stuttering and dysfluency were usually not distinct.

In an attempt to overcome the unreliable nature of the human judgment of stuttering behaviour Howell, Sackin and Glenn (1997) reported the development of automatic
recognition procedures designed to locate and assess stuttered incidences. The system is
designed to differentiate between fluent speech, dysfluencies that occur on single words
(lexical dysfluencies, LDs - repetitions, prolongations etc.) and dysfluencies that occur over
groups of words (supralexical dysfluencies, SDs - phrase revisions etc.). The modular
design of the proposed procedure allows for human segmentation markers to be employed
and for SDs to be removed by a parser supplied with word transcriptions, however the fully
automated procedure will be capable of working from acoustic inputs alone. Segmentation,
SD and LD recognition will be based on energy patterns and spectral change over time
without the need to recognise individual phonemes. The programme has, so far, only been
developed and trained to classify repetitions and prolongations in stuttered speech; when
the fully automated system is available it may not be suitable as a clinical tool until it has a
user-friendly interface.

Other diagnostic techniques suggest the inclusion of further language-based
measures in addition to the counting and measurement of dysfluent behaviours listed
above. For example linguistic factors have been evaluated in terms of position, vocabulary,
the stuttering of function words in relation to content words and found that stuttering rate
was highly dependent on whether the function word occurred before or after a single
content word, for example, i-i-i-n bed. The authors proposed that part word repetitions on
function words before their content words in young speakers is used as a delaying tactic
when the content word is not prepared for articulation. It is only when this strategy is
abandoned that the likelihood of persistent stuttering arises.

Researchers and therapists seeking a diagnosis or assessment of stuttering have also
augmented word counts with the administration of questionnaires and scales measuring a
variety of factors. For instance, Erickson (1969) submitted that stutterers differ from non-
stutterers in their attitudes to communication and that as a function of such differences the
responses of stutterers to inventory items about inter-personal communication would differ
from the responses of non-stutterers. Andrews and Cutler (1974) developed a 24 item scale
based on Erickson’s original concept, subsequent validation of the scale indicated that a low
score on the instrument predicted a favourable long term outcome.
The above review of diagnostic techniques has illustrated the problems inherent in obtaining accurate speech analysis. Diagnostic instruments that rely primarily on speech based criteria are not comprehensive. The multifactor approach taken in this project intends to minimise the reliance solely on speech measures with the goal of minimising the risk of misdiagnosis.

Critique of Diagnostic Research using the multifactor approach

The use of a combination of speech scores, attitude measurement and other factors in diagnostic instruments for stuttering has been employed in the stuttering literature. However, many of the strategies employing this technique do not use the information acquired as a "recipe" for diagnosis but as a guide for commercially-oriented therapeutic instruments. An example is Riley's (1980) Stuttering Severity Instrument (SSI) which measured not only the child's attitude to the dysfluency but also the parent's. Details of the family history of stuttering together with word counts of part word repetitions and prolongations are also recorded. However the way in which the information was obtained rendered it useful only in terms of the SSI and not in terms of a general diagnostic instrument. The assessment instrument proposed by Rustin (1987) suffers from similar problems to that of Riley. It uses a wide-ranging interview and assessment technique recording vast quantities of information but the information is obtained in such a manner that the data do not readily lend themselves to validation. Factors examined within the instrument include the attitude of both parent and child toward the dysfluency together with information about cerebral dominance, family history of stuttering and general health. Cerebral dominance is measured by 5 statements embedded in a 20 item inventory but the assessment booklet contains no guidance on how this, or any other factor, are to be scored or evaluated. For information gathered from interviews to be used in meaningful analysis a standardised measure must be obtained for each factor, particularly for the non-linguistic factors. Although having the advantage of taking a broader approach, assessment instruments (such as the Assessment and Therapy Programme of Rustin, 1987) would need to be able to elicit a valid numeric measure for each of the items assessed. Only then would it provide a consistent and reliable instrument for the evaluation of stuttering behaviour.
The issue of the diagnosis and assessment of stuttering is also central to investigations into the incidences of recovery from stuttering. To enable researchers to establish the extent of any recovery it is first necessary to verify the severity of the initial disorder. Then, it is necessary to confirm the diagnosis of stuttering, because cases of the "recovery from stuttering" may merely be instances of NNF and not in fact "recovery" at all. Assessment and confirmation of stuttering are confounded in two ways. First by the diversity of the diagnostic techniques employed by clinicians, one clinician may describe a sample of dysfluent speech as stuttering whilst another will define the same sample as NNF speech (in a similar way to the ambivalent definition of proper stuttering, Kully and Boberg, 1988). Second, in retrospective investigations into recovery from stuttering researchers invariably have to rely upon reports from subjects, or their parents, which leaves open the possibility of NNF being interpreted as stuttering and vice versa. If trained clinicians are unable to agree on a diagnosis of stuttering it is unlikely that untrained observers will be any more successful. An initial misdiagnosis of stuttering may account for some of the subsequent "recoveries" identified in stuttering research.

Although recovery is not the primary focus of this thesis, some discussion is appropriate. Reasons for this are (a) that it provides further information about the initial diagnosis (if your diagnostic criteria do not initially identify a child as a stutterer who is subsequently found to be a sufferer then your definition is probably wrong). (b) The goal of diagnosis is ultimately whether to commit to treatment or not.

Methods and findings of defining recovery
Two kinds of approach have predominated in research investigating spontaneous recovery from stuttering, namely prospective and retrospective. Prospective, or longitudinal studies normally identify young children as stutterers and subsequently assessing them during follow-up interviews. Retrospective studies utilise questionnaire and interview techniques to obtain information from recovered stutterers.

Review of Retrospective Studies
One of the earliest investigations into recovery from stuttering employed the retrospective approach, Wingate (1964) administered a questionnaire to 50 recovered stutterers.
Responses indicated that only nine subjects viewed therapy as having influenced their recovery, suggesting a spontaneous recovery rate of over 80%. However, there were problems in Wingate's study. Verification that the subjects were recovered stuttered was based upon the assumption that "the lay person knows what is meant by stuttering" and "upon the subjects description of their (own) stuttering" (Wingate, 1964; p313). This procedure cannot be deemed a scientific assessment of stuttering. In addition 50% of Wingate's sample of recovered stutterers also indicated that they stuttered occasionally at the time of completing the questionnaire.

Probably the most extensive, and certainly the most widely cited, retrospective studies are those of Martyn and Sheehan (1968) and Sheehan and Martyn (1966, 1970). These investigations conducted speech surveys of over 5000 new students entering the University of California. By means of speech samples, questionnaires and personal interviews, 147 subjects were identified as stutterers. Of these 147 students, 31 were considered as persistent stutterers and the remaining 116 considered as having stuttered at some time though they had recovered at the time of the survey. These data constitute the basis of the widely cited finding that approximately 80% of children who have ever stuttered have recovered from their stuttering without intensive, formal treatment prior to the age at which they entered college. Cooper, Parris and Wells (1974) replicated these findings with over 7000 incoming students at the University of Alabama. They found that 82% of students who said they ever stuttered reported recovery before they had entered college. However, when students who reported ever having received therapy were excluded, then only 52% of those who had ever stuttered reported recovering spontaneously.

A number of experiments have also been conducted in which groups of children of various ages were surveyed in order to determine onset and recovery of stuttering. Cooper (1972) essentially replicated the procedures used by Sheehan and Martyn with nearly 3000 junior and over 2000 senior high school children. Of those children who said they had ever stuttered, 30% of junior high school children and 44% of senior high school children reported that they had recovered spontaneously. Glasner and Rosenthal (1957) reported an experiment in which speech clinicians interviewed parents of children aged 5-7 years. A
total of 153 parents said that their children had stuttered at some time, but 54% of the parents reported that the affected children had stopped stuttering. In general the results of retrospective studies of pre-school and school age children put spontaneous recovery rates at between 30 and 55%.

Critique of Retrospective Studies

Depending on the age of the populations surveyed, and possibly depending on the experimental methodologies employed, the spontaneous recovery rates in the studies reviewed range between about 30 and 80%. This range is large enough to make meaningful analysis of the information difficult (Martin and Lindamood, 1986). The most serious of the methodological shortcomings that afflict retrospective studies is that of the reliability with which subjects, or parents of subjects, can report from memory episodes of presumed stuttering that have taken place in the past. Such data is particularly problematical with regard to stuttering recovery because of the difficulty of cross-validation. Without the extensive (and expensive) follow up procedures which would involve the examination of medical histories for a confirmed clinical diagnosis of stuttering, data resulting from retrospective studies should be viewed with caution.

Further doubt regarding the validity of self-reports are illustrated by the 50% of Wingate's “recovered” stutterers who reported they still stuttered occasionally because most fluent speakers would also report that their speech was occasionally dysluent. Reliance on self-report as a source of data must cast doubt upon the validity of the findings of the Wingate (1964) study.

The unreliable nature of information gained from retrospective studies involves not only the memory of subjects and parents but also the problem of the definition of stuttering. If clinicians and researchers are unable to agree upon a definition it is unlikely that a subject's affirmation that "Yes - I used to stutter" would refer to clinically significant stuttering. One of the few studies to directly assess reports of stuttering was carried out by Langford and Cooper (1974). These authors conducted telephone interviews with the parents of the 68 self-diagnosed stutterers in the Cooper (1972) study. About two thirds of these parents did not think that their children had ever stuttered. Failure by these parents to corroborate their children's self diagnosis of stuttering adds to the serious doubts about the
accuracy of information obtained in retrospective studies relative to the onset and recovery of stuttering.

Another methodological problem associated with some of the retrospective recovery experiments concerns the confounding variable of therapy. In these studies it is not clear what constituted spontaneous recovery. The term *spontaneous recovery* is generally used to indicate remission of symptoms without formal treatment, Finn (1996) suggests a more appropriate term would be *unassisted recovery*. Sheehan and Martyn (1966) defined spontaneous recovery as

(1) those who have received no attempt at therapy and
(2) those who have received an attempt so meagre it could not be considered therapy at all or therapy so far removed in time from the age of recovery that no effects could be attributed to it (p123).

"Meagre" and "so far removed in time" are open to interpretation, as is the definition "no attempt at therapy". Also does the definition of therapy apply only to treatment from a trained clinician? It is entirely possible that strategies employed by parents with stuttering children, for example slowing their own speech, and even self-directed strategies may have an effect on the remission of stuttering behaviour (and it is in fact a feature of the Lidcombe programme of treatment).

**Review of Prospective or Longitudinal Studies**

Another body of information that has been used to assist in the identification of children who recover spontaneously from stuttering has been acquired by prospective or longitudinal experiments. Longitudinal studies by their very nature are costly and time consuming experimental designs which probably accounts for the relatively small number of such investigations into the remission of stuttering.

By far the largest, and certainly the most cited, longitudinal study is the "1000 Family" study reported by Andrews and Harris (1964). This survey followed all the children born in May and June 1947 in Newcastle upon Tyne, England. The children were followed until they were 15 years old with information being obtained at periodic intervals
regarding a wide range of developmental activities and disorders, including stuttering. Andrews and Harris identified three groups of stuttering children.

(1) Transient nonfluent (n=16) - period of nonfluency that lasted less than 6 months and had remitted before the 5th year,

(2) Temporary stuttering (n=18) - stuttering lasted from 6 months to 6 years but had remitted before the 12th year,

(3) Persistent stuttering (n=9) - reported as still stuttering at age 15 years.

These data indicate that 34 (79%) of the 43 children who ever stuttered no longer stuttered by the age of 15. This 79% recovery rate reported by Andrews and Harris is used to support the view that approximately 80% of children who have ever stuttered will remit their stuttering by early adulthood.

A number of other longitudinal studies of stuttering have been reported (e.g. Johnson et al, 1959; Panelli, McFarlane and Shipley, 1978). For the most part these studies were not as extensive as the Andrews and Harris (1964) survey. The percentage of recovery reported in prospective studies ranges from about 33% to about 80%, that is, very similar to the rates found in the retrospective studies.

Critique of Prospective or Longitudinal Studies
As was the case with the retrospective studies, the prospective studies suffered from some methodological difficulties. Although reliance on subject and parent memory was less of a problem, the reliable identification of stuttering at both onset and recovery could said to be questionable. Both Ingham (1976) and Young (1975) concluded that the transient nonfluent group in the Andrews and Harris survey probably should not have been considered as stutterers and therefore should not be considered as recovered stutterers. With the removal of this group from the Andrews and Harris (1964) data the recovery rate falls from 79% to approximately 42%.

The onset and recovery study by Johnson et al (1959) also gives an example of the lack of agreement between observers regarding judgments about stuttering at onset and recovery. One hundred and eighteen children identified by their parents as stuttering were evaluated two and a half years after identification and, again according to their parents, one third of the children were said to have recovered. However 35 of the children who were
judged by their parents as still stuttering were evaluated by an interviewer; only 4 of the 35 children were judged by the interviewer to be stuttering. Depending on whether parental or interview judgments were utilised, the Johnson et al (1959) study can be cited to support a 60% or a 33% recovery rate.

Longitudinal studies in general suffer from subject attrition and those investigating recovery from stuttering are no exception. In the Johnson et al (1959) study for example, 21% of the stuttering children who participated in the initial evaluation were no longer available for the final analysis. The drop out rate in the Andrews and Harris 15-year study is even more dramatic with the original subject population reduced by more than one third over the course of the survey. The crucial, and of course unanswerable, question is whether the proportion of children reported to have once stuttered but recovered was the same for the children who dropped out of the study as it was for those who completed the study.

In summary, the unreliable nature of data derived from subject and parent memory, the lack of agreement as to what constitutes recovery from therapy in assessing spontaneous recovery and the high subject attrition rates in prospective studies make it difficult to place confidence in the suggestion that 80% of stuttering children will recover spontaneously.

Yairi's work on factors predicting recovery
Ehud Yairi of Illinois has for many years been examining CWS from onset of the disorder. This has given his research group a possibly unique opportunity to examine what factors promote the development of the disorder, issues well beyond the scope of the prospective and retrospective studies just reviewed. To this end Yairi, Ambrose, Paden and Throneburg (1996) examined factors that predict persistence (non response to treatment) and recovery (response to treatment) in CWS by assessments of phonological skills, language development, nonverbal skills, genetic background and speech dysfluency. The strategy adopted by Yairi et al (1996) was to compute and compare scores for the different target groups to see if there were differences between the speaker groups. Isolated factors that show a relationship with stuttering can be identified by this means but multifactor relationships cannot be determined in this manner.
Prospects for a multifactor examination of the causes of stuttering

Yairi (1996) considers stuttering as “a complex, multi-dimensional disorder, in which disfluency is but one component”. This multifactorial theory means that physiological, psychological, environmental and linguistic factors may contribute to the onset and development of stuttering. Physiological factors that can predispose a child to stutter are genetics or gender differences. Linguistic factors that could contribute are if the child’s language skills develop at a faster rate than their motor skills as this puts an increased demand on their motor skills. For a child who has a predisposition to develop a stutter, environmental stresses such as events or attitudes in the home and certain environmental demands can increase the likelihood of it developing. Psychological factors that have been suggested to contribute to the development of a stutter are personality, negative communication attitude and the effects of emotional arousal. It is unlikely that any one of these factors alone will cause a stutter to develop but research has been done in each of these different areas to establish the role each plays in stuttering and how they interact.

Some of the factors that were initially suggested to indicate persistence were gender differences and overt speech characteristics. Research was carried out on both of these areas. It was discovered that the male to female ratio of those who stutter was 2:1 near onset and 5:1 in older children (Yairi and Ambrose 1992). This suggests that girls have a higher recovery rate. Research on the relationship between persistence of stuttering showed that the presence of blocks and prolongations indicated a higher chance of persistence than the presence of repetitions. The early stages of research by Yairi, Ambrose, Paden and Throneburg (1996) showed that language indexes, non-verbal performance, phonological skills and genetics could all also be useful indicators of persistence.

A study by Guitar (1976) looked at the impact of frequency of stuttering, severity of stuttering, personality and communication attitude in order to establish which factors predict treatment outcome. Results showed that pre-treatment attitude is the best predictor of recovery. From this study Guitar established that negative attitude scores reflect strongly conditioned responses between stuttered speech and the environment. If these
attitudes are strong it may be difficult to break the conditioned response during treatment. However it is vital that they are taken into account if therapy is to be effective.

**Conclusion**

The intention of this review has been to take the reader through from what at the outset looks like a straightforward disorder to diagnose in order to show that that it is not so simple and how it can affect whether a person considers themselves successfully treated or not. Starting from early definitions, several problems in speech-based assessments have been identified and the problem of reliability of empirical assessments made of stuttered speech (e.g. Kully and Boberg, 1988). The need to include extra factors at initial assessment and follow children through post treatment has also been stressed.

This thesis will explore three factors identified in the review of the literature that could assist speech and language therapists in their diagnosis of CWS. (1) The linguistic content of the stuttered incidences in the speech of CWS will be examined in an attempt to overcome the reliability problems associated with stuttering counts. The linguistic analysis will be based upon the EXPLAN model of fluency failure. (2) The possibility of including an assessment of motor skills in the diagnostic assessment by using performance measures on a battery of cerebellar tasks will be explored. Children will be tested in discrete age groups to investigate relationships with speech milestones suggested by the EXPLAN model of fluency. A new technique for assessing (3) Social skills will be used to in attempt to provide a reliable instrument for the measurement of this factor for use in clinics.
Chapter 2.

The EXPLAN model of fluency failure

The three experimental chapters in this thesis examine whether a social component, a motor component and a speech-language component are useful in the diagnosis of stuttering and the possible therapeutic implications such measures would have. The particular tests conducted are (respectively) a sociometric investigation, a battery of tests that assess cerebellar problems and changes in the type and location of stutterings as children go from an age where recovery is highly likely i.e. childhood (Yairi and Ambrose, 1999) to an age where stuttering is likely to persist (from adolescence onwards). Though inclusion of social, motor and speech-language factors as factors relevant to diagnosis and treatment of stuttering can be justified on the a priori assumption that they are performance measures that should be assessed on persons who stutter, choice of the particular tests made does need justifying. The selection of the particulars of all of these was based on a theoretical perspective (the EXPLAN model) that Howell, Au-Yeung and colleagues at UCL have developed. The details of the theory have been developed in a number of publications and the theory itself applies to a range of phenomena associated with diagnosis and treatment of stuttering. A summary overview of the main points with particular attention to those topics relevant to the following three chapters is given. The description begins with EXPLAN’s position as a general theory of fluency development and control (this relates to the socialization and speech analyses). Then the physiological structures considered to be involved in fluency failures (normal nonfluencies and stutterings) are outlined (this relates to the motor analysis). Finally, the relevant aspects of EXPLAN for diagnosis and therapy of stuttering are presented. After the general order of the points in the argument for EXPLAN’s position has been established, some more detailed support for selected steps is given. This chapter will also compare and contrast the EXPLAN model to other theories and explanations of fluency failure.
A: EXPLAN as a model of fluency development.

1. During early language development a child will be under time pressure to produce speech. On occasions, the child will not be ready to produce certain words at the point they should appear in an utterance. The way the child reacts and the consequences on speech in the vicinity of these points constitute events referred to as fluency failures.

2. The events that lead to fluency failures occur in all young children (children who become fluent or those who develop a persistent stutter).

3. The words in the vicinity of a fluency failure are referred to as the context of the fluency failure. The event in these contexts that leads to fluency failure arises when there is a point of focal difficulty and when the context that contains such a focal point is attempted at too rapid a rate for that level of difficulty.

4. One way of specifying focal difficulty is in terms of the phonological properties of words. For instance, different consonants present different levels of difficulty to a child. Also, clusters of consonants are difficult for children to produce as evidenced by the fact that they simplify consonant clusters. A word like “split” that contains consonants that appear late in development and starts with a string of three consonants, will be a point of focal difficulty for a child.

5. A difficult word like “split” will usually appear in a particular context (e.g. “I split it”). Another factor that leads to a fluency failure is rate of speech. The chance of fluency failing increases if speech is spoken too rapidly.

6. Joint determinants of fluency breakdown: You can speak a phonologically difficult word without having a fluency failure or speak a simple stretch of speech fast. But if you try and speak a difficult stretch fast, the chance of fluency failure is higher.

7. The words of English that are phonologically difficult tend to be content words rather than function words. Function words include pronouns, articles, prepositions, conjunctions and auxiliary verbs. Linguistically, they are a closed class of words that do not carry a full lexical meaning but have a grammatical, or functional, role (Hartmann and Stork, 1972; Quirk, Greenbaum, Leech and Svartvik, 1985). Content words are nouns, main verbs, adverbs, and adjectives. Content words are an open class of words and play a crucial role in conveying semantic information.
8. A unit that EXPLAN theorists have found valuable for pinpointing contexts with a focal difficulty that is also a unit in which rate variations will occur, is Selkirk’s (1984) phonological words (PWs, initially defined only for English). By definition, these contain a single content word and (optional) function words that precede and follow it. The start of the content word in a PW tends to be phonologically complex and is identified as the point of focal difficulty. So, in the “I split it” example, the point of focal difficulty is the spl- cluster.

9. The focal difficulty is the event leading to fluency failure. The mechanism behind the fluency failure is that execution of the word prior to the point of focal difficulty (EX of “I”) is complete before the plan of the content word with the focal difficulty is ready (the PLAN of “split”). In an abstract sense, the function word is executed at a rapid rate as it is simple (the word “I”), so the speaker needs the plan of the content word that is more time consuming to produce earlier in this context. Rate is already taxed in this context, and the difficulty that arises from this is compounded when the speaker is attempting the utterance at a rapid rate.

B: What do CWS do differently from children who develop normal speech?

10. According to the mechanism described in (9), two forms of fluency failure can arise that reflect normal nonfluency and a sign of persistent stuttering, respectively.

11. Alternative 1: Stall before you start the content word to buy time to complete its plan. There are different ways of doing this pausing (filled or unfilled) repetition of the preceding whole word function word. These are instances of normal nonfluency (“normal” because all children exhibit these but most do not become stutterers).

12. Alternative 2: Start the content word before its plan is complete. The result is part content word dysfluencies (a known sign of persistent stuttering).

C: Physiological bases behind control in EXPLAN and how speakers without brain disorder can change from alternative 1 to alternative 2 fluency failures.

13. Speech rate provides a clue: Empirical findings show that speaking too fast precipitates fluency failure.
14. The clue in the preceding point is that rate control is performed by the cerebellum, so it may be implicated in fluency failure.

15. PET evidence supports the view that fluency failure in persons who stutter arises because of a functional (not a structural) problem in the cerebellum.

16. A mechanism for how the cerebellum controls fluency failures. Function word repetitions slow down the planning-execution cycle. If fluency failures arise because a speaker started execution of a word before the complete plan is ready, more of the plan will be produced in the execution interval. There will be a discrepancy between the plan at the start and end of execution (i.e. there will be a non-zero difference unlike the situation with fluent speech). These alerts, that occur selectively, signal where a part-word fluency failure happened. The alerts are detected by an external clock (in the cerebellum). The clock slows speech rate and fluency recovers by reducing the chance of planning rate getting behind execution rate.

D: Diagnostic implications. A child is at risk of becoming a persistent stutterer if she or he starts producing part-word fluency failures on content words.

E: Therapeutic and prognostic implications. Speech rate must be slowed for fluency to recover. The alternative ways in which fluency fails reflect two ways the system enforces slowing (by inserting pause or words to execute that do not need planning, versus running out of speech to execute). Different therapies can be classified either as slowing the PLAN-EX process or by interfering with the timekeeper in ways that lead to it making an alteration to rate.

These points are now amplified and some support given as illustration.

The view that stuttering arises out of the early childhood nonfluencies that all children show is a widely (though not universally) held perspective. According to Johnson and associates (1959) word repetitions and other stalling phenomena are frequently shown by children presenting at clinic and should be considered an event that indexes stuttering. In a syntactic analysis of spontaneous speech produced by CWS, Kadi-Hanifi and Howell (1992) showed that CWS produce many utterances starting with these words. Howell, Au-Yeung and Sackin’s (1999) analysis (to be discussed further
below) also shows that there is a high proportion of function word repetitions in stuttering children’s speech. Note that this is to some extent counter-intuitive, as these fluency failures appear to occur on function words that are simpler than content words. Fluent control children frequently show this pattern too. Clark and Clark (1977) observed that children who become fluent speakers exhibit a lot of repetition of prepositions and pronouns (instances of function words).

In the overview section, the different order in which phonemes are acquired (Sander, 1972) and simplification of consonant clusters were described as indications that children have difficulty with words starting with phonologically complex structures. These factors have been found to cause difficulty (increase the chance of stuttering) in people who stutter (Throneburg, Yairi and Padden, 1994; Howell, Au-Yeung and Sackin, 2000). Thus, it appears that phonological factors serve as an indication where stutterings will occur.

The second determinant of stuttering highlighted was speech rate. When global speech rate measures have been made, researchers have been in almost unanimous agreement that reducing speech rate decreases stuttering frequency. Johnson and Rosen (1937), for example, found that the amount of stuttering decreased during slow speech compared with normal speech rate. Other authorities that concur with this conclusion include Perkins, Kent and Curlee (1991), Starkweather (1985) and Wingate (1976). It is frequently reported that increased global speech rate has a complementary effect on stuttering frequency. Thus, Johnson and Rosen found that subjects had greater difficulty in speaking at fast rates compared to slower rates. Bloodstein (1987) also noted that high speaking rates can result in stuttering.

There is evidence that variation in rate causes the fluency of fluent speakers to vary with speech rate too. In an analysis of calls made to late night chat shows, Blackmer and Mitton (1991) showed that fluent adults produce a lot of fluency failures. This, they attributed, to speakers attempting to speak fast in this environment. A study by Howell and Sackin (2000) showed that content word dysfluencies can also be elicited from fluent
speakers when speech rate is increased. They required speakers to provide a running commentary on a cartoon. They had to speed up to keep up with the action and exhibited a proportion of content word fluency failures. To date there has been little work on how phonological difficulty and speech rate constitute joint determinants of stuttering. Kevin Eldridge from Northwestern University is examining this in CWS. At the time of writing, no data are available about this issue.

To briefly recap - function words include pronouns, articles, prepositions, conjunctions and auxiliary verbs. Linguistically, they are a closed class of words that do not carry a full lexical meaning but have a grammatical, or functional, role. Content words are nouns, main verbs, adverbs, and adjectives. Content words are an open class of words and play a crucial role in conveying semantic information. The higher complexity of content than function words is shown in analyses of the samples of spontaneous English speech used by Howell et al. (1999). This sample includes several different age groups of speakers who stutter and of fluent speakers. 95% of the function words used are monosyllabic and 99% of them carry no primary stress. 88% of the content words start with consonants whereas only 57% of function words do. 14% of content words start with consonant strings whereas this is the case in only 1% of function words. 34% of consonants at pre-initial vowel position in content words emerge late in development using Sander’s (1972) criteria whereas this applies to only 20% of function words. These properties remain roughly constant across normally fluent speakers and people who stutter ranging between 2 and 40 years.

It was outlined above how Selkirk’s PWs allow the point of difficulty in a phonological word to be identified and the two forms of fluency failure that ensue. The concept of PWs is explored in more detail in chapter 5. The situation in which speech is fluent is shown in Figure 1. Time is along the abscissa and the length of the bar indicates time for planning and execution.
So, in the fluent speech example, two segments that are quick to plan are followed by one that takes longer to plan. Execution lags production by one segment (starting after the end of the first planned segment) and execution time determines when the plan of the next segment needs to be ready. As long as there is sufficient time for the execution of one segment for the next one to be planned (or has been in the preceding sequence), speech will proceed fluently. Though not essential to the theory, we have used Selkirk’s (1984) phonological words to formulate some tests on English. Selkirk defines a phonological word as consisting of a content word and an optional number of function words preceding and following it. As it was shown earlier that function words are simpler than content words in English and if the simplicity is reflected in planning time, the fluent example in Figure 1 would represent a function-function-content word sequence (e.g. “in a trice”). As planning of “trice” can take longer than the time to execute “a” allows, “a” can finish execution before the plan for “trice” is ready. The speaker needs more time for planning. In fluent speakers, this can arise by pausing when the plan runs out or by repeating words that immediately precede the difficult word (shown in Figure 2).

Figure 2. Planning and execution using whole word repetition.

Execution of the part of the incomplete plan is shown diagrammatically in Figure 3.
Figure 3. Planning and execution on the basis of an incomplete plan.

Both the alternative ways of dealing with a fluency failure reflect a change in rate. The cerebellum is the mechanism that is usually given the role of controlling motor timing (see for example Ivry, 1997). It is also attributed a role of sensory-motor integration. One sort of sensory-motor control is illustrated by Kawato, Furakawa and Suzuki’s (1987) model of hand movement. In this the subject has a monitoring mechanism that computes the intended position of the hand. An adjustment is made if the hand does not reach the intended position. This calculation and adjustment is done continuously for every movement, no matter how slight the movement is. The cerebellum is considered to be the brain mechanism responsible for this action.

The cerebellum has also been implicated in a role controlling speech timing. Using lesion studies and functional imaging Ackerman and Hertrich, (2000) found evidence for cerebellum involvement in the timing and coordination of complex articulatory sequences. Several functional imaging studies have also produced evidence for a more direct link between the cerebellum and stuttering. Work with positron emission tomographic (PET) images (Ingham, Fox, Ingham, Zamarripa, Martin, Jerabek and Cotton, 1996; Fox, Ingham, Ingham, Zamarripa, Xiong and Lancaster 2000) found positive cerebellar activation correlates for stuttering rate, the correlations were more extensive in people who stutter than in controls. These, together with other functional imaging studies and behavioural techniques that indicate performance deficits in people who stutter, are discussed more extensively in Chapter 4.

The novel feature of EXPLAN is that high level processes are not used for monitoring. Fluency failures that are intermittent are detected on the basis of a simple
computation (differencing the timing pattern when execution starts and when it finishes). In models like Kawato et al.’s (1987) the continuous checks would be time consuming with the continuous control required in this (and all other) feedforward models.

The attraction of EXPLAN is that it covers a wide range of concerns that are central to an understanding of stuttering. Other theories are more selective as to the topics they address, so do not as readily lend themselves to both identification and treatment of stuttering. The next section of this chapter examines alternative explanations of speech control problems in persons who stutter and how these theories relate to the EXPLAN model.

Theories and models of fluency failure.
The Demands and Capacities Model (DCM) (Starkweather, 1987, 1997; Starkweather and Gottwald, 2000)

The DCM is based upon the premise that there are many events in a child’s communicative environment that can challenge the fluent use of the speech mechanism. The DCM proposes that these events, or demands on a child’s capacity for fluency, concern motor skills, language production skills, social/emotional skills and cognitive skills. Though this model addresses each of the topics covered in the experimental chapters of this thesis, DCM is more a framework that unifies these topics rather than offering a mechanism how they arise. EXPLAN can be described within this framework as it also implicates a motor, language and, to some extent, a social component in fluency failure but has the advantage that it includes causal mechanisms. These points are now explained in full.

In the DCM, an example of a demand on the motor skills involved in the production of fluent speech would be time pressure. Starkweather (1997) describes two kinds of time pressure that can place demands on the capacity for fluent speech – gross time pressure and fine time pressure. Gross time pressure concerns situations such as talking to people who talk fast or rushing to get ready for school. Fine time pressure
situations involve much smaller units of time. An example would be introducing yourself – it takes very little hesitation to look as though you have forgotten your own name. The DCM suggests that time pressure induces fluency failure in CWS because there is a deficit in the capacity for smooth, rapid movement of the speech mechanism when compared to fluent speakers. Evidence from adult studies is often cited. Adults who stutter are not as able as adults who do not stutter to coordinate the movements of the larynx (Freeman and Ushijima, 1978), mouth (De Nil and Brutten, 1988) and respiratory apparatus (Peters and Boves, 1987). There is very little evidence that these deficits are present in CWS so it remains unclear as to whether the differences observed in adults who stutter are a cause of the disorder or are themselves a result of the disorder.

The DCM also proposes that way language develops is a factor in fluency breakdown. There is evidence that children who are exposed to “language overstimulation” by families in which language is important and where adults talk a great deal, are prone to stuttering (Amster, 1989). Having a large vocabulary has a similar effect. As a child learns more words, its lexicon gets larger adding to demand. Later-learned words tend to be longer and more complex than those acquired in childhood and also increase demand. Overall, then, the model suggests that semantic and syntactic development places increased demands both on the act of word finding and on the motor skills required to produce complex utterances.

The EXPLAN model addresses the influence of time pressure and language skills in a more succinct manner. The model proposes that it is phonological complexity combined with increased speech rate (possibly instigated by time pressure) that causes fluency failure in spontaneous speech. Words that are phonologically complex in the English language tend to be content words. Content words are often longer than the function words that precede them and the mechanics of the fluency failure are based upon this difference. A function word can be planned and executed at a rapid rate so the speaker needs the plan of the content word, that takes longer to produce because of its complexity, earlier in such time pressure situations. It is possible that because of the speed of execution of function words the complete plan for the production of the content
word may not be available when required. It is the non-availabilty of the complete plan of the content word that results in fluency failure. Faced with only a part plan of the ensuing word in the utterance a speaker has two choices. The speaker can stall (wait for the complete plan to become available), this can be achieved by using filled or unfilled pauses or by repeating the preceding function word. These techniques are instances of normal nonfluency in that all children use them but are not regarded as stutterers. The alternative is to continue with the utterance using the part of the plan that is available. The result would be part word dysfluencies – a sign of persistent stuttering (Conture, 1990).

The DCM considers that both positive and negative emotions can affect fluency failure. Although there is compelling evidence that anxiety does not cause stuttering (Peters and Hulstijn, 1984) the DCM suggests that anxiety typically exacerbates the problem. The DCM also argues for a detrimental effect of positive emotion on fluency (e.g. the return of parents following a prolonged absence), although evidence for this is anecdotal. Although a social component is not central to the EXPLAN model there may a tangential role. The model indicates that when the events leading to a fluency failure occur the speaker is faced with a choice of either stalling (pausing, whole function word repetitions - normal nonfluency) or advancing to attempt the content word on the basis of the first part of the plan. The social or emotional status of the child may prove to be useful in indicating why some children maintain normal nonfluency and others abandon this technique and adopt a strategy that can lead to persistent stuttering. A child who is socially comfortable in communication circumstances that may elicit anxiety or contain time pressure may have an ability to maintain fluent speech that is not available to less confident, or less socially competent, peers. An example would be talking to a group of friends where there is pressure to maintain a place in the conversation. A confident, socially competent, child would be able to maintain the normal nonfluent technique of stalling (pausing, whole function word repetitions) because they would not worry about losing their place in the conversation. A child who is at risk of being socially marginalised or rejected by peers could be tempted to advance an utterance on the basis of a part plan in order to maintain their place in the group discussion.
Though EXPLAN and DCM have been compared and EXPLAN preferred because it offers a mechanistic account, this in no way seeks to undermine the DCM because it addresses issues from a practical, rather than theoretical, perspective. For instance, Starkweather (1997) explicitly states that the DCM is not a theory of stuttering. It does not address the causes of stuttering, nor does it confront the issue of why the majority of children who are diagnosed as stuttering will recover. The primary aim of the DCM is to provide a framework that organises the research literature to provide therapists with an understanding of the events that influence the development of fluency in children.

The Covert Repair Hypothesis (Kolk and Postma, 1997; Postma and Kolk, 1993)

To briefly recap what EXPLAN does, to bring the contrast with Covert Repair Hypothesis (CRH) into focus, if no differences occur in the timing patterns at the start and end of a word’s execution, speech continues fluently without other processes being involved. If the timings differ, alerts occur and the alerts signal that a rate change is needed. From this brief description, the differences between this and a monitoring view of fluency failure can be seen as a problem in timing (EXPLAN) or a problem arising because the production system generates errors (CRH). CRH (Postma and Kolk, 1993) is based on the work of Levelt (from which the notion of covert repairs derives). It maintains that stutterings arise out of lexical and other errors that are covertly repaired. In EXPLAN stutterings are timing problems with no errors in the conventional lexical sense at these points. The processes that lead to stuttering according to EXPLAN are not due to faulty hardware that gives rise to errors. The alert signals in EXPLAN are always (and only) used to indicate the need to slow speech rate. The differences between EXPLAN and CRH will now be reviewed in more detail.

Speakers who stutter may have a phonological planning deficit (Postma and Kolk, 1993). Alternatively, speakers who stutter and fluent speakers may perform their speech in ways that precipitate different levels of dysfluency (for example, they may be arrayed
at different points on a speech rate continuum that leads to planning not being completed). Each of these proposals will now be considered in more detail.

If speakers who stutter have a deficit in phonological planning, they would make more errors than speakers who do not stutter. Speakers who stutter severely might also have greater planning deficits (entailing more errors) than those who have a mild stutter. The CRH explicitly proposes that speakers who stutter have such a deficit. CRH suggests that dysfluency arises when errors occur in a phonetic plan that the speaker repairs. According to CRH, every error that occurs is not produced overtly. Events like interruptions (filled and unfilled pauses) and word and phrase repetitions are external signs of the underlying repair process being applied to correct the error. Levelt (1983) introduced this notion of covert repair but he disregarded this type of repair as it is not possible to establish firmly that an error has occurred or what level of linguistic processing is involved.

Though CRH offers a plausible account of stuttering in terms of error and repair processes, EXPLAN offers non-error based accounts that offer equally plausible explanations of these same data. The EXPLAN model of fluency failure proposes an explanation of dysfluencies that views them as reflecting interruption strategies that are engaged when speakers run out of input. Note that this explanation, unlike CRH, does not invoke a speech error (in the sense that the wrong phonemic, lexical or syntactic representation is generated at a point in an utterance). It may be thought that this definition of error is over-restrictive and should be extended to include timing errors that would include a speaker running out of planned input, and then CRH could be extended to include these types of “error”. There are reasons for thinking that running out of input is not a timing error (where the supposed timing error could be subsumed under the CRH explanation). This can be illustrated by an analogy. A car that runs out of petrol (equivalent to running out of input, the EXPLAN position) is not in need of repair (a process that sorts out an error, the CRH position). For similar reasons, tip-of-the-tongue states, where onset phones are known correctly but the rest of the word is not available, should not be regarded as errors. EXPLAN, in contrast to CRH, does not necessarily require that people who stutter have a phonological disorder. Nippold’s (1990, 2001)
reviews support this position as she concludes that the evidence suggesting a link between phonological disorders (i.e. errors that arise out of these processes) and stuttering in children is as yet unclear.

The EXPLAN model maintains that local phonological difficulty and local speech rate interact in spontaneous speech in a way that can lead to intermittent fluency failure. The term phonological difficulty is used to distinguish the problem experienced from phonological deficit (that implies an error) as used in CRH. Phonological difficulty in EXPLAN is determined by the structure of words (whether they start with a consonant, include consonant strings and so on) and the phonological word (Selkirk, 1984) context that they occur in. EXPLAN does not include (but does not necessarily preclude) speakers who stutter from having a phonological deficit.

To summarize the observations comparing CRH and EXPLAN, there is little evidence to support phonological errors in stuttered speech (Nippold, 1990, 2001) and the interpretation that a covert error has occurred in an utterance when there is no overt sign of it is hard to defend. Moreover, CRH has little to say about the practical matters of diagnosis and treatment of the disorder.

To go over the main points regarding the observations made about all three models, EXPLAN can be described within the framework of the DCM in that there is a timing and linguistic element in both models and also, to a certain extent, a social component. However, unlike EXPLAN the DCM does not purport to explain the causes of stuttering and should be regarded more as a distillation of the research literature organised in a manner to aid therapists to understand the development of fluency in children. EXPLAN differs from CRH in a number of ways, the principal two being that in the latter there is the involvement of phonological deficit in childhood stuttering and the need for continuous of speech planning and production. A phonological deficit in people who stutter is not included in EXPLAN (based mainly on Nippolds’ reviews) but is central to CRH, The CRH proposes that speech planning is continually monitored for errors and, when detected, these errors are covertly repaired producing stuttering incidences. EXPLAN takes a non-monitoring perspective and suggests that alerts to slow
speech rate only occur when asymmetry in speech planning and production is detected by a timing mechanism located in the cerebellum. Therefore, the preferred perspective in this thesis is EXPLAN over DCM and CRH.

**EXPLAN – a developmental perspective.**

In the earlier review, social, motor and speech factors were highlighted as important to investigate in stuttering from the EXPLAN perspective that is adopted as the framework for this thesis. One particular concern is diagnosis of stuttering that has to be made in childhood where the disorder is most prevalent, some extra consideration is given about what insights and justifications EXPLAN affords about childhood stuttering.

EXPLAN was originally based on different patterns of speech seen during development in speakers who stutter (function word repetition in young children who stutter, part-word content word disfluencies in older speakers who stutter). Social factors are likely to be differentially involved at these two ages. In particular, around puberty, all children are reassessing their role in society at large and the change in the way they tackle these interactions with peers, adults and other speakers may affect communication. In particular, it may be hypothesised that at puberty, social relations change that affect communication that could be linked to the change in speech patterns that speakers who stutter produce. The way this could arise is through peer pressures around puberty that lead the speaker to fear losing their turn in communication if they are stuck repeating function words. In turn, this leads them to advance to the following (content) word and, as that word is not prepared, the associated problems of part-word disfluencies. This is not a strong prediction of EXPLAN as are the ones on motor and speech factors (it is largely a circumstantial prediction). Nevertheless, examination of how a child socializes in class with his or her peers was deemed desirable both as a result of this circumstantial argument and, more importantly, because of the widespread belief amongst therapists about this factor (see previous chapter). Another factor that has a bearing on a child’s self perception about their speech was attitude to speech. This was also investigated by design of an attitude questionnaire. Though two rounds of validation were performed, more are still needed and that work is reported in preliminary fashion in Appendix A.
If fluency failures arise because a speaker started execution of a word before the complete plan is ready, as argued in EXPLAN, more of the plan will be produced during the time it takes to execute the word. There will be a discrepancy between the plan at the start and end of execution (i.e. there will be a non-zero difference unlike the situation with fluent speech). These alerts, that occur selectively, signal where a part-word fluency failure happened. EXPLAN proposes that an external clock (in the cerebellum) detects these alerts. The clock slows speech rate and fluency recovers by reducing the chance of planning rate getting behind execution rate. Chapter 4 investigates the hypothesis that CWS will show performance deficits on a series of tasks designed to measure the function of the cerebellum when compared to children who do not stutter. It will also investigate the pattern of these deficits across age groups. Predicting a pattern of cerebellar deficit that follows the exchange dysfluencies on function words to one of dysfluencies on content described above.

The final experimental chapter, Chapter 5, will examine the linguistic component of EXPLAN. Examination is made of the two patterns that are seen at different points in development of stuttering (function word repetition and part-content word dysfluencies) that were the original observations on which EXPLAN was based. The investigation will use the extensive library of audio recordings of CWS available to the Speech Research Group at UCL, and current recordings made specifically for this project. The audio recordings of a group of CWS made at initial assessment and currently will be analysed using phonological word analysis to determine the rate of dysfluency on both function words and content words. Chapter 5 will investigate the hypothesis implicit in EXPLAN that CWS who exchange whole word repetitions on function words for a pattern of part word repetitions on content words are at risk of severe, persistent stuttering.
Chapter 3.

Sociodynamic relationships between CWS and their non-stuttering classmates

Abstract
The sociometric status of CWS is examined by investigating peer relationships in CWS in a school setting. Social preference, social impact and assignment of children to behavioural categories was made based on Coie, Dodge and Coppotelli (1982). Analysis of the data indicated that CWS were rejected significantly more than their peers, and were significantly less likely to be popular. CWS were less likely to be found in the class’s average social group. When compared to children who do not stutter, CWS were less likely to be nominated as leaders and were more likely to be nominated to the “bullied” and “seeks help” categories. In order to examine for a social component to the EXPLAN model of fluency failure the relationship between social status and stuttering severity was examined. Results demonstrated no significant relationship between severity of stuttering and social status.

Introduction
There are remarkable individual differences in the level at which children are accepted by their peers. Some children are well liked by all and have many friendships, others are widely disliked and have no friends.

This study examines acceptance of CWS by their peers. The study also explores the validity of using such a measure in the identification and treatment of CWS. An important component of the study is to ascertain if the methodology used in this study to define the sociometric status of CWS is viable in a clinical setting. Finally, in order to examine for a social component to the EXPLAN model of fluency failure the relationship between social status and stuttering severity is examined.

Peer rejection and bullying can have severe and long-lasting effects as shown in the review by Parker and Asher (1987). They examined low peer acceptance or peer rejection and their influence on later personal adjustment problems such as depression and early school dropout. Also Sharpe (1995) found that pupils who were persistently bullied in school were likely to experience physical illness, sleeplessness and difficulty in
concentrating on schoolwork. Hodges and Parry (1996) identified three peer-related factors that increased the risk of a child being bullied - few friends, low-status friends and rejection by peers. O’Moore and Hillery (1989), Martlew and Hodson (1991), Nabuzoka and Smith (1993) and Whitney, Smith and Thompson (1994) have all reported that children with special educational needs are more susceptible to bullying than their peers, and are more likely to have few friends and be rejected.

The reason for thinking that these criteria might apply to CWS is that they are often reluctant or unable to participate verbally in school activities (or social groups in general). In turn, this may lead them to be seen as shy or withdrawn and, possibly because of these perceived characteristics, CWS have difficulties with peer relationships and are targets of bullying. There is some previous research investigating sociodynamic factors and their relationship to stuttering and this is arranged for review under the techniques they have used. It will be apparent that a lot of this research was carried out over a quarter of a century ago and although useful from an historical perspective may not be relevant to current practice.

Interest in social factors was popularised by Johnson (1930), in his autobiographical account of the early development of a child who stutters. In this, he described the intolerant behaviours that militate against the social integration of the speech handicapped. Van Riper (1982) pointed out that the organisation of social groups depends on communication and that stuttering impairs a person’s ability to find and maintain a suitable place in the social structure. He suggested that this was most apparent in the harsh environment of school and playground - where "teasing, mockery and rejection are common experiences for a child who stutters" (Van Riper, 1971; p204).

Empirical investigations, using the clinical instruments available around this time, followed from the interest these accounts stimulated. CWS have to contend with a well-established negative stereotype of themselves. Woods and Williams (1971) found that even people with professional experience of working with dysfluent patients attributed undesirable characteristics to CWS. When asked to list adjectives to describe CWS,
approximately 75% of clinicians used words that were grouped within the category of "nervous and fearful" and 64% listed words that were included in the category "shy and insecure". Perrin (1954) found that CWS were not readily accepted as members of their classroom, and suggested that stuttering students who were more able to adjust to interpersonal situations responded better to therapy. McKinnon, Hess and Landry (1986) reported that college students reacted to moderate speech disorders (including stuttering) with a tendency of increased social distance in addition to judgements of lower evaluation and higher anxiety.

Though these studies present a coherent picture of problems a stuttering child has in different social groups, other studies have failed to find any influence of social factors on the status of CWS. Brissey and Trotter (1955) examined the social relationships within a group of speech impaired children enrolled in a six week summer residential clinic. They found no indication that social status was correlated with the severity of speech impediment. They concluded that the composition of the study group may have led the members to be more tolerant of speech dysfluencies compared with when one stuttering child had been in a group of fluent peers. Woods (1974) reported evidence that showed the social relationships of a stuttering child were no better or worse than those of fluent classmates. These studies using early clinical investigative tools are somewhat dated and have not reported consistent findings.

Retrospective reports of problems in social groups by people who stutter have also been obtained. Mooney and Smith (1994) reported that bullying has an effect on the fluency of CWS. They found 11% of adults who stutter said they had been bullied at school and that this had a negative effect on the fluency of their speech. The most recent retrospective report was by Hugh-Jones and Smith (1999). In this study 74% of 276 adults who stutter who took part in the survey reported that they had been bullied during their time at school. Of the 205 respondents that indicated they were bullied at school, 6% reported that the bullying had a long-term effect on their fluency. However, the study lacked a control group of children who do not stutter to establish whether fluent speakers were bullied less often. Comparison of this with studies of fluent children indicates that
CWS are probably more at risk of bullying than their peers. Haynie, Nansel, Eitel, Crump, Saylor, Yu and Simons-Morton, (2001) reported that around 30% of schoolchildren stated that they had been bullied within the last school year. Hugh-Jones and Smith (1999) note limitations in the project, common to all retrospective studies: Respondent’s recollections may be distorted and there is no way of validating the responses. The authors also concede that the sample may be limited by the fact that the respondents were a volunteer sample from the British Stammering Association that may have resulted in a cohort that were particularly aware of the issues surrounding their dysfluency and its effects. Hugh-Jones and Smith (1999) concluded that there is little evidence to suggest that bullying, peer rejection or low social status causes stuttering. This is also supported by the fact that onset of stuttering usually occurs between the ages of 3 and 5 (Dalton and Hardcastle, 1977) whereas peer rejection and bullying are prevalent at later ages. Hugh-Jones and Smith (1999) give the age at onset of bullying as between 11 and 13 years in CWS. The usefulness of data from retrospective studies is limited by the inherent problems with the methods as well as by the contradictory findings.

Sociometric methods have also been used to assess the dynamics of groups containing CWS. Marge (1966) reported a study that used these procedures to assess intellectual and social status, physical ability and speech skills of CWS. The study examined 197 third grade (8-9 years) public school students, of whom 36 had been diagnosed with a moderate or severe speech dysfluency. Sociograms were obtained on each of the four components investigated based on Moreno (1960). Marge reported that dysfluent children held a lower social position than fluent ones. Sociograms were also obtained from teachers on the same four component skills for each child. The data from the study indicated that, with regard to intellectual skills in school and social activity outside school, the dysfluent child held a significantly lower position than that of his or her fluent peers. In the other areas of playground activity and speech skills, no significant difference between the groups was found. The results from the teachers corroborated the findings of the peers. Though these sociodynamic methods have made interesting
findings, the study was limited to a single question about social status in each of four areas (classroom, playground, out of school and speaking) and is, again, dated.

The methods used for investigating sociodynamics that have been reviewed have inherent problems and limitations, and contradictory findings have been reported. It is also notable that the majority of research into the social status of CWS uses data from respondents who were in the educational system more than two decades ago (either because the publications are dated or adult respondents provided retrospective reports). It is possible that the attitude of children toward their peers with disabilities (including those of speech) has changed in the intervening period. This may be linked to changes in the way the education system in England and Wales has addressed social and behavioural problems in schools over a similar period.

There was little attempt to address the problem of bullying in UK schools until 1989. In 1989 the Elton Report on school discipline was published, and this together with Scandinavian studies of bullying (Olweus, 1993), led to an increase in activity. The issue of bullying is now addressed by the Office for Standards in Education (OFSTED) during their inspection of schools. This, combined with schools instigating peer support systems for vulnerable children, suggests that there is reason to believe that the situation with regard to bullying in schools is improving. Although there is little evidence that the particular difficulties of CWS are fully recognised by schools it is possible that dysfluent children are less at risk than they were two decades ago. Following the Warnock Report (1978) that highlighted the need for specific teacher training and resources to accommodate special needs children into mainstream schools, there has been a considerable increase in the integration of children with disabilities and special needs of all kinds into mainstream education. CWS are now absorbed into a larger group of potentially socially vulnerable children and might no longer be a high profile target for rejection and bullying.

The current study uses a sociometric scale to assess CWS in classes of fluent peers. Such scales have only been used once with CWS (Marge, 1966). The Marge
(1966) method is limited in scope and dated. Here the method of Coie, Dodge and Coppotelli (1982) as adapted by Nabuzoka and Smith (1993) to investigate the sociometric status and social behaviour of learning disabled children is employed. Each child in the social group is interviewed individually. During the interview, the child names the three children in the group they like the most and the three children they like the least. Each child is also asked to assign three children in the group to each of eight behavioural categories (shy, assertive, co-operative, disruptive, leader, seeks help, bully and bully victim). The peer nominations to social status groups (“liked most” and “liked least”) produces a Social Preference (SP) score, which measures popularity/rejection and a Social Impact (SI) score, which measures social influence. The peer nominations allow children to be allocated to one or more of the eight social behavioural categories. With regard to differences between the two peer groups the questions addressed are whether CWS differ from fluent peers on (a) social status and (b) social behaviour. In light of the previous research reviewed above it is hypothesised that the social status of CWS will be significantly lower than that of their peers and that CWS will be nominated to positive behavioural groups significantly less and to negative behavioural groups significantly more than their peers.

The study will have a second objective which is to establish if it is possible to obtain an accurate sociometric for a child who stutters in the time available to speech and language therapists at initial assessment. Similar to Marge (1966), sociometric measures are obtained from teachers for each of the children in the study. In this study the Social Behaviour at School (SBS) Questionnaire (Spence, 1985) will be used to obtain teacher ratings. The SBS Questionnaire was also used by Nabuzoka and Smith (1993) in their study investigating the social status of learning disabled children. If the relationship between teacher and peer sociometric ratings proves to be significant, teacher ratings could be a convenient method for speech and language therapists to obtain accurate and reliable information on the social status of CWS.

The sociometric measures obtained in this study will also be used to investigate the relationship between stuttering severity and social status. The EXPLAN model of fluency
failure (see previous chapter for a complete review and explanation) suggests that fluency failures are a result of a combination of phonological complexity and speech rate. What happens is that shorter, simpler function words can be executed before the complete plan for the production of a subsequent content word is ready. The function word can be planned and executed at a rapid rate to cope with time pressure so the speaker needs the plan of the content word, that takes longer to produce because of it’s complexity, earlier in time pressure situations. It is possible that because of the speed of execution the complete plan for the production of the content word may not be available when required. It is the non-availability of the complete plan of the content word that results in fluency failure. Faced with only a part plan of the ensuing word in the utterance a speaker has two choices. The speaker can stall (wait for the complete plan to become available), this can be achieved by using filled or unfilled pauses or by repeating the preceding function word. These techniques are instances of normal nonfluency in that all children use them but are not regarded as stutterers. The alternative is to continue with the utterance using the part of the plan that is available. The result would be part word dysfluencies – a sign of persistent stuttering (Conture, 1990).

It could be argued that children who are less well placed socially would be less able to cope with the time pressures placed upon conversational speech. In conversation, even among friends, there is pressure to maintain a place in the conversation environment. A child who is confident and socially comfortable in such an environment would be able to maintain the normal nonfluent technique of stalling (pausing, whole function word repetitions) because they would not worry about losing their place in the conversation. A child who felt at risk of being socially marginalised or rejected by peers could be tempted to advance an utterance on the basis of a part plan in order to maintain their place in the group discussion. This would result in the part word dysfluencies described above. It is hypothesised that there will be a significant negative relationship between stuttering severity and social status.
Method

Participants
A total of 403 children (range 8 years 3 months - 14 years 9 months) took part in the study. These children came from 16 classes in 16 different schools across England. There was one child who stuttered in each of the 16 classes. The schools were located in rural, suburban and urban areas across England. The locations and further details of the schools are in Appendix C. The mean age of the CWS was 11 years 9 months and the mean age of the children who do not stutter was also 11 years 9 months. Fifteen of the 16 CWS were boys (mean age 11 years 9 months), the girl who stuttered was aged 11 years 6 months. 204 of the 387 children who did not stutter were boys (mean age 11 years 11 months) and 183 girls (mean age 11 years 7 months). Complete information regarding the age of individual CWS and the composition of their peer groups is in Appendix D.

The CWS had been referred for therapy to The Michael Palin Centre for Stammering Children in London following initial diagnosis of stuttering by a speech pathologist in their local region. Twenty-five parents were asked about their willingness to allow their children to participate (all agreed). Subsequently contact was made with the schools of the CWS requesting permission to conduct the study. Initial contact was by letter and 16 of the 25 schools approached agreed to take part in the study. The parents of the target child (the child who stutters), the head teacher, and special educational needs co-ordinator in the schools involved were aware of the true nature of the investigation. All of the children (stuttering and fluent) and the parents of children who do not stutter were not aware of the true purpose of the study. The parents of the children who do not stutter were sent letters via their schools asking if their child could take part in a study on relationships (a copy of one of these letters can be found in Appendix E). All of the children were informed that the investigation was about children’s friendships and behaviours.

Procedure
Initially each class was seen as a group at which point the general purpose of the research project was described and they were told that each child would talk individually with the
researcher during the course of the day. Care was taken not to identify the stuttering child in the class as the focus of the study. It was stressed that the replies that the children gave to the researcher's questions would be treated confidentially and the children were requested not to discuss the interview with peers.

Following the brief introduction each child was seen individually. The interviews were conducted on a one-to-one basis in a room close to the classroom. It was considered that the presence of an authority figure (e.g. teacher) or other children might affect the children's responses given the personal and confidential nature of the information the child provided. The child was shown the class register and asked to confirm that he or she knew all the children. After establishing this, he or she was asked to pick three children of either sex they liked the most, and three children they liked the least (these provide the information for the social status scores of the children). The researcher then asked the child to nominate three children from the class who best fit each of eight behavioural descriptions, shy, assertive, co-operative, disruptive, leader, uncertain, bully and bully victim. The descriptions for the behavioural categories were adapted from Coie et al. (1982). The eight behavioural descriptions are listed fully in Appendix F. The children were allowed to nominate the same child for more than one category. At the end of the interview, each child was re-assured regarding the confidentiality of his or her responses and was reminded not to discuss the interview with classmates.

Following completion of the interviews the class teacher was given the Social Behaviour at School Questionnaire developed by Spence (1985), a measure of a child's social competence on a number of interpersonal skills. The questionnaire contained 42 items describing a variety of situations, the teacher was required to answer "Yes" or "No" with regard to whether they viewed the situation as a problem for the particular child. A copy of this questionnaire is in Appendix G. The class teacher was asked to complete Social Behaviour at School Questionnaire for each child in the class and return them to the researcher in the pre-paid envelope provided. The class teacher was not aware of the responses given by the children during the interviews.
Results

Worked examples

Before proceeding with an overall analysis of the data, a worked example of how subjects were allocated to social status and behavioural categories follows.

Social status

Table 1. An example of a single child’s allocation to a social status group.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DP</td>
<td>2</td>
<td>-0.40</td>
<td>9</td>
<td>1.92</td>
<td>-2.33</td>
<td>-1.39</td>
<td>1.51</td>
<td>1.39</td>
</tr>
</tbody>
</table>

During a structured interview each child nominated three children in the classroom group that they liked the most and the three children that they liked the least. The liked most and liked least nominations for each child were then calculated, these were transformed into standardised scores for each child within the classroom group (z scores). In the example above the child received 2 positive nominations (liked most) and 9 negative nominations (liked least) from his classmates which were then standardised to an (LM) score of -0.40 and to a (LL) score of 1.92 respectively. The subject’s social preference (SP) score was then computed as the LM score minus the LL score, resulting in an SP score of -2.33. Similarly the subject’s social impact score (SI) was calculated by adding the LM and the LL scores, giving an SI score of 1.51. The SP and SI scores were then standardised again within each classroom group (z scores), giving scores of -1.39 (SP) and 1.39 (SI). Having received an SP score of less than -1.0 (-1.39) and an LM score of less than 0 (-0.40) and a LL score of more than 0 (1.93) the subject could be placed in the rejected social group. The complete criteria for allocation to social status groups are listed below (See Overall Analysis - social status).

Behavioural category

To be allocated to a behavioural category a subject must receive a number of peer nominations to that category which are at least one standard deviation above the classroom group mean for that category. In the above example the participant was allocated to the behavioural categories of disruptive and bully because in each instance the number of nominations received was more than one standard deviation above the
classroom group mean for those categories. For example, in the **bully** category JP’s 4 nominations were outside the range \(1.12 + 1.99 = 3.11\).

### Table 2. Worked example of a single subject’s (JP) allocation to behavioural categories.

<table>
<thead>
<tr>
<th>Behavioural Category</th>
<th>Class mean of nominations to each category</th>
<th>Standard deviation</th>
<th>No. of nominations for JP</th>
<th>Allocated to category</th>
</tr>
</thead>
<tbody>
<tr>
<td>shy</td>
<td>1.68</td>
<td>4.06</td>
<td>0</td>
<td>no</td>
</tr>
<tr>
<td>assertive</td>
<td>2.80</td>
<td>4.37</td>
<td>6</td>
<td>no</td>
</tr>
<tr>
<td>co-operative</td>
<td>2.40</td>
<td>2.33</td>
<td>1</td>
<td>no</td>
</tr>
<tr>
<td>disruptive</td>
<td>1.92</td>
<td>2.61</td>
<td>9</td>
<td>yes</td>
</tr>
<tr>
<td>leader</td>
<td>1.88</td>
<td>2.79</td>
<td>0</td>
<td>no</td>
</tr>
<tr>
<td>seeks help</td>
<td>2.08</td>
<td>2.41</td>
<td>1</td>
<td>no</td>
</tr>
<tr>
<td>bully</td>
<td>1.12</td>
<td>1.99</td>
<td>4</td>
<td>yes</td>
</tr>
<tr>
<td>bully victim</td>
<td>1.68</td>
<td>2.98</td>
<td>2</td>
<td>no</td>
</tr>
</tbody>
</table>

**Overall analysis**

**Social status**

For social status scores, the frequency of positive nominations and negative nominations (liked most, LM, liked least, LL) for each child were computed and transformed into standardised normal deviates for like (ZLM) and dislike (ZLL) categories within each classroom group. A social preference score (SP) was computed as the ZLM score minus the ZLL score. A social impact score (SI) was computed as the sum of the ZLM and ZLL scores. The SP and SI scores were then standardised within each classroom group.

Each child was then classified into groups based on the following criteria: (a) **Popular**, receiving an SP score greater than 1.0, a ZLM score greater than 0, and a ZLL score less than 0. (b) **Rejected**, receiving an SP score less than -1.0, a ZLM score less than 0 and a ZLL score greater than 0. (c) **Neglected**, receiving an SI score less than -1.0, a ZLM score less than 0 and a ZLL score less than 0. (d) **Controversial**, receiving an SI score greater than 1.0, a ZLM score greater than 0 and a ZLL score greater than 0. (e) **Average**, Receiving an SP score between -0.5 and 0.5 and an SI score between -0.5 and 0.5. (f) **Other**, all remaining children. The percentage of stuttering and non-stuttering children who fell into each of the status groups was calculated and are shown in Table 3.
Table 3. Percentage of children meeting criteria of nomination to social status groups by fluent and stuttering groups using all nominations.

<table>
<thead>
<tr>
<th>Social Status</th>
<th>Fluent (n=387)</th>
<th>Stuttering (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rejected</td>
<td>18.86</td>
<td>43.75</td>
</tr>
<tr>
<td>Neglected</td>
<td>4.39</td>
<td>6.25</td>
</tr>
<tr>
<td>Controversial</td>
<td>8.79</td>
<td>12.5</td>
</tr>
<tr>
<td>Popular</td>
<td>25.84</td>
<td>6.25</td>
</tr>
<tr>
<td>Average</td>
<td>26.87</td>
<td>6.25</td>
</tr>
<tr>
<td>Other</td>
<td>15.25</td>
<td>25</td>
</tr>
</tbody>
</table>

More than twice as many CWS were rejected (43.75%) than children who do not stutter (18.86%), 6.25% of CWS were found to be popular, compared to 25.84% of children who do not stutter. Children who do not stutter (26.87%) were more than 4 times as likely to be found in the average social grouping than were CWS (6.25%). There was little difference in the proportion of CWS and children who do not stutter in the remaining three status groups. This indicates a trend toward CWS being viewed by their peers in a socially negative aspect and not as popular members of the class.

Approximately 15% of children who do not stutter and 25% of CWS were allocated to the “other” category when Coie et al.’s (1982) categorisations were used and this effectively dismissed these data. Examination of the raw scores indicated that some of these children had different affects for the children in their peer reference group. For example in some classroom groups a child received three nominations as “liked most” and no nominations as “liked least” and were placed in the other category. Similarly at the negative end of the social scale there was an example of a child receiving 2 “liked most” nominations and 5 “liked least” nominations that was also placed in the other category. In the light of this, children who received an SP score of greater than 0, a LM score of greater than 0 and a ZLL score of less than 0 were allocated to a new social group of liked. Children who received an SP score of less than 0, an LM score of less than 0 and an LL score of more than 0 were allocated to a new social group of disliked. In this sample, all the children who were reassigned to the two new groups were taken from the other social group. The percentage of children in liked, disliked and other categories are given in Table 4.
Table 4. Percentage of children meeting criteria of nomination to social status groups by fluent and stuttering groups using liked and disliked groups (all nominations).

<table>
<thead>
<tr>
<th>Social Status</th>
<th>Fluent (n=387)</th>
<th>Stuttering (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liked</td>
<td>6.46</td>
<td>18.75</td>
</tr>
<tr>
<td>Disliked</td>
<td>3.10</td>
<td>6.25</td>
</tr>
<tr>
<td>Other</td>
<td>5.94</td>
<td>0</td>
</tr>
</tbody>
</table>

Chi-square tests using raw data (observed frequencies) indicated that there were significantly fewer CWS in the popular ($\chi^2 (1) = 3.14, p< .05$) category and more in the rejected ($\chi^2 (1) = 5.98 p< .01$), average ($\chi^2 (1) = 3.39 p< .05$) and liked ($\chi^2 (1) = 3.59, p< .05$) categories. The small number of CWS in the study could cast doubt on the usefulness of statistical analysis. For example in each of the three chi-square analysis reported above one cell had n<5. However this study takes the position often used in contemporary research that with a sample size more than 20 statistical analysis can tolerate 25% of cells with n<5 (Coolican, 1994). Overall, it appears, then, that the CWS are regarded more negatively with respect to social status.

The percentage of children allocated to each social group within each class was calculated. Thirteen out of the 16 CWS were in classroom social groups that contained a higher proportion of children than the mean for all schools. This could signify a trend for CWS to adopt the predominant social characteristic of their classroom group.

A complete list of social status scores for each CWS together with class means is in Appendix D.

Analysis using same-sex nominations only

There have been issues raised concerning the validity of cross-sex versus same-sex sociometric scores (Daniels-Beirness, 1989; Hyden-Thompson, Rubin and Hymel, 1987) although these concerns have received comparatively little attention. This would seem surprising as there are consistent findings that sex segregation in children’s school play groups is virtually complete in the 8 – 12 year old age range (Maccoby and Jacklin, 1987; Shrum, Chuck and Hunter, 1988). As the focus of this study is primarily within this age range it was decided to re-analyse the data using only same-sex nominations. The
percentages of stuttering and non-stuttering children who fell into each of the status groups was calculated using only same-sex nominations and are shown in Table 5.

Table 5. Percentage of children meeting criteria of nomination to social status groups by using same sex nominations

<table>
<thead>
<tr>
<th>Social Status</th>
<th>Children who do not stutter (n=387)</th>
<th>Children who stutter (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popular</td>
<td>23.15</td>
<td>6.25</td>
</tr>
<tr>
<td>Rejected</td>
<td>16.67</td>
<td>43.75</td>
</tr>
<tr>
<td>Neglected</td>
<td>3.71</td>
<td>6.25</td>
</tr>
<tr>
<td>Controversial</td>
<td>12.96</td>
<td>6.25</td>
</tr>
<tr>
<td>Liked</td>
<td>6.94</td>
<td>25</td>
</tr>
<tr>
<td>Disliked</td>
<td>1.38</td>
<td>6.25</td>
</tr>
<tr>
<td>Average</td>
<td>20.83</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>14.36</td>
<td>6.25</td>
</tr>
</tbody>
</table>

Inspection of the data in Table 5 indicates that the use of same-sex nominations has made little differences to the allocation of social status categories to both CWS and to their peers. However, the number of children who do not stutter allocated to the popular social status group has been reduced. This reduction meant that children who do not stutter were no longer significantly more likely to be allocated to this group ($\chi^2 (1) = 2.48$, ns). The significant differences remained in the rejected ($\chi^2 (1) = 3.10 p< .05$), average ($\chi^2 (1) = 4.14 p< .05$) and liked ($\chi^2 (1) = 6.50, p< .01$) categories. There were significantly more CWS in the rejected and liked categories and significantly less CWS in the average category. In view of the fact that the use of same-sex nominations made little difference to the overall profile of both groups, only the results using data from all nominations will be discussed.

Behavioural categories
The number of nominations each child received for each of the eight behavioural categories (shy, assertive, co-operative, disruptive, leader, uncertain, bully and bully victim) was calculated. The criterion for assigning a child to a behavioural category was that he or she had to receive a number of peer nominations to that category which are at least one standard deviation above the classroom group mean for that category.

The percentages of stuttering and children who do not stutter falling into each of the behavioural categories are shown in Table 6.
Children who do not stutter were almost twice as likely to be nominated as leaders (12.92%) than were CWS (6.5%). There were considerably more CWS in the bully victim (37.5%) and seeks help categories (25%) than there were children who do not stutter (10.6% and 13.18% respectively). CWS and children who do not stutter showed little difference in their nominations to the shy, co-operative, disruptive, bully and assertive categories. These data indicate that CWS predominate in the vulnerable behavioural categories of seek help and bully victim and are under-represented in the more positive category of leader. Of the trends noted, chi-square tests on the number of children in each category showed that the only significant difference was between the number of CWS and the number of children who do not stutter in the bully victim category ($\chi^2 (1) = 10.80 p< .001$).

Table 6. Percentage of children meeting criteria of nomination to behavioural categories by fluent and stuttering groups using all nominations.

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Fluent (n=387)</th>
<th>Stuttering (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shy</td>
<td>12.4</td>
<td>12.5</td>
</tr>
<tr>
<td>Assertive</td>
<td>14.21</td>
<td>12.5</td>
</tr>
<tr>
<td>Co-operative</td>
<td>15.5</td>
<td>18.75</td>
</tr>
<tr>
<td>Disruptive</td>
<td>14.21</td>
<td>18.75</td>
</tr>
<tr>
<td>Leader</td>
<td>12.92</td>
<td>6.5</td>
</tr>
<tr>
<td>Seeks Help</td>
<td>13.18</td>
<td>25</td>
</tr>
<tr>
<td>Bully</td>
<td>13.18</td>
<td>12.5</td>
</tr>
<tr>
<td>Bully Victim</td>
<td>10.6</td>
<td>37.5</td>
</tr>
</tbody>
</table>

To summarise the results in tables 6,

- CWS are more likely to be bully victims and to seek help.
- Children who do not stutter are more likely to be seen as leaders than are CWS.
- Behaviours such as shy, assertive, co-operative, disruptive and bully are equally likely in either group.

A complete list of behavioural nomination scores for individual CWS together with class means is in Appendix D.
Analysis using same-sex nominations

As with social status, the allocation to behavioural categories was re-calculated using only same-sex nominations. The percentages of CWS and children who do not stutter that were allocated to each of the behavioural using same-sex nominations are shown in Table 7.

Table 7. Percentage of children meeting criteria of nomination to behavioural categories using using same sex nominations

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Children who do not stutter (n=387)</th>
<th>Children who stutter (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shy</td>
<td>11.57</td>
<td>25</td>
</tr>
<tr>
<td>Assertive</td>
<td>17.13</td>
<td>12.5</td>
</tr>
<tr>
<td>Co-operative</td>
<td>12.5</td>
<td>18.75</td>
</tr>
<tr>
<td>Disruptive</td>
<td>18.98</td>
<td>18.75</td>
</tr>
<tr>
<td>Leader</td>
<td>12.5</td>
<td>6.25</td>
</tr>
<tr>
<td>Seeks Help</td>
<td>13.89</td>
<td>31.25</td>
</tr>
<tr>
<td>Bully</td>
<td>17.13</td>
<td>18.75</td>
</tr>
<tr>
<td>Bully Victim</td>
<td>11.11</td>
<td>31.25</td>
</tr>
</tbody>
</table>

Using same-sex nominations, children who do not stutter continued to be twice as likely to be nominated as leaders (12.5%) than were CWS (6.25%). There were considerably more CWS in the bully victim (31.25%) and seeks help categories (31.25%) than there were children who do not stutter (11.1% and 13.89% respectively). Same-sex nominations indicated that CWS were more than twice as likely to be seen as shy than were their peers that do not stutter (25% compared to 11.57%). CWS and children who do not stutter showed little difference in their nominations to the co-operative, disruptive, bully and assertive categories. These data indicate that CWS predominate in the vulnerable behavioural categories of seek help, bully victim and shy and are under-represented in the more positive category of leader. Of the trends noted, chi-square tests on the number of children in each category showed that there were significant differences between the number of CWS and the number of children who do not stutter in the bully victim category ($\chi^2 (1) = 10.80 p< .001$) and in the seeks help category ($\chi^2 (1) = 3.51 p< .05$). The use of same-sex nominations made little difference to the overall profile of both groups, bearing this in mind only the results using data from all nominations will be discussed.
Stuttering severity, social status and behaviour

In order to assess stuttering severity, speech samples were obtained in the form of audio recordings of spontaneous speech from the children who stutter that participated in this study. A researcher who was not involved in this study made the recordings in a relaxed atmosphere at a speech and language therapy clinic. Topics that were suggested for the spontaneous monologue were family, school, television, computer games and so on. The children were able to speak continuously on these topics and they were suitable for all age groups. A two-minute section of speech from each child was chosen at random and assessed by noting the number of stuttered incidences. Subsequently it was possible to compute the percentage of the total number of syllables that had been spoken during the two-minute recording that had been stuttered (%SS). Interjudge reliability measures were obtained by asking a Human Communications Science final year student to re-assess the speech samples. These second assessments were made independently (i.e. the second judge did not have the first judge’s assessment). The Kendall’s coefficient of concordance between the two judges was significant - Kendall’s W x^2(2)=29.27, p<.05. This indicates a high level of agreement between the two judges. It should be noted that the 16 CWS that participated in this study did not form part of the cohort that took part in the studies on motor skills and speech that are reported in the following two chapters. Therefore these speech samples did not form part of the analysis carried out in Chapter 5.

The relationship between %SS and the liked most and liked least nominations was explored. The correlations were weak and no significant relationships were found. Similar results were obtained when the relationship between %SS and Social Preference and Social Impact Scores were explored. The results of the correlational analysis are listed in table 8.
Table 8. Relationship between %SS and social status.

<table>
<thead>
<tr>
<th>Liked Most nominations</th>
<th>r = -.107, not significant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liked Least nominations</td>
<td>r = .048, not significant.</td>
</tr>
<tr>
<td>Social Preference score</td>
<td>r = .057, not significant.</td>
</tr>
<tr>
<td>Social Impact score</td>
<td>r = .160, not significant.</td>
</tr>
</tbody>
</table>

The relationship between stuttering severity and nominations to behavioural categories was also explored. The resulting r values are listed in table 9. The correlation between %SS and nominations to the bully category was shown to be moderate but generally the analysis showed only weak relationships between %SS and the nomination scores to the behavioural categories. None of the correlations were significant.

Table 9. Relationship between %SS and behavioural nominations

<table>
<thead>
<tr>
<th>Shy</th>
<th>r = .209, not significant</th>
<th>Assertive</th>
<th>r = -.151, not significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-operative</td>
<td>r = -.080, not significant</td>
<td>Disruptive</td>
<td>r = .019, not significant</td>
</tr>
<tr>
<td>Leader</td>
<td>r = .028, not significant</td>
<td>Seeks Help</td>
<td>r = .040, not significant</td>
</tr>
<tr>
<td>Bully</td>
<td>r = .346, not significant</td>
<td>Bully Victim</td>
<td>r = -.130, not significant</td>
</tr>
</tbody>
</table>

The lack of any meaningful relationship between stuttering severity and social or behavioural status is exemplified by the profiles listed in table 10. It can be seen from this table that the children in this study who were classed as mild stutterers (less than 5%SS) were more likely to be rejected by their peers (3 out of 5 children in this group were rejected) than were children with a moderate (1 out of 5) or severe (2 out of 6) stutter. The table also indicates that the children in this study with a mild stutter were less likely to be victims of bullying as were children with a severe stutter. Forty per cent (2 out 5) children with a mild stutter were reported by their peers to be victims of bullying compared to 50% of the children with a severe stutter (3 out of 6 children).
Table 10. Relationship between stuttering severity, social status and social behaviour.

<table>
<thead>
<tr>
<th>Child</th>
<th>Age</th>
<th>Severity (%SS)</th>
<th>Social Status</th>
<th>Social Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>KK</td>
<td>11 yrs 11 mths</td>
<td>1.5 / MILD</td>
<td>CONTROVERSIAL</td>
<td>DISRUPTIVE, SEEKS HELP</td>
</tr>
<tr>
<td>BF</td>
<td>12 yrs 1 mth</td>
<td>2 / MILD</td>
<td>LIKED</td>
<td>CO-OPERATIVE</td>
</tr>
<tr>
<td>IZ</td>
<td>13 years</td>
<td>2.5 / MILD</td>
<td>REJECTED</td>
<td>ASSERTIVE</td>
</tr>
<tr>
<td>SR</td>
<td>12 yrs 8 mths</td>
<td>3 / MILD</td>
<td>REJECTED</td>
<td>ASSERTIVE, DISRUPTIVE, BULLY VICTIM</td>
</tr>
<tr>
<td>AB</td>
<td>12 yrs 9 mths</td>
<td>3.5 / MILD</td>
<td>REJECTED</td>
<td>SHY, BULLY VICTIM</td>
</tr>
<tr>
<td>MJ</td>
<td>13 yrs 6 mths</td>
<td>5.5 / MODERATE</td>
<td>REJECTED</td>
<td>SEEKS HELP, SHY BULLY VICTIM</td>
</tr>
<tr>
<td>JL</td>
<td>13 yrs 4 mths</td>
<td>6 / MODERATE</td>
<td>LIKED</td>
<td>CO-OPERATIVE</td>
</tr>
<tr>
<td>HA</td>
<td>10 yrs 2 mths</td>
<td>6 / MODERATE</td>
<td>REJECTED</td>
<td>LEADER</td>
</tr>
<tr>
<td>RR</td>
<td>11 yrs 1 mth</td>
<td>7 / MODERATE</td>
<td>DISLIKED</td>
<td>BULLY</td>
</tr>
<tr>
<td>DF</td>
<td>11 yrs 1 mth</td>
<td>9.5 / MODERATE</td>
<td>POPULAR</td>
<td>DISRUPTIVE</td>
</tr>
<tr>
<td>SL</td>
<td>8 yrs 6 mths</td>
<td>11 / SEVERE</td>
<td>NEGLECTED</td>
<td></td>
</tr>
<tr>
<td>SH</td>
<td>9 yrs 5 mths</td>
<td>12.5 / SEVERE</td>
<td>REJECTED</td>
<td>BULLY</td>
</tr>
<tr>
<td>CB</td>
<td>14 yrs 3 mths</td>
<td>13.5 / SEVERE</td>
<td>LIKED</td>
<td>CO-OPERATIVE, SEEKS HELP, BULLY VICTIM</td>
</tr>
<tr>
<td>AP</td>
<td>10 yrs 8 mths</td>
<td>16 / SEVERE</td>
<td>OTHER</td>
<td>BULLY VICTIM</td>
</tr>
<tr>
<td>JB</td>
<td>11 yrs 6 mths</td>
<td>18.5 / SEVERE</td>
<td>AVERAGE</td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td>11 yrs 5 mths</td>
<td>14.5 / SEVERE</td>
<td>REJECTED</td>
<td>SHY, SEEKS HELP BULLY VICTIM</td>
</tr>
</tbody>
</table>
The EXPLAN model of fluency failure indicates that the important changes that occur in the speech patterns of children at risk of persistent stuttering happen in the age range of 8 – 12 years. In order to investigate for changes in social status that might occur during this developmental period the relationship between age and the liked most and liked least nominations was explored. The relationships were weak and not significant.

The relationship between social status and behavioural categories
The relationships between social status (liked most, liked least) and the peer behavioural nominations was examined separately for each the speaker groups. All correlations between liked most and the eight behavioural categories and liked least and the eight behavioural categories were computed. It was expected that there would be a significant positive correlation between the “liked most” nominations and behavioural categories such as leader and co-operative and between the “liked least” nominations and the negative behavioural categories of disruptive, seeks help and bully. Correlation analysis showed that this was only the case for the control (children who do not stutter) group with 5/8 liked most and 7/8 liked least correlations significant. These are listed in table 11 below. The lack of significance found in the experimental (CWS) group may be a function of the small number of participants in this group. It is interesting to note that the only correlation that approached significance in the experimental group was a positive correlation between liked most and disruptive nominations. In the control group disruptive nominations were significantly positively correlated with liked least nominations.

Teacher rating
A teacher rating of social status was obtained by summing each of the positive responses to the items on the SBS Questionnaire. This would give a possible maximum score of 42 with higher scores indicating a more elevated level of social acceptance.

Completed questionnaires were received from seven out of the sixteen schools who participated in the study. The relationship between the teachers’ SBS scores of social behaviour and subjects’ SP and SI scores was examined. Although the SBS questionnaire is primarily a measure of social behaviour it was decided to explore the relationship
Table 11. Comparison of correlations between peer behavioural nominations and sociometric measures of liked most and liked least.

<table>
<thead>
<tr>
<th>SOCIAL STATUS</th>
<th>liked most</th>
<th>liked least</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BEHAVIOUR</strong></td>
<td><strong>cws (n=16)</strong></td>
<td><strong>Cwdns (n=387)</strong></td>
</tr>
<tr>
<td>Shy</td>
<td>-.353</td>
<td>-.057</td>
</tr>
<tr>
<td>Assertive</td>
<td>.137</td>
<td>.213**</td>
</tr>
<tr>
<td>co-op</td>
<td>.232</td>
<td>.279**</td>
</tr>
<tr>
<td>Disruptive</td>
<td>.486</td>
<td>-.106</td>
</tr>
<tr>
<td>Leader</td>
<td>.101</td>
<td>.341**</td>
</tr>
<tr>
<td>seeks help</td>
<td>.168</td>
<td>-.151*</td>
</tr>
<tr>
<td>Bully</td>
<td>-.116</td>
<td>-.011</td>
</tr>
<tr>
<td>Bully victim</td>
<td>.254</td>
<td>-.289**</td>
</tr>
</tbody>
</table>

*=sig,p<.05, **=sig,p<.005

between the teacher scores and social status as measured by SP and SI scores. Significant positive correlations were found between the teachers’ SBS scores and SP scores in all seven schools. This could be construed as evidence that the SP score is a reliable indicator of social status. Significant negative correlations between teachers’ SBS scores and SI scores were found in only two schools, the remaining 5 correlations were not significant. These correlations are shown in table 12.

Table 12. Correlations between SP / SI scores and teachers’ Social Behaviour at School Questionnaire scores

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SP</th>
<th>Significance</th>
<th>SI</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPS (n=26)</td>
<td>.578</td>
<td>p&lt;.01</td>
<td>-.444</td>
<td>p&lt;.05</td>
</tr>
<tr>
<td>LMS (n=24)</td>
<td>.564</td>
<td>p&lt;.01</td>
<td>.043</td>
<td>ns</td>
</tr>
<tr>
<td>COS (n=30)</td>
<td>.544</td>
<td>p&lt;.001</td>
<td>-.526</td>
<td>p&lt;.01</td>
</tr>
<tr>
<td>CS (n=22)</td>
<td>.386</td>
<td>p&lt;.05</td>
<td>-.137</td>
<td>ns</td>
</tr>
<tr>
<td>FBS (n=27)</td>
<td>.358</td>
<td>p&lt;.05</td>
<td>-.263</td>
<td>ns</td>
</tr>
<tr>
<td>HTS (n=29)</td>
<td>.467</td>
<td>P&lt;.05</td>
<td>-.072</td>
<td>ns</td>
</tr>
<tr>
<td>TAS (n=25)</td>
<td>.574</td>
<td>p&lt;.01</td>
<td>.050</td>
<td>ns</td>
</tr>
</tbody>
</table>

Using the social status categories of popular and rejected as criteria for social acceptance and rejection, biserial correlations were used to establish whether teachers and
students agreed on which children were accepted and which were rejected. The relationship between teachers' SBS scores and peer nominations for the social status groups of popular and rejected were examined.

Table 13. Biserial correlations between teachers' SBS scores and popular / rejected social status groups.

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Popular significance</th>
<th>rejected significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPS</td>
<td>r=.27 ns</td>
<td>r=.42 p&lt;.025</td>
</tr>
<tr>
<td>LMS</td>
<td>r=.46 p&lt;.025</td>
<td>r=.40 p&lt;.025</td>
</tr>
<tr>
<td>COS</td>
<td>r=.17 ns</td>
<td>r=.31 p&lt;.05</td>
</tr>
<tr>
<td>CS</td>
<td>r=.12 ns</td>
<td>r=0 ns</td>
</tr>
<tr>
<td>FBS</td>
<td>r=.14 ns</td>
<td>r=.46 p&lt;.01</td>
</tr>
<tr>
<td>HTS</td>
<td>r=.14 ns</td>
<td>R=.48 P&lt;.01</td>
</tr>
<tr>
<td>TAS</td>
<td>r=.05 ns</td>
<td>r=.27 ns</td>
</tr>
</tbody>
</table>

Significant correlations were found between teachers' SBS scores and the rejected group in five out of the seven schools who returned questionnaires. The correlation between teachers' SBS scores and the popular group was significant in only one school (see table 13).

The SBS scores allocated by teachers to CWS were slightly lower than those allocated to children who do not stutter. The mean SBS score for children who do not stutter was 37.44 (sd 6.13) and for CWS it was 36.86 (sd 6.99). The difference was not significant; - t(193) = 0.24, ns.

Discussion
Social status.
Results from the study indicate that there is a trend for CWS to hold a lower social position to that of children who do not stutter. A higher proportion of children who do not stutter were in the positive social status groups than were CWS. Only one child who stutters was nominated to the "popular" status group and a higher percentage of CWS were nominated to the negative status group of "rejected". The significant difference between the speaker groups in terms of social status is consistent with findings of previous research on other groups of children (Perrin, 1954; Marge, 1966; Wood and Williams, 1976). The difference in social status between CWS and children who do not stutter has also been found in previous research.
In the two decades since the bulk of research into the socialisation of CWS was completed there has been a considerable increase in the integration of children with disabilities into mainstream education. Following the Warnock Report (1978) which highlighted the need for specific teacher training and resources to accommodate special needs children into mainstream schools. Hegarty and Pocklington (1982) found that there was an increase in the degree of acceptance of children with disabilities on the part of mainstream teachers: 90% of all respondents felt that the placement of handicapped pupils at their school was appropriate. Howarth (1987) suggested that pupils reflect teacher attitudes, and this, combined with direct contact, is the most effective way of improving attitude among pupils. After a period of initial curiosity, the presence of pupils with special needs is accepted as a matter of course; rejection is uncommon (Howarth, 1987). There is also ample opportunity for direct contact, with between 18 and 20 per cent of children in mainstream education being designated as special needs (Howarth, 1987). These views in society at large do not appear to be reflected in the judgements of CWS by their classmates in this study.

Data from the study could also be interpreted to indicate that some of the similarities in social status between CWS and children who do not stutter is a result of a deliberate social strategy adopted by the CWS. In 13 out of the 16 classes that participated in the study, the stuttering child was found to be in a social status group that was, proportionally, larger than the mean for that group across all schools. That is to say the stuttering child would seem to be adopting the prevailing social profile of the particular class, perhaps in a bid to be socially accepted or perhaps to avoid being noticed and therefore avoid the bullying and teasing that his or her stuttering may attract. For example if the classroom group contained a high percentage of controversial children (children who are assertive, leaders, bullies etc., and are therefore liked and disliked almost equally) the stuttering child might well adopt this social identity.

The small number of CWS observed in this study prevent any firm conclusions being drawn on this point, however if the finding for CWS to adopt the prevailing social
profile stands up to further test, it would have implications for therapeutic practice. First, the pattern of behaviour indicates that CWS are not only aware of their dysfluency but are also aware of the negative reactions it could prompt from fluent peers. Second, it would indicate that CWS tend not to be prepared to expose themselves to the risk of negative peer reaction and subsequently adopt the predominant social mood of the classroom group. In the light of this trend, the social skills training given to CWS in many therapeutic programs might need to address this inclination for CWS to "go along with the crowd".

Social behaviour
As with social status, there was a tendency for CWS to be seen to be different to their non-stuttering peers with regard to some aspects of social behaviour, though with these measures most of the comparisons were found to be non significant. Children who do not stutter were seen by their peers as more representative of the positive behavioural categories than were CWS. One child who stutters (6.25%) was nominated to the behavioural category of leader compared to 12.9% of their fluent peers. CWS tended to be nominated to behavioural categories that reflect vulnerability or inadequacy. CWS were more likely to be nominated to the “seeks help” category (25% compared to 13.8%) and significantly more likely to be seen as victims of bullying (37.5% compared to 10.6%). However CWS were seen as more co-operative than children who do not stutter. There was little difference between the groups in the percentage of children nominated to the assertive, co-operative, disruptive and bully categories.

The lack of significant differences between the two experimental groups with regard to classifications to behavioural categories may be a function of the small number of CWS in the study. However, Nabuzoka and Smith (1993) reported a similar pattern in a sociometric study with children with learning difficulties. Although CWS are not regarded as having special educational needs, the findings of this study, and that of Nabuzoka and Smith (1993) could point toward there being different criteria of popularity for children that are different from the perceived norm.
There was a noticeable difference between the groups when the relationship between peer behavioural nominations and the peer nominations of "liked most" and "liked least" was examined. The "liked most" nominations for children who do not stutter were significantly positively correlated with nominations for the behavioural categories of assertive, co-operative and leader, and were significantly negatively correlated with the bully victim category. This was not the case with CWS where none of the correlations were significant. There were parallel differences in the relationship between the "liked least" and behavioural nominations. Whereas "liked least" nominations for children who do not stutter showed significant positive correlations with the behavioural categories of disruptive, seeks help, bully and bully victim and significant negative correlation with shy, co-operative and leader, this was not the case for the CWS. It is interesting to note that one of only two correlations that approached significance in the CWS group was a positive correlation between the liked most and the disruptive nominations. In the control group there was a significant positive correlation between the liked least and the disruptive nominations. Speech and Language Therapists often report anecdotal evidence of CWS who are disruptive or become the “class clown” in order to gain favour or to divert attention away from their dysfluency. This would seem to indicate that children who do not stutter respond positively to disruptive behaviour in CWS but not in the other children in the class. This premise is supported by the indication that the only child who stutters that was found to be popular (D.F. – see table 10 above) was also regarded as disruptive by his classmates. Another child who stutters (S.R.) who was regarded as disruptive by his classmates was placed in the controversial social group, this group comprises children who are liked and disliked equally by their classmates.

There are some indications from the data that CWS may be similar to children who do not stutter in some areas of behaviour – for example, similar proportions of the two groups were seen as assertive. However, this does not carry over to the social status of the CWS. Where social acceptance (being popular for example) for children who do not stutter was significantly correlated with being assertive and being a leader, this was not the case for CWS. Even when socially accepted, their peers did not view CWS as leaders, this may be because there are few role models of CWS as leaders in the media or sport with which CWS can be identified.
Analysis of the data also showed that some CWS tended to be more co-operative than their fluent peers, this could point to another deliberate behavioural strategy adopted by some CWS. This would involve maintaining a circle of friends by co-operation, a policy that would ensure protection and safety. Such a strategy would preclude any leadership aspirations and would ensure a stuttering child would not "stand out from the crowd". It would appear that the stuttering child is aware of his or her dysfluency and is probably aware, through previous, perhaps isolated, incidents of the teasing and rejection that dysfluency can incur. By adopting a social policy of maintaining a close circle of friends and avoiding any high profile situations, the stuttering child would hope to minimise the risk of such incidents. Even if the stuttering child had the necessary resources to take on a role demanding leadership it would seem unlikely that he or she would do so. This behavioural strategy adopted by some CWS is successful in a limited way. There was a weak to moderate correlation between the liked most nominations and the co-operative nominations in the CWS group and three out of the four CWS who were regarded as co-operative by their classmates were placed in the liked social group.

In summary, the differences in social behaviour between the speaker groups could be explained by two coping strategies adopted by the CWS. Some CWS adopt a disruptive behavioural style in order to gain favour or to deflect attention from their dysfluency whilst other CWS use a more co-operative, low-key approach in order not to attract attention. Data from this study would indicate that both strategies have a positive effective on how CWS are regarded within classroom social groups. These findings concur with those of similar studies with learning disabled children (Nabuzoka and Smith, 1993; Frederickson and Furnham, 1998b). Frederickson and Furnham (1998b) interpret these differences with reference to social exchange theory (Secord and Backman, 1974). According to social exchange theory interaction with popular CWS may be thought of as involving minimal costs and average benefits, whereas interaction with rejected CWS may be thought of as involving minimal benefits and average costs.
Stuttering Severity

The sociometric measures obtained from this study found no relationship between severity of stuttering and social status. The EXPLAN model of fluency failure suggests that time pressure in a speech situation, combined with phonological difficulty, puts a speaker at risk of fluency failure. The EXPLAN model proposes that how speakers cope with these fluency failures is important in determining the developmental pathway of childhood stuttering. This study investigated the premise that CWS who were socially competent would be better able to cope with time pressure and therefore have the resources to avoid the types of dysfluency that EXPLAN and other research associates with severe and persistent stuttering. The data from this study suggests that there is little or no social involvement in the EXPLAN model of fluency failure. This indicates that the reason why some children do not slow speech rate when faced with a shortfall in speech planning and execution concern motor and/or speech-language factors that will be examined in subsequent chapters.

Teacher ratings

The measure of social acceptance allocated to children by teachers (SBS questionnaire responses) indicated that CWS were not as socially competent as their peers. However, as with some of the peer-derived ratings, this difference was not found to be significant. With teachers from seven schools responding this may be a function of lack of power in the statistical analysis. The study found that there was a significant relationship between the teachers’ SBS scores and the social preference (SP) scores derived from peer nominations in all of the seven schools that returned questionnaires. This would indicate that an assessment of social competence obtained from a class teacher could be a valid measure to assist speech and language therapists in the identification and treatment of CWS. However there was a significant relationship with the social impact (SI) score in only two schools. The differences in the relationship between the measures of social status (SP and SI scores) and the teacher ratings on the SBS questionnaire could be interpreted two ways. One would be to argue that the relationship between the teacher rating and the SP score provides a measure of validation and that the SP score is the more reliable of the two scores as an indicator of social status. The second would be to propose
that the SI score is measuring something different from that measured by the items on the SBS questionnaire. Although the correlations between the SP scores and the teacher’s rating on the SBS questionnaire were significant in all of the seven schools that returned, the proportions of overlapping variance were small. Bearing this in mind it would not be safe to assume that the teacher ratings could be used reliably by speech and language therapists to indicate the social status of children referred to them for assessment.

Point biserial correlations between the teachers' SBS scores and social status groups present a more complex picture. The popular and rejected status groups were selected as bi-polar measures of social status. Teachers' SBS scores demonstrated a significant correlation with the rejected social status group across all schools, but there was a significant correlation with the popular status group in only one school out of the six. The criteria for allocation to both the popular and rejected status groups is derived from the SP score, which has previously been indicated as possibly the more reliable indicator of social status.

The less than 50% response rate from teachers could be seen as a possible problem for therapists attempting to obtain social reports for assessment purposes. However, in this study teachers were asked to supply assessments for all the children in their class whereas therapists would only require a single assessment.

Methodological constraints. This research project was undertaken based upon evidence from previous studies (for example Perrin, 1954; Marge, 1966) that there was a significant difference between the social status of CWS and children who do not stutter. Could the lack of significant differences in some areas of this study be due to methodological shortcomings?

The method of measuring social status in this study - the sociometric scale derived by Coie, Dodge and Coppotelli (1982) gives two key scores social preference (SP) and social impact (SI) and requires individual structured interviews with each child participating in the study to elicit those scores. This method, as opposed to Likert-type or
Yes/no questionnaire supplies an accurate indication of each child’s social position. Of the two scores derived the SP score would appear to be the better indicator of social status. It is logically constructed by subtracting the standardised liked least score from the standardised liked most score, this validity of the measure is also confirmed by the significant relationship it shows with teacher-based SBS questionnaire. The SI score would not appear to have a significant role in the measurement of social status - there is no significant relation with the teacher assessment and it is difficult to see what exactly SI is measuring. On the evidence of this study the SP and/or SBS questionnaire scores can be taken as valid indicators of social status. However, the Coie, Dodge and Coppotelli (1982) method of allocating subjects to social status groups based on the SP, SI, liked most and liked least scores (see method and results section for a full explanation) may be a contributory factor to the lack of significant difference in social status between speaker groups that has been found in this study. The different groups that were used to compare the social status of CWS and their peers and the parameters set for allocation to each of the status groups would appear to diffuse the validity of the SP and SBS scores rather than helping to clarify the measurement of social status. These social status groups showed only isolated relationships with teacher assessment scores. The arbitrary nature of the groupings was further emphasised when relaxation of the parameters to create new groupings affected the distribution of the stuttering population.

The lack of significant differences between the nominations for the two speaker groups to the majority of the social behaviour categories may simply be a reflection of a sampling error caused by the small number of CWS that were observed. The small number of stuttering subjects was brought about by two factors. In order to achieve an accurate sociometric picture of the stuttering child it was necessary to conduct structured interviews with all of the children in the target child’s class, each additional stuttering child in the experimental group would have required a visit to another school and a further 25-30 interviews. This was not possible within the constraints placed upon the study, this vividly illustrates the importance of obtaining a good, reliable measure of sociometric status that does not require extensive one-to-one interviewing. In addition because there were only sixteen subjects in the experimental group, the scope and power of statistical analysis was restricted. Although trends in social status and behaviour were
evident, the low subject numbers in the experimental group may have prevented this reaching significant levels.

This study investigated the difference in social status between CWS and children who do not stutter and also examined a means by which an accurate, numeric measure of social status could be obtained. The relationship between stuttering severity and social status was also investigated. The study found significant differences between social status of CWS and their peers with CWS allocated to negative social status groups (neglected and rejected) and not to positive groups (popular). There was a trend for CWS to be allocated to the more negative behavioural categories with a significant difference between the speaker groups in the bully victim category. CWS were significantly more likely to victims of bullying than were their peers. The study found evidence to indicate that a teacher rating was a reliable indicator of social status, suitable for use by speech and language therapists at initial assessment. No evidence was found to indicate that there was a relationship between the level of social status allocated to a child who stutters by his peers and the severity of his or her stutter.

Further research is envisaged which will address the methodological problems experienced in this study, these were:

1) The small number of subjects restricted the scope and power of statistical analysis.
2) The difference between speaker groups with regard to social behaviour and the behavioural coping strategies adopted by some CWS requires further examination. The sociometric scale used in this study does not supply a numeric measure for social behaviour, further research would be needed to develop, pilot and validate such an instrument.

The findings from this study could aid speech and language therapists in their identification and treatment of CWS. The possibility that a number of children who are diagnosed as stuttering based primarily on dysfluency rate are in fact producing normal non-fluencies and are not stuttering is investigated in chapter 5. A measure of social status (together with other non-speech factors) may assist in identifying those children at
risk of persistent stuttering. Evidence from the study regarding the behavioural profile of CWS is also clinically relevant. The knowledge that CWS are significantly more at risk of being bullied than are their peers and that they are at risk of being rejected or neglected in a social environment could influence therapeutic techniques. Specific social skills training and advice on coping with bullying would prevent CWS from being excluded from normal social interaction.
Chapter 4. Assessment of Cerebellar Performance in CWS and Controls

Abstract
The incidence of stuttering changes when a speaker alters timing of speech. One explanation of this is that the cerebellum (responsible, among other things, for motor timing in general) malfunctions (either because its structures are damaged or because it functions differently during dysfluent speech). The EXPLAN model of fluency proposes that an external timekeeper (the cerebellum) generates an alert when speech rate is too fast to maintain fluent speech. PET scan and experimental behavioural techniques also support the hypothesis that the cerebellum is involved when speech is stuttered. The study investigated whether techniques introduced by Dow and Moruzzi for assessing cerebellar dysfunction in lesion patients, reveal performance differences between speakers who stutter and controls for three different age groups (8-12 years, 13-14 years, 15-19 years). The tests are divided into those measuring balance and posture, complex movement and hypotonia. The study provides some support for the EXPLAN model by demonstrating that CWS exhibit changes in cerebellar function at an age that EXPLAN proposes is critical for language development. Results from show that deficits in performance by CWS on some of the subgroups of tests depend on the age group tested. Balance/posture performance only led to significant differences between fluency groups in the younger age groups and complex movement only differed for the two oldest age groups (hypotonia did not differ significantly between fluency groups of any age). It is argued that these results show that speakers can share attention between input and output and that balance/posture tests reflect input and complex movement reflect output. Differential amounts of attention given to input and output by different fluency groups are then revealed by what subgroups of the tasks lead to performance differences between the two groups of speakers. Thus early deficits by CWS in balance/posture tests suggest a focus on output processes at this age and later deficits on complex movement indicate a focus on input.
Introduction

The EXPLAN model of fluency failure was introduced and explained in Chapter 2. However, the main points that concern timing will be briefly reviewed here.

The EXPLAN model stresses that motor levels are as important as the linguistic planning levels in leading to fluency failure. The model proposes that two types of fluency failure, stalling and advancing (or, more precisely, part-word) fluency failures, both arise as a consequence of a complete speech plan not being available in time for execution. The EXPLAN model suggests that when there is an asynchrony between speech planning and execution an alert to slow speech rate is triggered through an external timekeeper located in the cerebellum. Furthermore the model suggests that stuttering persists because no adjustment is made to speech rate when the alerts occur. No fluency group is precluded from producing any type of fluency failure. However, persistent stuttering is characterised by frequent incidence of advancing fluency failures rather than those that characterise stalling.

One of the major roles that the cerebellum serves is controlling the timing of a variety of actions (Ivry, 1997; Ivry and Keele, 1989). In support of this, patients with cerebellar lesions experience problems controlling the timing of motor responses (Ivry and Keele). People who stutter are known to have problems in controlling the timing of speech (van Riper, 1982). Consequently this may indicate that timing structures or functions in the cerebellum of these speakers do not operate like normally fluent speakers.

One line of support that is consistent with the view that stuttering involves cerebellar dysfunction is that the co-ordination between the articulators used in production of a sound is more variable in people who stutter than normally fluent speakers (see van Lieshout, 2001 for a review of this work). A second line of evidence that is also consistent with stuttering involving cerebellar timing problems is that gross manipulations of timing influence, to some extent, the severity of stuttering. Studies usually manipulate overall speech rate and examine what effects this has on frequency of stuttering. If speakers are required to decrease average speech rate over an entire passage
(change in global speech rate) stuttering frequency has been found to decrease in the majority of studies (see reports by Perkins, Kent and Curlee, 1991; Starkweather, 1985; Wingate, 1976). In an early study by Johnson and Rosen (1937), for example, the amount of stuttering decreased during slow speech compared with stuttering rate in speech produced at a normal rate.

Speech rate changes when auditory feedback is altered with electronic techniques such as delayed auditory feedback (DAF). Under DAF, a speaker’s voice is relayed back to the speaker via headphones after a short delay. Delays of around 130 – 200 milliseconds have been found to be most effective in enhancing fluency. Whilst experiencing DAF, speakers slow their speech rate dramatically (Lee, 1950). The fluency of speakers who stutter improves under this manipulation (Ryan and van Ryan, 1995). This might arise because of the slower rate induced by the procedure. A second type of altered auditory feedback, that also leads to fluent speech in people who stutter (Howell, El-Yaniv and Powell, 1987) is frequency shifted feedback (FSF). FSF involves a time synchronous shift in pitch to the voice that is relayed back to the speaker via headphones. FSF is interesting in relation to the possible explanation just mentioned, as speech under this manipulation appears (superficially) to have a normal speech rate. If true, this would suggest that a slower rate of speech is not a necessary requirement to induce fluency. However, more detailed examination of speech rate indicates FSF does influence speech rate.

The more detailed analysis is based on the observation that speech rate varies within an utterance and these variations are a natural prosodic feature that make a message more interesting and easier to understand (monotone speech, in contrast, sounds unnatural). Howell, Au-Yeung and Pilgrim (1999) showed that such local rate variations could affect whether words are stuttered or not. They reported that locally fast stretches of speech attracted a higher rate of stuttering than locally slow stretches in the same passage. The examination of speech under FSF, until recently, was superficial insofar as only mean speech rate over a global utterance was reported. The way speech rate varies locally within an utterance can affect stuttering rate (in the way just described).
local rate changes can occur without affecting global rate. Putting these two facts together, it is possible for local rate variations to occur and decrease stuttering rate without global rate being affected. Howell and Sackin (2000) argued that if speakers control speech rate by removing the locally fast sections, speech would be more likely to be fluent. For fluency to be maintained in people who stutter according to the EXPLAN model, speech rate only needs to be reduced in the region of phonologically complexity.

If global speech rate remains constant, the influence that removing the locally fast sections would have on the global mean would need to be offset by removing locally slow sections. The end result of this would be that variance about the mean would be reduced. Howell and Sackin (2000) went on to look at the distribution of rate variations when speakers spoke an utterance under FSF and normal listening conditions. Variance around mean speech rate reduced under FSF compared with normally spoken speech indicating that locally fast sections of speech as well as locally slow sections were lost under FSF. (FN: Reduced variance about the same mean without change in the higher moments of the distribution would indicate that locally fast and locally slow regions are lost to about the same extent. A higher rate of loss of slow to fast regions would be indicated by changes in the skewness of the distribution. Howell and Sackin (2000) did not examine this statistic to establish whether the loss of rate sections was more marked for locally fast sections.) Thus, there are local rate variations under FSF. Howell et al.’s (1999) results suggest that loss of the fast sections (whether accompanied by loss of slow sections or not) would be sufficient for fluency to improve in people who stutter and that there need not necessarily be an associated change in global rate.

Kalinowski and colleagues have conducted a number of experiments (Kalinowski et al., 1993, 1995, 1996) where speakers who stutter were given different forms of altered auditory feedback (the main form of alteration they investigated was FSF). They also required their subjects to adjust their overall speech rate under this alteration. They reported that speakers could decrease stuttering under altered auditory feedback without any change in global rate. However, their analysis was only made on global rate. Consequently, it is not clear whether their speakers changed the distribution of local rate sections when they made changes to global speech rate (loss of locally fast regions is
sufficient to lead to reduced stuttering rates and can occur independent, to some extent, of global rate changes).

Increased global speech rate is usually reported as having a complementary effect on stuttering frequency to decreased global speech rate. Thus, Johnson and Rosen (1937) found that subjects had greater difficulty in speaking at fast rates compared to slower rates. Bloodstein (1987) also noted that high speaking rates can result in stuttering. In an experiment on the effects of speech rate on stuttering frequency, Kalinowski et al. (1993) found that when reading at a faster than normal articulatory rate, seven out of nine subjects showed an increase in stuttering frequency. In a later study, however, Kalinowski et al. (1995) found no difference in stuttering frequency between normal and fast rates. In the light of this discrepancy, Kalinowski et al. (1995) concluded that an increase in articulatory rate does not determine stuttering frequency with the same consistency as does a decrease in rate. The lack of a local analysis of speech rate again limits the implications of these results. Thus, a shift up in global speech rate can be achieved without a change in incidence of locally fast sections if the variance of the rate distribution increases. If speakers change speech rate in this manner, stuttering rate would not change even if it were a determinant of such fluency breakdown.

Though timing control is a widely recognised role of the cerebellum and as varying timing relates directly to stuttering, the implication of cerebellar mechanisms in stuttering via rate control is circumstantial. Studies that examine cerebellar involvement in stuttering more directly are reviewed next.

There is extensive evidence from functional imaging studies that indicate people who stutter have problems that reflect the processing of information in the cerebellum is different to that in normal speakers. Most functional imaging studies use positron emission tomography (PET) and usually take one of two approaches.

A number of studies have compared neural activation of people who stutter and nonstutterers when they were engaged in some type of speech or language task. These
studies typically show significantly increased activation in speaker who stutters in the cerebellum (Braun et al, 1997; Kroll, De Nil, Kapur, and Houle, 1997; Fox et al 2000). A link between the observed cerebellar activation in speakers who stutter and automaticity of performance is supported by the observation that cerebellar activation in speakers who stutter increased significantly immediately following an intensive treatment programme aimed at the acquisition of fluency-inducing motor skills (De Nil, Kroll and Houle 2001). One-year post treatment, the overall level of activation in the stuttering subjects, who had been able to maintain their post-treatment fluency, was largely normalised. This would seem to indicate that the motor skills tasks learned during therapy had initially caused greater activity in the cerebellum but once automated, activity levels returned to normal levels.

An alternative research method in this area is to compare neural activity in people who stutter whilst fluency is being manipulated. The popular way of varying fluency in PET studies is by requiring the speaker who stutters to speak along with a tape recording (called choral speaking). Fox et al. (1996) compared activation patterns of people who stutter in solo and choral speaking conditions. The metric Fox et al. (1996) used for assessing what happens when fluency is achieved by choral speaking is volume of tissue that is active in brain areas quantified according to a specified criterion. The tissue volumes were broken down with respect to identified areas in the central nervous system. Comparison of choral speech with normal speech in people who stutter, indicated decreased activation in the cerebellum and auditory areas (superior motor area, superior left premotor area and insula) during choral (fluent) speech. Interestingly, Ingham, Fox, Ingham & Zamarripa (2000) reported a very similar pattern of activation changes during covert (imagined) speech, indicating that the presence of overt speech may not be necessary to reveal these differences between stuttered and fluent speech. A different approach to study the relationship between brain activity and stuttering was used by the Fox et al (2000) study reported above. Fox et al (2000) correlated levels of brain activation with observed stuttering rate. They found a significant positive relationship between stuttering scores and left cerebellar activation.
An important finding from functional imaging studies on people who stutter is that these speakers do not appear to have a lesion in the cerebellum (or in fact any other area of the brain). This is shown in a study by Ingham et al. (1996) who investigated whether activation differences were structural (mild lesion), or functional. The latter would be related to different ways people do the task in the two speaking conditions such as change rate locally or globally and to differences that could occur across speaker groups. To test this, they compared activity across fluency groups when speakers were at rest. They found no differences in these conditions and concluded that the problem is functional, not structural.

Whilst the results from functional imaging studies consistently link increased cerebellar activation with stuttering, the finding need to viewed with some caution. First of all, relatively few functional imaging studies have been carried out, providing scant opportunity to replicate findings across, or even within laboratories. Secondly, all of these studies have used adults as participants. This leaves open the question whether the observed differences reflects characteristics of speech production acquired over time as compensatory or other learned strategies, or whether they reflect truly inherent differences in neural processes.

Behavioural techniques that are known to assess cerebellar processing have also revealed performance deficits in people who stutter that may reflect the functional problem these speakers experience in this structure. The technique that has been most extensively used for assessing cerebellar timing control (in general) is a tapping task due to Wing and Kristofferson (1973). As will be seen below, this has relevance to speech processing since the timing mechanisms are deemed to be general purpose as well as the fact that a speech version has been used with people who stutter. Wing and Kristofferson (1973) required subjects to repeat manual responses at a precisely-timed interval and variability in performance was measured. Overall variance (Tv) in the timing of the taps was obtained and decomposed into variance associated with a timekeeper (Cv) and that associated with motor (Mv) processes. The reasoning behind Wing and Kristofferson’s (1973) method for decomposing Tv is that if a response varies due to motor factors, two
intervals will be affected (e.g. if motor variability leads one response to be positioned in
time in a way that leads to a long interval, this will lead to the next one in the sequence
being short). On this assumption, 2Mv can be estimated from the negative covariance
between adjacent responses. The residual component when 2Mv is subtracted from Tv
represents timekeeper or clock variance (Cv). Ivry and Keele (1989) employed this task
with patients known to have lesions (and their location) in the cerebellum to validate that
damage to the area of the brain leads to performance deficits in the variance estimates.
The Mv and Cv estimates were obtained and it was reported that Mv was selectively
affected in patients with lesions to the medial areas of the cerebellum and Cv was
selectively affected in patients with lesions to the lateral areas of the cerebellum. The
performance estimates were not only related to cerebellar damage, then, but the processes
that lead to the two variance estimates appears to be performed in anatomically distinct
areas of the cerebellum.

Versions of the Wing-Kristofferson task have been conducted to study speech
timing (Howell, Au-Yeung and Rustin, 1997; Howell and Sackin, in press; Hulstijn,
task that involved repeated movement of the lower lip in children. Hulstijn et al. (1992)
had subjects repeat syllables. These speech versions of the Wing-Kristofferson task, like
the original tapping response version, allow Mv and Cv components to be obtained. Both
Howell et al. (1997) and Hulstijn et al. (1992) found that the main source of variance
increased in speech timing versions of the task in people who stutter compared with
fluent speakers is in Mv. Howell and Sackin (in press) had fluent subjects perform a
speech version of the Wing-Kristofferson task where a syllable is repeated while they
heard DAF. As observed earlier, the DAF-manipulation disrupts speech timing control,
and Howell and Sackin reported that it selectively led to an increase in Cv.

As with PET scans, the Wing-Kristofferson task is difficult to perform,
particularly with CWS. Consequently, though they implicate cerebellar processing
problems in stuttering, they are of little practical value for assessments in clinics at
present. Also, the problems people who stutter have in speech control means that there
may be extraneous influences on the measured variances. They do provide evidence about processing that is definitely known to be associated with the cerebellum. Nevertheless, given their practical difficulties, more convenient methods that have been validated as involving cerebellar processing need to be sought.

A potentially suitable cerebellar test has been used previously with dyslexic children. Fawcett, Nicolson and Dean (1996) used the Dow and Moruzzi (1958) battery of tasks. These tests are known to show performance deficits in people who are known to have cerebellar lesions. The battery of tasks is divided into three components—tasks involving balance/posture, hypotonia and complex movements (these tasks are described fully in the method section). Fawcett et al. (1996) administered the complete battery of tasks to people with dyslexia. They found that the dyslexics showed significant performance deficits on virtually every task in the Dow-Moruzzi battery. They concluded from these findings dyslexia involves a cerebellar processing deficit.

Though this battery is easy to administer, there is a question whether they apply in the same way to people with no lesion as they do to people with a lesion. Put another way, performance deficits on the Dow-Moruzzi battery of tests by patients with structural cerebellar lesions do not necessarily imply that people showing performance deficits have a structural cerebellar lesion. This is particularly pertinent in the case of people who stutter where the cerebellum appears to be functionally (but known not to be structurally) involved in the problem (Ingham et al., 1996). Problems in performing certain of the Dow and Moruzzi tasks in subjects in whom the cerebellum is free of lesions might arise out of processing problems in different brain structures. This applies, in particular, to the balance and posture tests. Balance and posture are subserved by different brain structures including (as well as the cerebellum) the vestibular system. Problems with balance and posture are likely to be dominated by the cerebellum in patients with lesions to this area of the brain. But balance-posture deficits might arise from problems in the vestibular structures in people who have properly functioning cerebellar structures. A performance deficit in Dow and Moruzzi’s balance and posture tasks need not necessarily reflect a problem associated with the cerebellum. It is also possible that balance-posture problems
could affect other types of processing too. For instance, if, as just argued, balance problems derive from the vestibular system, given that this system is housed in the same structures as the peripheral auditory system, any balance-posture problem might also affect peripheral auditory processing.

To address this issue about interpretation of results from the Dow and Moruzzi battery of tests, Howell, Davis and Williams (submitted) tested subjects with no known lesions to the cerebellum (nor any speech-language disorder). They were tested on the complex movement and balance posture tests in the Dow and Moruzzi battery (hypotonia measures were considered too subjective to be useful). These same subjects were also given tests validated as to their involvement with processing at different sites in the CNS that could be linked to the sub-batteries on the Dow-Moruzzi tests in non-lesion subjects. These additional tests were speech versions of the Wing-Kristofferson task that Ivry’s work validates as being associated with cerebellar processing mechanisms and tests of peripheral hearing that could be associated with the balance-posture system. Tests of central hearing were also included in case more central auditory sites are linked with balance-posture problems. A principal component analysis revealed that the complex movement sub-battery of tests weighted on the same factors as the Wing-Kristofferson task indicating that this sub-battery assesses cerebellar processing. Measures of balance-posture performance weighted on the same factors as the measures of peripheral (but not central) hearing. This can be interpreted as showing that the balance-posture tests reflects the state of the vestibular system and that influences on the vestibular system also affect the peripheral auditory system.

Certain of the tests in the Dow and Moruzzi battery appear suitable for testing cerebellar involvement and are suitable for use with children. This is important as the occurrence of cerebellar processing problems over age groups will depend on the point of view about when stuttering is established during development. If stuttering arises out of early normal nonfluency, it would not be established until late in development and any cerebellar signs would also be expected at this age. If the problem arises in early development, Yairi (1993) argues for early and sudden onset, cerebellar processing
problems might be evident early on life. The Dow and Moruzzi tests are made on three age groups of children aged 8 ¾ years upwards to establish if and when performance deficits on the battery occur. The complex movement sub-components of the Dow and Moruzzi battery appear to indicate cerebellar performance even in non-lesion subjects. The balance-posture sub-set was included to see if auditory problems occur because there is a suspicion of auditory involvement in the disorder relating to the fluency-inducing effects when auditory feedback is altered. It is also of interest whether there is any change over ages as Howell, Sackin and Williams (1999) have shown that children have different susceptibility to FSF (so there may be different auditory involvement in young subjects) compared with older speakers if balance posture is associated with balance. Hypotonia is included for completeness.

To briefly recap, the EXPLAN model advocates that an external timekeeper located in the cerebellum produces an alert to slow speech rate when speech planning and execution are out of synchrony. In addition the model indicates that stuttering persists because no adjustment is made to speech rate when the alerts occur, suggesting that the cerebellum functions differently in those children at risk for persistent stuttering. Evidence from functional imaging studies and behavioural studies also implicates the cerebellum (together with other CNS structures) in stuttering. In order to investigate the EXPLAN hypothesis this study will compare the performance of a group of CWS and a control group of children who do not stutter on a battery of tests designed to measure cerebellar performance that has been fully described above.

Method
Participants.
Thirty eight CWS and thirty four children who do not stutter took part in the study. CWS were recruited from a database of children whose families had agreed to participate in speech research studies following attendance at intensive speech therapy courses in London. The time between attending these courses and the current study was between 6 months and 7 years and depends, to some extent, on the current age of the child. The CWS were not (as can occur) a selected group of CWS with a persistent disorder (the rest of whom have dropped out). They were all diagnosed on similar criteria. Children in the
control group were recruited by advertisement. There were 33 boys and 5 girls in the experimental group, ages ranged from 9 years 4 months to 18 years 5 months with a mean age of 14 years 3 months. In the control group there were 19 boys and 14 girls, ages ranged from 8 years 9 months to 19 years 6 months with a mean age of 14 years 4 months. The children were allocated to three age groups, young children, older children and adolescent, the demographic composition of the groups is indicated in Table 1.

Table 1. Composition of Experimental groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Male</th>
<th>Female</th>
<th>Age Range</th>
<th>Mean Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWS (all)</td>
<td>38</td>
<td>33</td>
<td>5</td>
<td>9y 4m – 18y 5m</td>
<td>14y 3m</td>
</tr>
<tr>
<td>Control (all)</td>
<td>34</td>
<td>19</td>
<td>15</td>
<td>8y 9m – 19y 6m</td>
<td>14y 4m</td>
</tr>
<tr>
<td>CWS (young children, 8 – 12 years)</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td>9y 4m – 12y 6m</td>
<td>11y 2m</td>
</tr>
<tr>
<td>Control (young children, 8 – 12 years)</td>
<td>12</td>
<td>7</td>
<td>5</td>
<td>8y 9m – 12y 7m</td>
<td>10y 8m</td>
</tr>
<tr>
<td>CWS (older children, 13 – 14 years)</td>
<td>16</td>
<td>12</td>
<td>4</td>
<td>13y 2m – 14y 9m</td>
<td>14y 0m</td>
</tr>
<tr>
<td>Control (older children, 13 – 14 years)</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>13y 2m – 14y 9m</td>
<td>14y 1m</td>
</tr>
<tr>
<td>CWS (adolescent, 15 – 19 years)</td>
<td>13</td>
<td>12</td>
<td>1</td>
<td>15y 0m – 18y 5m</td>
<td>16y 8m</td>
</tr>
<tr>
<td>Control (adolescent, 15 – 19 years)</td>
<td>14</td>
<td>4</td>
<td>10</td>
<td>15y 1m – 19y 6m</td>
<td>17y 7m</td>
</tr>
</tbody>
</table>

Selection of tasks and general procedure for Dow and Moruzzi balance/posture and complex movements. There are three types of test in the Dow and Moruzzi (1958) battery: The first type tests subjects’ ability to maintain posture and muscle tone while standing and in response to active displacement of station; the second group assesses subjects’ ability to initiate and maintain a complex voluntary movement. The final series tests for hypotonia of the upper limbs in both a standing and a sitting position, in response to active or passive displacement of the limbs. The three components of the Dow and Moruzzi battery of tests were always administered in the order; (1) balance; (2) complex movement; (3) hypotonia. The order of the different tests within each component was randomised across subjects. Fawcett and Nicolson (1996) modified the tests for experimental use and these modified forms were used here with some additional changes. The main change made was to use equipment to measure balance/posture (described fully below). Some minor modifications were made with some of the remaining measures (also detailed below). Intra-reliability measures of pushing pressure in the posture conditions and inter-rater and intra-rater reliability checks were carried out on the timing and scoring protocols for finger-to-finger and finger-to-thumb tests.
**Balance and posture measures.** An electronic force platform – SwayWeigh (Raymar Healthcare Products) was used to measure wobble, defined by the variation in weight distribution over time. SwayWeigh has a low profile, load-sensitive platform that measures the distribution of the weight of the body in left-foot to right-foot direction. The platform consists of an active, pressure sensitive plate and a fixed plate. Subjects removed their shoes and stood upright on the active plate of the SwayWeigh while it was calibrated for their weight. Following calibration each subject stood with the right foot on the active plate and the left foot on the fixed plate. At this point the researcher blindfolded them. When they became accustomed to the blindfold and were comfortably balanced they were asked to stand as still as possible, looking straight ahead with their arms at their sides for 30 seconds. Variation in weight distribution was recorded onto a Picolog data recording program via a link to a Dell PC. The above measurement procedure was conducted: (1) with arms by the side with the palms of the hands facing inwards; (2) with arms outstretched and the palms of the hands facing down.

**Postural Stability.** In the postural stability conditions, subjects were pushed in the back and on the arms while they were blindfold (they were informed that they should expect this). On different trials, this was done with arms outstretched and by the side. During a 30-second trial period, the subject was pushed in the small of the back and on the upper arm from the right and left side by the researcher using the palm of his hand. Pressure was applied to each point for one second and then released. The researcher used a 2kg pressure (previously calibrated by practicing pushing at 2kg on kitchen scales). Analysis for the reliability of the researcher’s pushing pressure showed that this was accurate to +/- 3%.

The variance of the weight distribution as recorded by the SwayWeigh equipment was calculated for each participant for each of the two balance and two postural stability tasks.
Selection of tasks and general procedure for complex movement tasks. The complex movement tasks used were past pointing, finger-to-finger pointing, adiadochokinesis and finger-to-thumb opposition. The details of these are now given.

Past Pointing. A bulls-eye target printed black on white paper was fastened onto a wall at eye level for the subject. The target was 200mm in diameter with a 10mm diameter bulls-eye at the center and nine concentric rings increasing in radius by 10mm. The subject was positioned centrally to the target and at arm’s length from it and held a marker pen in the dominant hand. The subject practiced pointing at the bulls-eye. After five practice attempts the researcher placed a blindfold on the subject. The researcher then placed the subject’s hand so that the tip of the marker pen was central in the bulls-eye and instructed him/her to retract the marker pen and make 10 attempts to hit the bulls-eye with the point of the pen. The researcher ensured that the subject maintained a constant position in relation to the target and that the hand was withdrawn to this position after each attempt. The marker pen provided a permanent record of performance. The attempts were scored ten for the bulls-eye and the score decreased by one for each ring so the outer ring of the target that scored one point. Attempts falling outside the target received no points. The ten attempts for each subject were cumulated allowing a range of scores from 0 – 100 for each subject.

Finger to Finger Pointing. Another copy of the bulls-eye target was used that consisted of the bulls-eye at center and four concentric rings. The subject placed the index finger of the non-dominant hand through an aperture made in the center of the bulls-eye and faced the researcher with both arms held out from the side at shoulder level. They were then asked to bring the hands together in front of their body and attempt to touch their index fingers together, they were asked to do this as quickly as possible. After two practice attempts, the researcher placed a blindfold on the subject and made five experimental attempts. The researcher ensured that the subject maintained a constant position and that both arms returned to the outstretched position between trials. The researcher scored each attempt based on the accuracy of the pointing - five points was given for perfect performance (touching finger to finger), and scores decreased by one for each ring out so
the outer ring scored one point. Attempts falling outside the target received no points. This allowed for a range of scores from 0 – 25 for each child.

Adiadochokinesis (ADK). The subject was seated and moved both hands on to the knees alternately in supination and pronation movements. The test was paced by a computer-generated tone, with four speeds (10, 20, 30 and 60 movements per minute). Subjects practiced each movement once and then performed the test at that speed. Subjects received a score between one and five based on their ability to keep pace with the speed of the tone, while maintaining a consistent pattern of performance. A score of five indicated the subject completed all four levels of the task, with successful performance at all speeds, a score of four indicated that the subjects successfully completed the first three levels, and attempted the fastest level and so on.

Finger to Thumb. Subjects placed the index finger and thumb of one hand onto the thumb and finger, respectively, of the other hand. Keeping the top thumb and finger together, they were shown how to separate the lower finger and thumb, and turn one hand clockwise and the other counterclockwise, so that the finger and thumb touched again. This sequence of movements was practiced until the subject completed a sequence of five movements fluently. The subjects were then told to perform the successive opposition ten times, as fast as possible, at a given signal from the researcher. The researcher recorded the time taken using a stopwatch. Total time taken to complete ten finger to thumb movements was used as the score for the finger to thumb condition. To establish reliability of the researcher’s timekeeping, six independent raters timed video recordings of seven subjects performing the Finger to Thumb task. Subsequent reliability analysis showed that times recorded by the independent raters and the researcher varied between +/- 0.25 sec (approximately 4%). A paired sample t-test revealed no significant difference between the mean of the times recorded by the independent raters for each of the seven trials and those recorded by the researcher, t(6) = -2.277, ns. Inter-rater reliability was .999 (sig, <.001). Intra-rater reliability was measured by the researcher timing the above videos twice, with an interval of one week between them. The times varied between +/-
0.11 sec (approximately 2%). A paired sample t-test revealed no significant difference between the two times, t(6) = 1.400, ns. Reliability was 1.000.

The total time taken to complete ten finger to thumb movements was used as the score for the finger to thumb condition.

Details of tasks measuring hypotonia (reduced muscle tone) Performance on the hypotonia tasks in the Dow and Moruzzi battery is based on subjective measures. However, for completeness, the two least subjective tasks were performed by the subjects.

**Arm displacement** Subjects were blindfolded and asked to stand with their feet together, with their arms held out in front of their body. The experimenter tapped each hand gently in turn, for a series of three taps to each hand. On each trial, the subject was given a score between 0 and 2 reflecting the amount of movement in the limb. The maximum score was 12 for the six taps.

**Arm shake.** The subject was seated with his/her elbows resting on the arms of the chair. The arm and hands dangled loosely (as in the previous task). The experimenter grasped each hand at the wrist and shook it lightly from side to side. Each arm was shaken twice. Degree of movement was assessed on a scale from 1 (little movement) to 3 (large, floppy movement). The maximum score was 12 for the four trials.

**Results**

There are some factors that might specifically affect the profile of the CWS in the different age groups. Two were identified. First, the CWS in the different age groups differ in terms of the number of years in therapy (generally speaking those children who are oldest have also been in therapy longest). Second, though care had been taken that all children were followed up, it may nevertheless be the case that children who persist in their speech disorder may have influence different age groups differentially (e.g. if by chance there is a higher chance of stuttering in some age groups than others). Neither
years in therapy nor persistent/recovered status correlated significantly with performance on any of the tests. There are other factors that might have influenced any differences over fluency groups for each of the age groups (sex and age). Correlational analysis of each age group for each of tests separately for each fluency group showed occasional significant correlations (there was an effect of gender in CWS age group 13-14 in the postural stability hand by side task $r=-0.512, p=0.009$; there was an effect of age of subjects in the CWS adolescent group 15-19, in the past pointing task $r=0.493, p=0.01$).

Put through ANCOVA for the particular age and fluency group for the respective test (i.e. wherever the correlation was significant). In neither case was there a significant effect of the covariate (that would have indicated these were affecting outcomes across fluency groups). The planned comparisons that are made between age groups represent the primary purpose of this study and as the number of comparisons are reasonably small (three), the null hypothesis are rejected at the usual per comparison probability level. (Keppel, Saufley and Tokunaga, 1992).

Summary data

Not all children took part in all tests for a number of reasons. For example a wrist injury prevented one child from attempting the complex movement tasks. Also, equipment failure occurred for some of the children on the balance and ADK tasks. The number of participants in each test is displayed in Table 2.

Table 2. Number of participants for each test.

<table>
<thead>
<tr>
<th>a) Balance</th>
<th>CWS</th>
<th>Control</th>
<th>CWS</th>
<th>Control</th>
<th>CWS</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age range</td>
<td>8-12</td>
<td>8-12</td>
<td>13-14</td>
<td>13-14</td>
<td>15-19</td>
<td>15-19</td>
</tr>
<tr>
<td>Balance time (arms by side)</td>
<td>8</td>
<td>10</td>
<td>15</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Balance time (arms outstretched)</td>
<td>8</td>
<td>10</td>
<td>15</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Postural stability (arms by side)</td>
<td>9</td>
<td>10</td>
<td>16</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Postural stability (arms outstretched)</td>
<td>9</td>
<td>10</td>
<td>16</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>b) Complex Movement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age range</td>
<td>8-12</td>
<td>8-12</td>
<td>13-14</td>
<td>13-14</td>
<td>15-19</td>
<td>15-19</td>
</tr>
<tr>
<td>Finger to finger</td>
<td>9</td>
<td>12</td>
<td>16</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Finger to thumb</td>
<td>9</td>
<td>12</td>
<td>16</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Past pointing</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>ADK</td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>6</td>
<td>8</td>
<td>13</td>
</tr>
</tbody>
</table>
b) Hypotonia

<table>
<thead>
<tr>
<th>Age range</th>
<th>CWS</th>
<th>Control</th>
<th>CWS</th>
<th>Control</th>
<th>CWS</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>arm shake</td>
<td>9</td>
<td>10</td>
<td>16</td>
<td>8</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>CWS</td>
<td>15-19</td>
<td>15-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The data for control and experimental subjects were analysed by independent t-test for each task and for each age group. The t scores and significance levels are reported in the statistical analysis section that follows. The data were analyzed in this manner because information was required about the sensitivity of each task in discriminating between CWS and controls for each age group. The differences between the performance of CWS and children who do not stutter for each age group and for each of the ten tasks (arranged by Dow and Moruzzi test sub-groups) are summarized in Table 3. In this table, a grey background indicates the tasks where differences between the groups were found to be significant.

Table 3. Summary data for performance on each of the tests across age and experimental groups.

a) Balance

<table>
<thead>
<tr>
<th>Age range</th>
<th>CWS</th>
<th>Control</th>
<th>sig</th>
<th>CWS</th>
<th>Control</th>
<th>sig</th>
<th>CWS</th>
<th>Control</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance time (arms by side) variance</td>
<td>5.15 (3.29)</td>
<td>2.30 (2.21)</td>
<td>P=&lt;.05</td>
<td>4.98 (6.86)</td>
<td>1.98 (0.88)</td>
<td>ns</td>
<td>1.63 (1.67)</td>
<td>1.16 (0.78)</td>
<td>ns</td>
</tr>
<tr>
<td>Balance time (arms outstretched) variance</td>
<td>7.66 (4.50)</td>
<td>3.07 (2.91)</td>
<td>P=&lt;.01</td>
<td>5.89 (9.78)</td>
<td>1.87 (1.82)</td>
<td>ns</td>
<td>1.64 (1.49)</td>
<td>2.17 (2.48)</td>
<td>ns</td>
</tr>
<tr>
<td>Postural stability (arms by side) variance</td>
<td>80.15 (45.98)</td>
<td>77.93 (44.80)</td>
<td>ns</td>
<td>82.47 (30.40)</td>
<td>51.32 (27.54)</td>
<td>P=&lt;.05</td>
<td>69.21 (42.77)</td>
<td>73.42 (45.12)</td>
<td>ns</td>
</tr>
<tr>
<td>Postural stability (arms outstretched) variance</td>
<td>90.24 (70.02)</td>
<td>54.18 (33.80)</td>
<td>ns</td>
<td>79.67 (36.62)</td>
<td>44.78 (38.39)</td>
<td>P=&lt;.05</td>
<td>57.46 (36.18)</td>
<td>64.27 (31.22)</td>
<td>ns</td>
</tr>
</tbody>
</table>

c) Complex Movement

<table>
<thead>
<tr>
<th>Age range</th>
<th>CWS</th>
<th>Control</th>
<th>sig</th>
<th>CWS</th>
<th>Control</th>
<th>sig</th>
<th>CWS</th>
<th>Control</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger to finger Total score</td>
<td>19.44 (1.42)</td>
<td>18.42 (3.34)</td>
<td>ns</td>
<td>16.56 (2.85)</td>
<td>18.38 (2.62)</td>
<td>ns</td>
<td>17.92 (2.60)</td>
<td>18.43 (3.13)</td>
<td>ns</td>
</tr>
<tr>
<td>Finger to thumb time in secs</td>
<td>17.63 (8.17)</td>
<td>12.49 (5.87)</td>
<td>ns</td>
<td>19.65 (6.91)</td>
<td>9.97 (4.14)</td>
<td>P=&lt;.01</td>
<td>10.47 (4.57)</td>
<td>8.84 (1.93)</td>
<td>ns</td>
</tr>
<tr>
<td>Past pointing total score</td>
<td>60.00 (18.49)</td>
<td>66.25 (10.85)</td>
<td>ns</td>
<td>35.19 (20.25)</td>
<td>53.50 (18.28)</td>
<td>P=&lt;.05</td>
<td>49.38 (24.66)</td>
<td>64.50 (12.28)</td>
<td>P=&lt;.05</td>
</tr>
<tr>
<td>ADK level</td>
<td>3.75 (0.46)</td>
<td>4.11 (0.60)</td>
<td>ns</td>
<td>4.09 (0.94)</td>
<td>4.67 (0.52)</td>
<td>ns</td>
<td>4.23 (0.72)</td>
<td>4.89 (0.33)</td>
<td>P=&lt;.05</td>
</tr>
</tbody>
</table>
Two factor analysis of variance (ANOVA) tests were carried out on the data for all of the tasks in the Dow and Moruzzi battery. The two factors were experimental group (CWS and control children) and age group (8-12 yrs, young children; 13-14 yrs, early teenage; and 15-19 yrs, adolescent). For reasons of brevity these age groups will be referred to as young, early teens, and adolescent. Where significant main effects or interactions were found, t-tests have been used to establish the location and direction of the differences in performance.

Balance and posture.

**Balance time (arms by side).** CWS showed more variability (performed less well) in all three age groups on this task. Figure 1 (below) shows that this difference in performance is more marked in the young and early teens age groups. The difference between the experimental groups in the young age group was significant, $t (16) = 2.19$, sig $p< .05$. The differences in the two younger age groups contributed to significant main effect of experimental group, $F (1,62) = 6.69$, sig $p< .05$. Overall analysis showed that the control group performed significantly better that CWS, $t (66) = 2.50$, sig $p< .05$.

**Balance time (arms outstretched).** The performance profile of the two groups on this task was similar to that for the balance time (arms by side) task reported above. This is illustrated in figure 2 below. In the two younger age groups CWS performed less well than the control children (in the adolescent age group CWS performed marginally better than the control group). Again the difference between the experimental groups in the young age group was significant, $t (16) = 2.62$, sig $p< .05$. An ANOVA indicated a main effect of experimental group, $F (1,62) = 4.26$, sig $p<.05$. The overall difference in performance between the two experimental groups was not significant.
Figure 1. Variance in the balance time (arms by side) task

Figure 2. Variance in the balance time (arms outstretched) task

Postural stability (arms by side). CWS and controls showed little difference in performance in the young and adolescent age groups (see figure 3 below). However in the early teens age group CWS showed a significant performance deficit when compared to controls, $t(22) = 2.44$, sig $p < .05$. As such a results profile would suggest, ANOVA indicated no significant main effects or interaction.
Postural stability (arms outstretched). CWS showed performance deficits in the young and early teens age groups but performed better than control children in the adolescent age group (see figure 4 below). Control children performed significantly better than CWS in the early teens age group, $t(22) = 2.18$, $p < .05$. The performance differences in the two youngest age group contributed to a main effect of experimental group, $F(1,64) = 4.45$, sig $p < .05$. There were no other significant effects or interactions.
The results of the statistical analysis for the balance and posture tasks will now be briefly summarised. CWS showed more variability than the control group, that is demonstrated performance deficits, in the two youngest age groups (young and early teens) on all four balance and posture tasks. However, in the adolescent age group CWS showed superior performance in three (balance time arms outstretched and both the postural stability tasks) out of the four conditions. The data for separate age groups showed that CWS in the young age group exhibited significantly more variability in the two balance conditions than did the control children. No significant differences were found for this age group in the postural stability tasks. In the early teens age group CWS were consistently more variable than the control group. For this age group (in contrast to the younger group), the differences were not significant for the two balance tasks but were for the two posture tasks. In the adolescent age group the picture is more mixed. The performance of the CWS is more variable than the control group in only one of the four tasks. The differences between the two groups were not significant for any of the four tasks.

Complex Movement. 

Finger to finger task. It is apparent from figure 5 (below) that the CWS in the early teens age group showed performance deficits on this task compared to the children in all the other age and experimental groups. ANOVA indicated no main effects of experimental or age group and no interaction between the factors. Statistical analyses indicated that there were no significant differences across experimental or age groups.
Finger to thumb task. CWS in all three age groups showed performance deficits on this task when compared to control children (these deficits were more apparent in the young and the early teens age group, see figure 6 below). ANOVA results reflected this in showing a significant main effect of experimental group \( - F (1,66) = 4.22, \text{ sig } p < .05 \).

There were no other significant effects or interactions. Examination of the data indicated that in the early teens age group CWS took almost twice as long to complete ten finger to
thumb sequences and the differences between the times was significant ($t(22) = 3.631$, $p < .001$). No other significant differences were found.

**Past Pointing.** CWS in all three age groups showed performance deficits on this task when compared to control children. In this instance the deficits were more apparent in the *early teens* age group and *adolescent* age groups (see figure 7 below). ANOVA indicated main effects for both experimental group, $F(1,65) = 8.98$, sig $p<.005$, and age group, $F(2,65) = 5.88$, sig $p<.05$. There was no significant interaction.

**Figure 7. Mean total scores for the past pointing task.**

Analysis investigating the differences between the experimental groups indicated that in the *early teens* age group and *adolescent* age groups, control children were significantly more proficient at the task than were CWS. In the *early teens* age group, the results of an independent $t$-test was $t(22) = -2.153$, $p < .05$ and in the *adolescent* age group the result was $t(25) = -2.051$, $p = < .05$. Overall there was a significant difference between experimental groups, $t(69) = -3.73$, sig $p<.001$. Analysis investigating the differences in performance between the age groups found significant differences between the *young* and the *early teens* age groups, $t(42) = 4.11$, sig $p<.001$ and between the *early teens* and *older* age groups, $t(49) = -2.74$, sig $p<.05$. These results, together with an inspection of the marginal means, and of table 3, gives a clear indication that the deficit in performance
found in the *early teens* age group, particularly in CWS, accounts for a considerable amount of the statistical effects.

**ADK.** As was the case with the finger to thumb and past pointing tasks, CWS showed performance deficits in all three age groups on this task when compared to control children. However in the ADK task it is apparent that children in both experimental groups become more proficient as they become older (see figure 8 below).

**Figure 8. Mean levels for ADK task.**

ANOVA indicated main effects for both experimental group, $F(1, 49) = 8.35$, sig $p<.05$, and age group, $F(2, 49) = 4.48$, sig $p<.05$. There was no significant interaction. Analysis investigating the differences between the experimental groups indicated that in *adolescent* age group, control children were significantly more proficient at the task than were CWS. The results of an independent t-test was $t(20) = -2.530$, sig $p < .05$. The overall analysis between experimental groups also indicated that control children performed better than CWS on this task. Statistical analysis resulted in $t(55) = -2.96$, sig $p < .05$. Analysis investigating the differences in performance between the age groups only revealed significant differences between the *young* and the *adolescent* age groups, $t(36) = -3.62$, sig $p < .001$. These results support the indication that control children perform better than CWS and emphasise the developmental nature of the increase in proficiency in this task.
The results of the statistical analysis for the complex movement tasks will now be briefly summarised. ANOVA revealed a significant main effect of experimental group in three out of the four tasks – finger to thumb, past pointing and ADK. In each of these tasks inspection of the means and/or t-tests indicated that control children were more proficient at these tasks than CWS. In the past pointing and ADK tasks ANOVA also indicated a significant effect of age. Inspection of the means and/or t-tests indicated that in the past pointing task the significant performance of the CWS in the early teens age group was largely responsible for this effect. In the ADK task this effect was the result of a developmental trend for increased proficiency in both experimental groups. The differences between the performance of the experimental and control groups on each of the complex movement tasks for each of the age groups were assessed by t tests. For the young age group, CWS performed less well than the control group on the three out of the four tasks (the exception was the finger to finger task). However, none of the differences were significant. For the early teens age group, CWS performed less well than the control group on all four of the tasks. The differences in performance on the finger to thumb and past pointing tasks were significant. The differences in the other two tasks were not significant. In the adolescent age group, the CWS again showed performance deficits on all four of the tasks. There were significant deficits in performance on the past pointing task and ADK task. It should be emphasised that the heterogeneity of the variance in data indicates that the results should be interpreted with caution.

Hypotonia.

Arm displacement. Higher estimates of arm displacement indicate inferior muscle tone. The graph in figure 9 indicates little difference in muscle tone between the two experimental groups in the young and early teens groups on this task. Children in the control group display an overall developmental trend for improved muscle tone that was not apparent in the CWS in the adolescent age group.
Statistical analysis using ANOVA demonstrated no significant main effects or interaction. Independent t-tests showed no significant differences between any of the experimental or age groups.

**Arm shake.** Higher estimates of arm displacement indicate inferior muscle tone. Figure 10 indicates that children in the control group show superior muscle tone across the three age groups.
age groups in this task and that both groups show a developmental trend for improved muscle tone. This is supported by the results of an ANOVA that found a main effect of experimental group, \( F(1,64) = 5.54, \text{ sig } p<.05 \). An independent t-test found a significant difference between the two experimental groups, \( t(68) = 2.09 \text{ sig, } p<.05 \).

The results of the statistical analysis for the tasks measuring hypotonia will now be briefly summarised. Inspection of the overall results show that CWS exhibited a higher degree of hypotonia than the children who do not stutter. Performance levels indicated that CWS demonstrated reduced muscle tone in all age groups and tasks except the arm displacement task in the middle age group (13 –14). This difference was found to be significant in the arm shake task. The differences between the performance of the experimental and control groups on each of the complex movement tasks for each of the age groups were assessed by t tests. However, the differences between the groups were generally small there were no significant differences were found.

A table giving the age, gender and individual scores on all tasks for all the participants can be found in Appendix H.

Discussion
The intentions of this article were to establish cerebellar involvement in the disorder of stuttering and to locate convenient techniques that are validated as indexing cerebellar problems and to document any changes in cerebellar involvement over age groups. Performance on the Dow and Moruzzi (1958) battery of tests was investigated across age and fluency groups. The tasks can be arranged into groups that assess hypotonia, complex movement and balance/posture. Fawcett et al. (1996) found dyslexics had deficits across all these tasks and at all ages.

The situation with CWS is different to that with the dyslexics. Performance on the four postural stability tasks was significant, either at the youngest or middle age group (none of the differences between fluency groups were significant in the oldest age group).
This suggests that whatever leads to the balance/posture differences, it is a feature of stuttering at an early age that diminishes after teenage.

Three of the four complex movement tasks (finger-to-thumb time, past pointing and ADK level) gave significant performance differences between fluency groups. In contrast to the balance/posture tasks, differences in performance were significant in the middle and older age groups but were not significant for the younger age groups. This suggests that whatever leads to the differences between fluency groups in complex movement tasks is a feature of older speakers who stutter. There were no performance differences between fluency groups for any age group with the hypotonia tasks.

According to Howell et al. (submitted), balance-posture reflects input processing (related to peripheral auditory and balance structures) so this would appear to be at deficit in the youngest age groups. Again according to Howell et al. (submitted), complex movement reflects cerebellar output processing, deficit only in the middle and oldest age group. Something appears to change in performance on these tasks around or after age 13-14. Other changes in performance of people who stutter have been reported to occur at roughly this same age. For instance, Howell, Au-Yeung and Sackin (1999) have reported that speech performance changes from predominantly repetition of whole function words to stutterings involving parts of content words around early teenage years. The interesting possibility arises that there is some common factor underlying these changes that occur roughly at around the same ages. An explanation is offered of the change from deficits in the balance-posture to complex movement tasks based on another aspect of Fawcett et al.’s (1996) report.

Fawcett and Nicolson (1992) and Fawcett et al. (1996) have reported extensive results that suggest dyslexic children also have deficits in dual task performance. They argued that writing is also an opportunity for reading and learning input, so, in some sense, writing is a dual task. A child that has motor problems will need to devote more resources to this aspect of performance and, conversely will have less to devote to concurrent input. This explains why these children have problems reading when the
initial source is in motor processes. The age-related change from balance-posture (youngest age group) to complex movement (older age group) could also be a change from input problems (peripheral auditory system) to output problems (cerebellar system) across the corresponding age groups. The latter is also supported by the more obviously motor based dysfluencies shown by the older group, namely, the production of parts of words in those words that are most complex - content words (Howell et al., 1999).

Speaking may be regarded as involving input (the sound of the speaker’s own voice) and output processes. Following Fawcett and Nicolson’s (1996) proposal regarding sharing resources between input and output, deficits in the balance and posture tests in the young speakers would suggest resources are being focused on output, so input processes (and, more generally, all processes subserved by the auditory-vestibular input system) suffer. At later ages, speakers would then pay more attention to input so output processes suffer. Note that this account of the problem does not rely on speakers having structural problems in the peripheral auditory or motor systems (neither peripheral hearing losses nor chronic motor processes are usually seen in people who stutter). Rather, they depend on the resources the speaker elects to allocate to these respective processes and when the allocation changes (as it does over age groups), the external signs of the problem change as well.

The EXPLAN model of fluency failure indicates that fluency breakdowns are caused by a timing problem. Previous research has indicated that speaking too fast induces fluency failure (e.g. Bloodstein, 1987) and that rate control is performed by the cerebellum (e.g. Ivry, 1997). The EXPLAN model also proposes that if speech is proceeding fluently other processes are not involved. Fluency failures are detected by a simple computation – differencing the timing when execution starts and when it finishes. If the timings are different an alert occurs and signals that a rate change is needed. As indicated in chapter 2, the EXPLAN model does not implicate higher level processes for monitoring.
These alerts would only be triggered by the occurrence of part word dysfluencies, a feature in the speech of older CWS. Whole word reps would not compute a difference between planning and execution. It is proposed that the alert, which is a serially ordered event, goes to an external timekeeper located in the cerebellum, similar to that proposed by Wing and Kristofferson (1973).

This study has shown that the performance of CWS on cerebellar tasks, as measured by the Dow and Moruzzi (1958) battery, changes across age groups. Young CWS perform less well than fluent control children on the balance/posture group of tasks that research has suggested involve peripheral hearing (Howell, Davis and Williams, submitted). As CWS become older this deficit on balance/posture tasks diminishes and is replaced by a performance deficit on complex movement tasks. Research has shown that complex movement tasks reflect cerebellar output processing (Howell, Davis and Williams, submitted). This change in performance occurs at an age when CWS often change to a fluency pattern, part word repetitions on more complex content words, that predicts persistent stuttering. In this respect, performance on a battery of tasks validated to measure cerebellar function could prove to be useful to speech and language therapists for the diagnosis and treatment of CWS.
Chapter 5.

Diagnosing stuttering using linguistic analysis of dysfluent speech

Abstract
This study investigates the use of linguistic analysis in the identification of stuttering, based on the EXPLAN model of fluency failure described in chapter 2. Recordings of the speech of a group of CWS (n=35) taken at initial assessment and at follow up were examined using phonological word analysis (Au-Yeung and Howell, 1998). Five children were stuttering predominantly on parts of content word at the time of initial assessment. Four of these children were found to have persisted in their stutter when followed up three years later. Children with high overall stuttering rates but producing predominantly function word repetitions were found not to be stuttering at follow up. These findings are discussed with respect to the diagnosis and treatment of stuttering.

Introduction
The previous chapter examined physiological and behavioural factors associated with cerebellar processing that previous research has indicated may predict persistence (non response to treatment) or recovery (response to treatment) of stuttering. This chapter analyses speech samples from the same group of children studied in previous chapters. In the thesis up to now, CWS have been regarded as a homogeneous group based on the diagnosis of stuttering by a qualified speech therapist and have been recommended for speech therapy. This chapter goes a step further and employs the EXPLAN model of speech fluency that this thesis considers appropriate for the examination of these children as stutterers.

The EXPLAN model is a non-monitoring account of fluency failure that suggests that stuttering arises out of the normal nonfluencies that all children produce. According to the model, fluency failures in spontaneous speech can be caused by a combination of phonological complexity and fast speech rate. A phonologically difficult word can be spoken slowly or a simple passage of speech can be spoken quickly without causing fluency failure. But if a phonologically difficult passage is spoken at a fast rate, the chance of fluency failure is higher. The model identifies content words as phonologically difficult in the English language. The EXPLAN model uses phonological word analysis.
to indicate that content words are usually preceded by less complex function words that can be executed at a fast rate. This can result in execution being ahead of planning, the fast speech rate on the function words does not allow for the full speech plan for the more complex content word to be prepared. In this situation two forms of fluency failure can arise. One that reflects the normal nonfluencies produced by many speakers and a second that is a sign of persistent stuttering. The normal nonfluent technique is to stall before attempting to start the content word in order to gain time to complete the plan. There are several ways of doing this, using filled or unfilled pauses or repeating the preceding whole function word. These are regarded as normal nonfluencies because all children do this but most do not become stutterers. However, if a child advances to attempt the content word on the basis of a part plan the result is often part word dysfluencies – a known sign of persistent stuttering. This chapter will investigate these different types of fluency failure to establish if they provide an indication of the developmental progress of the disorder - that is, whether the child has recovered from, or persisted with their stutter.

The problems faced by therapists in attempting a diagnosis of stuttering stems from the difficulty in defining the disorder. These problems have been fully reviewed in Chapter 1. Many previous studies have provided definitions of stuttering which comprise lists of symptoms and these are often subdivided into core and secondary behaviours that extend to feelings and attitudes. An illustrative example is Van Riper (1982) who described the core or basic behaviours of stuttering that occur involuntarily;

- Repetitions are frequently observed at onset and in early childhood stuttering. Repetitions can occur on single syllables, monosyllabic whole words and polysyllabic whole words.
- Prolongations or fixations occur in the developing stutterer. They are a result of the speaker's articulators extending the normal latency of a sound or airflow.
- Blocks tend to appear at later stages of dysfluency. These are characterised by the immobility of the articulators when the airflow or voice ceases.
- Tremors or struggle behaviours may develop as the severity of the block increases.

Secondary behaviours can be viewed as learned responses to the core behaviours.
Escape behaviours include head nods, eye blinks, interjections and concomitant movements.

Avoidance behaviours include starter or filler words, delays and changing words. Stuttering can also lead to situation avoidance such as not answering the telephone, or ordering in restaurants.

A problem with simply listing symptoms as a method of defining stuttering, particularly with children, is that many children actually go through a transient period known as normal non-fluency (NNF). In this stage, they tend to repeat whole words (that appear as signs of stuttering in the above and other lists) though the repetitions are made easily and apparently effortlessly. Also some adults may be non-fluent without calling their behaviour 'stuttering'. The observation that dysfluencies that look, at least superficially, like stuttering are ubiquitous is important because it supports the view of a continuum between transient dysfluency or normal nonfluency (that involves dysfluencies predominantly on function words) and persistent stuttering (that involves dysfluencies predominantly on content words). From this perspective, stuttering is located on a continuum with one end being normal non-fluency and with severe or pathological stuttering at the other end (Bloodstein, 1970). This debate as to the exact point on the continuum that constitutes a diagnosis of stuttering has been in progress for many years and continues to the present day. A recent exchange between Onslow and Packman and Ambrose and Yairi (2001) highlights some of the issues. This overlap between NNF speech and stuttering makes definition extremely difficult. Consequent on this lack of an agreed definition, diagnosis of stuttering also becomes a problem. A condition cannot be diagnosed if it cannot be defined.

The issue of the diagnosis and assessment of stuttering is central to investigations into the incidences of recovery from stuttering. It has been reported that up to 89% of children diagnosed as stutterers recover spontaneously (Yairi and Ambrose, 1992). To enable researchers to establish the extent of any recovery it is necessary to verify that they were suffering from the disorder initially. Without confirmation of the initial diagnosis as stuttering, it may be the case that a "recovered" stutterer was merely exhibiting NNF and so
did not "recover" at all. Assessments and confirmation of stuttering are problematic for at least two reasons. First there is the diversity of the diagnostic techniques employed by clinicians. One clinician may describe a sample of dysfluent speech as stuttering while another will identify the same sample as NNF speech (Kully and Boberg, 1988). Second, in retrospective investigations into recovery from stuttering, researchers invariably have to rely upon reports from subjects, or their parents, which leaves open the possibility of NNF being interpreted as stuttering later on and vice versa. If an agreed definition is difficult to make by trained clinicians, it is unlikely that untrained observers will be any more successful. An initial misdiagnosis of stuttering may account for some of the subsequent "recoveries" identified in stuttering research.

Previous work that has used speech analysis as a diagnostic tool has relied on stuttering rate as a prime indicator (see a review by Conture, 1990). The variation in this criterion could lead to one therapist diagnosing a child as stuttering and another coming to a different conclusion. This study takes a linguistic approach to speech analysis and uses a technique devised by Au-Yeung and Howell, that is now the basis of the EXPLAN model of fluency failure (Au-Yeung and Howell, 1998; Au-Yeung, Howell and Pilgrim, 1998; Howell, in press; Howell and Au-Yeung, in press; Howell, Au-Yeung and Pilgrim, 1999; Howell, Au-Yeung and Sackin, 1999; Howell, Au-Yeung and Sackin, 2000; Howell and Sackin, 2000). The technique looks at stuttering rate on function words and content words as separate units. Function and content words have been explicitly defined in chapter 4, just to recap – function words are phonologically simple and have a grammatical role and content words are more complex and convey semantic information.

Available research helps characterize the pattern that occurs in fluent speech. MacKay and Osgood's (1959) corpus shows word repetition and pausing occur frequently in fluent speakers' speech. Clark and Clark (1977) suggested that such repetition and hesitation occur when the speech plan for a later word is not ready for execution. Au-Yeung et al. (1998) pointed out that the words that are repeated in MacKay and Osgood's (1959) corpus are predominantly function words and that the words that are likely to take a long time to plan (Clark and Clark, 1977) are content words. Thus, the frequent pattern
observed in fluent speech is repetition and hesitation on function words that precede content words. Au-Yeung et al. (1998) hypothesised that the repetition and pausing round simple function word, allows the speaker to delay execution of a subsequent content word until the complete speech plan for the content word is available. If repetition of function words delays production of the subsequent content word until the plan is complete, dropping the delaying strategy would require speakers to attempt to produce content words on the basis of an incomplete plan and this would lead to dysfluencies on the content word. Thus, with true, persistent stutterers, stuttering on function words should decrease as the child becomes older and that on content words should increase. Howell et al (1999) hypothesised that the shift in locus of stuttered dysfluencies from function words in children to content words in adults could indicate that people who persist in their stutter abandon the delaying strategy at some point during development. From this perspective, whole word repetitions may be regarded as normal non-fluency (NNF), and are a strategy that is consciously employed to prevent a breakdown of fluency on content words. Persistent stuttering would arise when speakers either abandon or are unable to use this delaying strategy and carry on and attempt production of the subsequent, partly-prepared, content word.

To test predictions of the EXPLAN hypothesis, methods were developed by Au-Yeung and Howell that allow the position of a function word relative to a content word to be determined. The reason for this is illustrated by an utterance like "I look after my mother". In this example there are two function words between the content words "look" and "mother". The question is whether one or both of the function words occurs before "mother" (and, consequently could be used to delay its production) or whether they appear after "look" (when they could not be used to delay production of either "look" because it is phonological word final or "mother" as it is not part of the phonological word containing this content word). Au-Yeung and Howell (1998) and Au-Yeung et al. (1998) have developed an analysis procedure based on Selkirk’s (1984) phonological words for the purpose of establishing the position of function and content words. The concept of phonological words was briefly introduced in chapter 4 and will now be explained in more detail. Phonological words are defined as consisting of a single content
word as its nucleus and any number of function words that serve as prefixes or suffixes to the content word \( (F_nCF_m, \text{where } n \text{ and } m \text{ can be zero or a positive integer in value}) \). By segmenting speech into phonological words as described in the method, it is possible to determine the position in relation to the content word of all function words. Applying this procedure to the preceding example, "after" is part of the phonological word that includes "look" and cannot be used to delay production of the content word as it occurs in final position in the phonological word. "My" is part of the phonological word that includes "mother". In this case, as "my" appears prior to "mother", it can be used to delay production of the content word. Au-Yeung et al. (1998) used speech segmented into phonological words to show that the majority of stuttering on function words occurs when the function word appears prior to a content word (like "my" in "my mother") as opposed to function words that appear after a content word ("after" in "I look after").

In support of the EXPLAN hypothesis about the basis of persistent stuttering, Howell et al. (1999) showed that the amount of stuttering on initial function words in phonological words decreased and that on content words increased as CWS got older. Also, the fact that the likelihood of dysfluency on a function word depends to a marked extent on whether these words appear in initial position in a phonological word (Au-Yeung et al., 1998) is consistent with the view that these words are used to delay production of the content word. There is other support for the EXPLAN hypothesis in work on the linguistic determinants of stuttering. Content words are a characteristic that Brown (1945) identified as one of his four linguistic attributes that increase the likelihood of a word being spoken dysfluently by adults who stutter. These would be individuals who have carried on stuttering beyond childhood and who exhibit the persistent pattern. In contrast with Brown's (1945) observation about adults, Bloodstein and Gantwerk (1967) and Bloodstein and Grossman (1981) have reported that CWS are more likely to be dysfluent on function words than on content words, consistent with the view that young children use function word repetition to gain time to complete the plan of a subsequent content word and are, thus, successful at avoiding these types of dysfluency.
In the current study, a group of children who have been diagnosed as stuttering were used to test some predictions about changes in the distribution of dysfluencies over time. The speech was segmented into phonological words. The type of phonological words that are of particular interest are of the form $F_nC_m$, where the integer subscripts take the values $n > 0$ and $m \geq 0$. The reason why phonological words of this form were chosen was because they have an initial function word that allows establishment of whether speakers are using the delaying tactic or not.

The aim of the chapter is to examine the diagnostic and prognostic validity of indices of persistence of stuttering based on indices suggested by the EXPLAN theory. The Speech Research Group at UCL has an extensive archive of speech samples of children who have been assessed by speech clinicians and have been diagnosed as exhibiting stuttering behaviours. These children were recorded when they attend clinic for the first time prior to therapy and at subsequently follow up visits to the clinic and to their homes. Forty one of these children were invited to attend the speech laboratory at UCL. Speech samples were subsequently obtained from 35 of the 41 children, which along with the speech samples taken at initial assessment at clinic, are used in this study. The EXPLAN theory regards children who show whole word repetition of function words (NNF characteristics) as potentially misdiagnosed stutterers. If the children abandon this delaying strategy and go on to attempt more complex content words on the basis of incomplete plans (Blackmer and Mitton, 1991), they are at risk of persistent stuttering. Phonological word analysis of the speech samples of these 35 children taken at initial assessment can be used to indicate which of these children had abandoned the delaying strategy and were producing content word dysfluencies at this time, leading to more errors on content words than function words. Criteria based on relative function and content words dysfluency rates are used to divide the group of 35 children into two subgroups; (1) children exhibiting speech errors predominantly on function words and (2) children exhibiting speech errors predominantly on content words. Analysis of the final recordings then enables identification of those children whose speech has improved during the intervening years and also those children whose dysfluent speech has proved to be resistant to therapy. The hypothesis is that the children who had already abandoned
the delaying strategy and had exchanged function word dysfluencies for content word
dysfluencies at the time of initial assessment are significantly more at risk of persistent
stuttering than those who have not.

The EXPLAN model of fluency failure indicates that changes in fluency patterns
are a result of alterations to the timing of speech. One explanation of this is that the
cerebellum (responsible, among other things, for motor timing in general) functions
differently during periods of dysfluency. In order to assess the relationship between
cerebellar function and fluency patterns that is suggested by EXPLAN, the results from
the previous study (Chapter 4) will be examined in relationship to those from this study.
The EXPLAN model would predict a significant negative relationship between
performance on those cerebellar tasks that measure motor timing and stuttering rate on
content words.

Method
Participants Thirty-five children who had been diagnosed as stuttering and had been
recommended for speech therapy participated in the study. There were 30 boys and 5
girls. Individual details of the participants, including gender and age at the times of
recordings, are given in table 2.

Speech material Two separate recording sessions of spontaneous speech were
used for analysis and assessment. Each recording session comprised a monologue,
(suggested topics were family, friends, television, computer games, sport etc.), and a
dialogue with an experienced researcher. Each component contained a minimum of two
minutes of speech from the child being assessed. The first recording was made in a quiet
room when the child who stutters attended clinic prior to receiving treatment. The second
was made in a quiet room when the children attended the Department of Psychology,
University College London between December 2000 and March 2001. At this time
cerebellar and auditory assessments were also carried out. The time between the two
recordings ranged between 2 years and 7 years, the mean length of time between
recordings was 3 years 10 months. Ages at first recording ranged from 7 years to 12
years (mean age 9 year 8 months), ages at second recording ranged from 9 years to 18
years (mean age 13 years 8 months). Recordings were made on a Sony TCD-D3 DAT recorder, calibrations were checked frequently to ensure that intensity did not drift over time. A Sennheiser K6 microphone was used to transduce the sound.

The recordings were transcribed using a broad band phonetic transcription in fluent regions and a narrow system in the region of dysfluency.

Segmentation of Phonological Words
The phonetic transcriptions and subsequent phonological word analysis were carried out by my colleagues Dr James Au-Yeung and Isabel Vallejo-Gomez. Although I am cognisant of the methods and techniques employed my proficiency is not at a level that would allow me to develop the system. To establish whether a function word is a prefix to the subsequent, or suffix to the preceding, content word, Au-Yeung and Howell (1998) and Au-Yeung et al. (1998) employed modifications of Selkirk's (1984) semantic sense unit rules which she developed for intonational phrasing. (see Howell et al., 1999 for a detailed description). Before the modifications that are necessary for applying sense unit conditions for segmenting phonological words are described, it is first shown how her rules are applied to segmentation of intonational phrases. According to Selkirk's rules, two constituents C_i and C_j form a sense unit if one of the following is true of the semantic interpretation of the utterance:

Rule (a) \(C_i\) modifies \(C_j\) (a head)

Rule (b) \(C_i\) is an argument of \(C_j\) (a head).

It can be seen straight away that application of these rules allow more than one content word to appear within an intonational phrase. The following example is taken from Selkirk (1984) where brackets delimit the words within different intonational phrase boundaries:

(1) (a) (Jane) (gave the book to Mary).
   (b) (Jane gave the book to Mary).

There can be a large number of possible intonational phrase segmentations for a sentence (Selkirk 1984); the segmentations in (1) are two out of many given by Selkirk. The segmentation of an utterance into intonational phrases is considered grammatical as long
as it satisfies the two rules for semantic sense units. The first intonational phrase in (1a) contains one content word while the second contains three content words. In (1b), the intonational phrase encompasses the whole sentence and contains four content words. The verb "gave" has three arguments, "Jane", "the book" and "to Mary". In contrast to the multiple content words that are allowed in an intonational phrase, Selkirk's phonological words allow one and only one content word per phonological word. Consider the following example: (the *' sign is used here to indicate illegality/ungrammaticality)

(2) (a) Intonational phrase: (Jane) (gave) (the book) (to her).
(b) Intonational phrase: * (Jane) (gave) (the book to her).
(c) Phonological word: * [Jane] [gave] [the book] [to her].
(d) Phonological word: [Jane] [gave] [the book to her].

The round brackets are used to indicate intonational phrasing while the square brackets are used to indicate segmentation of phonological words. The sense unit rules allow intonational phrases which have no content word (2a) while it would be illegal for phonological words as in (2c). The segmentation of the sentence in (2) into phonological words is given in (2d). The equivalent segmentation into intonational phrases is illegal (in 2b) as it violates the original two semantic sense unit rules: "the book" and "to her" cannot form a sense unit. "the book" and "to her" can only form a sense unit if and only if the word "gave" is included as well. Thus, "gave" serves as a pivot for linking the two constituents "the book" and "to her". In order to allow the "indirect link", the following two rules were introduced (Ck is another constituent in the same utterance):

Rule (c) both Cj and Cj modify Ck (a head).
Rule (d) both Ci and Cj are arguments of Ck (a head).

Another example that requires the additional rules is "[I saw] [a red] [car]" where "a" and "red" cannot form a semantic sense unit as laid out by Selkirk. A phonological word can be formed via a third part outside the phonological word "car" where "a" is an argument and "red" is a modifier.

Since Selkirk's (1984) rules (a) and (b) can produce a segmentation into both an intonational phrase and a phonological word, they have precedence over the additional rules, (c) and (d) which deal with cases for phonological word segmentation that cannot be handled by rules (a) and (b).
All words were classified as function or content words and segmented into phonological words. Stuttering events were marked and these involved word and part word repetitions and segmental or syllabic prolongations. Single word answers such as *yes* or *no* were excluded from the analysis. Transcribers estimated the duration of pauses and prolonged segments to the nearest 50ms, and these were entered in the transcriptions.

**Analysis and results**

**Speech analysis**

The phonological word analysis described above enabled the stuttering rate on function words, content words and an overall stuttering rate to be examined for both the initial and final speech samples. The stuttering rate is the percentage of the total number of words produced in the speech sample that were stuttered as defined by word type. For example the function word stuttering rate would be the percentage of all function words that were stuttered. An example is shown in table 1.

<table>
<thead>
<tr>
<th>Id code</th>
<th>Recording</th>
<th>Age at recording</th>
<th>Fw rate %</th>
<th>Cw rate %</th>
<th>Overall rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR32</td>
<td>Initial</td>
<td>8</td>
<td>19.14</td>
<td>15.97</td>
<td>17.83</td>
</tr>
<tr>
<td>AR32</td>
<td>Final</td>
<td>13</td>
<td>3.37</td>
<td>0.60</td>
<td>2.19</td>
</tr>
</tbody>
</table>

The EXPLAN theory of fluency breakdown suggests that stuttering does not occur until children change from a strategy of stuttering predominantly on function words to one of stuttering predominantly on content words. For the purpose of this analysis children were considered to have made this change if the following criteria were fulfilled

- Stuttering rate on content words was 50% higher than that on function words.
- Stuttering rate on content words was above 5%
- Overall stuttering rate was above 7%

In the example illustrated in table 1, the child (AR32) would not have been diagnosed as stuttering regardless of the high overall rate of stuttering produced at the initial assessment.
These criteria classify 30 out of the 35 children who had been diagnosed as stuttering by a speech and language therapist as non-stutterers. Using the same criteria for the final speech samples it was shown that 4 of the 5 children identified as stutterers from analysis of the initial recording continued to meet the criteria (had persisted). Of the 30 children defined by the above criteria as not stuttering at the initial recording stage, one child met the criteria to be defined as stuttering at final recording. The results of the speech analysis at initial and final recordings for all 35 children are listed in table 2.

Table 2 allows for more detailed inspection of the patterns of fluency demonstrated by the 35 children participating in this study. It shows that 13 out of the 30 (43%) children that were classified as CWS by speech and language therapists (but not by the phonological criteria suggested by the EXPLAN model) had overall dysfluency rates in excess of 10% at initial assessment. The same group of 30 children also showed indications of recovery. Twenty-five out of the group of 30 (83%) show a reduction in overall stuttering rate between initial and final assessment. Fourteen children (47%) showed dysfluency rates of below 3% at final assessment, this is viewed as a mild stutter and some clinicians regard this rate as within normal fluency limits.

Table 2. Summary data from the linguistic analysis of stuttered incidences at initial and final assessments (continued on next page)
A summary of the results using the phonological analysis suggested by EXPLAN as a diagnostic criteria with 35 children previously diagnosed as stuttering is given in table 3 below.

### Table 3. Summary of childrens’ fluency groups as at initial and final recordings.

<table>
<thead>
<tr>
<th></th>
<th>Stuttering at initial recording as defined by EXPLAN (n=5)</th>
<th>Not stuttering at initial recording as defined by EXPLAN (n=30)</th>
<th>Stuttering at final recording (n=4)</th>
<th>Not stuttering at final recording (n=1)</th>
<th>Stuttering at final recording (n=1)</th>
<th>Not stuttering at final recording (n=29)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fluent</td>
<td>Fluent</td>
<td>Fluent</td>
<td>Fluent</td>
<td>Fluent</td>
<td>Fluent</td>
</tr>
</tbody>
</table>

Comparison of performance on cerebellar tasks with dysfluency patterns indicated by phonological analysis

The 35 children that participated in this study also participated in the study investigating performance on a battery of cerebellar tasks reported in Chapter 4. Each child completed the cerebellar tasks and audio recordings (for final assessment) at one visit to Speech
Research Group at UCL. This procedure enabled the relationship between the performance on these two tasks to be explored.

Results from the previous chapter indicated that the tasks that index cerebellar output processing, and are therefore involved in speech timing, are the complex movement tasks. Results from this chapter indicate content word dysfluencies are indicative of the changes in speech patterns that predict persistent stuttering. Therefore this results section will investigate the relationship between performance on complex movement tasks and content word dysfluencies in the group of 35 children diagnosed as stuttering by speech and language therapists. The performance on complex movement tasks for three groups of children (persistent stutters, recovered stutters, and fluent controls) will also be examined.

An investigation of the connection between content word dysfluencies and performance on complex movement tasks indicated only one relationship that was significant. There was a significant positive correlation between content word stuttering rate and performance on the finger to finger task (r = .300, sig p = .04). This indicates that as the rate of content word dysfluencies increase, performance on the finger to finger task becomes less proficient (the time taken to complete the task also increases). A full correlation matrix is shown in table 4.

<table>
<thead>
<tr>
<th></th>
<th>CW RATE</th>
<th>FTOTH</th>
<th>PPOINT</th>
<th>FTOFING</th>
<th>ADK</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW RATE</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig -</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTOTH</td>
<td>- .56</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig .375</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPOINT</td>
<td>- .107</td>
<td>-.255</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig .274</td>
<td>Sig .018</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTOFING</td>
<td>.300</td>
<td>-.220</td>
<td>.206</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig .040</td>
<td>Sig .035</td>
<td></td>
<td>Sig -</td>
<td></td>
</tr>
<tr>
<td>ADK</td>
<td>.242</td>
<td>-.087</td>
<td>.211</td>
<td>.289</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Sig .081</td>
<td>Sig .266</td>
<td></td>
<td>Sig .065</td>
<td>Sig .017</td>
</tr>
</tbody>
</table>

CW = content word, FTOTH = finger to thumb task, PPOINT = past pointing task, FTOFING = finger to finger task.
The five children who were designated persistent stutterers, were randomly age and gender matched to a group of five children who were found to have recovered and five control children. The performance of the three groups (persistent stutterers, recovered stutterers and controls) on each of the cerebellar tasks was compared. Tables 5 – 8 show the mean scores for each of the groups on the four tasks. Examination of the performance of the groups on the finger to thumb and past pointing tasks indicate that the control group performs better than the two stuttering groups and that persistent stutterers to show performance deficits when compared to recovered stutterers. On the finger to finger and ADK tasks the control group again perform better than the two stuttering groups, however in these tasks the recovered group show performance deficits when compared to the persistent group. One-way ANOVA tests indicated that the differences in performance between the groups on each of the four tasks were not significant. It is also evident from the data reported in tables 5 - 8 that CWS (both persistent and recovered) show more variability in their performance (particularly on the finger to thumb and past pointing tasks) than the control group. Examination of the individual scores (see Appendix XX) shows that is primarily due to one child in each group.

Table 5. Comparison of the performance of fluency groups (persistent stutterers, recovered stutterers and control children) on the finger to thumb task.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean (time in secs)</th>
<th>Standard Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent</td>
<td>5</td>
<td>26.97</td>
<td>29.42</td>
<td>10.69</td>
<td>77.46</td>
</tr>
<tr>
<td>Recovered</td>
<td>5</td>
<td>18.44</td>
<td>9.01</td>
<td>8.92</td>
<td>28.99</td>
</tr>
<tr>
<td>Controls</td>
<td>5</td>
<td>13.04</td>
<td>5.48</td>
<td>6.48</td>
<td>19.44</td>
</tr>
</tbody>
</table>

A one-way ANOVA indicated that the differences in performance between the groups on the finger to thumb task was not significant – F (2,12) = 0.757, ns.

Table 6. Comparison of the performance of fluency groups (persistent stutterers, recovered stutterers and control children) on the past pointing task.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean (score)</th>
<th>Standard Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent</td>
<td>5</td>
<td>38.40</td>
<td>30.74</td>
<td>5</td>
<td>75</td>
</tr>
<tr>
<td>Recovered</td>
<td>5</td>
<td>43.20</td>
<td>26.94</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>Controls</td>
<td>5</td>
<td>51.80</td>
<td>16.75</td>
<td>25</td>
<td>68</td>
</tr>
</tbody>
</table>

A one-way ANOVA indicated that the differences in performance between the groups on the past pointing task was not significant – F (2,12) = 0.354, ns.
Table 7. Comparison of the performance of fluency groups (persistent stutterers, recovered stutterers and control children) on the finger to finger task.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean (score)</th>
<th>Standard Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent</td>
<td>5</td>
<td>19.20</td>
<td>2.95</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>Recovered</td>
<td>5</td>
<td>16.60</td>
<td>3.65</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Controls</td>
<td>5</td>
<td>19.80</td>
<td>1.92</td>
<td>17</td>
<td>22</td>
</tr>
</tbody>
</table>

A one-way ANOVA indicated that the differences in performance between the groups on the finger to finger task was not significant – F (2,12) = 1.689, ns.

Table 8. Comparison of the performance of fluency groups (persistent stutterers, recovered stutterers and control children) on the ADK task.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean (level attained)</th>
<th>Standard Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent</td>
<td>5</td>
<td>4.40</td>
<td>0.55</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Recovered</td>
<td>5</td>
<td>4.20</td>
<td>1.30</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Controls</td>
<td>5</td>
<td>4.80</td>
<td>0.45</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

A one-way ANOVA indicated that the differences in performance between the groups on the ADK task was not significant – F (2,12) = 0.614, ns.

Discussion

This study has taken a linguistic approach to the diagnosis of stuttering in children. Based on the EXPLAN theory of stuttering, phonological word analysis was used to determine the rate of stuttering on function and content words. The EXPLAN theory suggests that normal non-fluencies (whole word repetition of function words – a strategy used to slow speech in areas that are difficult) in young children are often misdiagnosed as stuttering. The theory proposes that stuttering only occurs when children abandon this delaying strategy and go on to attempt more complex content words on the basis of incomplete plans (Blackmer and Mitton, 1991).

The audio recordings of the speech of a group of 35 children who had been diagnosed by speech clinicians as exhibiting stuttering behaviour were taken at initial assessment at clinic and at final follow up several years later. The use of phonological word analysis enabled separate stuttering rates for function and content words to be
established. This information enabled those children who had maintained normal non-fluid techniques and those who had abandoned this strategy to be categorised into separate groups. Similar analysis of the speech samples from the final follow up also enabled categorisation of children who had persisted with their stutter and those whose stutter had improved. Analysis of the speech of the 35 children at initial assessment indicated that 5 (14.29%) had abandoned the technique of whole word repetitions on function words and were attempting content words on the basis of incomplete plans (for ease of explanation these will be referred to as the stuttering group). This resulted in their stuttering behaviour being typified by part word repetitions and prolongations on content words. The EXPLAN theory would put these 5 children at risk of persistent stuttering and suggest that the remaining 30 children (the non-stuttering group) were not “true” stutterers and that there was little risk of long-term dysfluency. This is borne out to a great extent by the analysis of the speech samples taken at final follow up. Four of the 5 children in the stuttering group had persisted in their stuttering behaviour. Of the 30 children in the non-stuttering group 29 (96.67%) were not stuttering at final follow up. The child in the non-stuttering group who was exhibiting stuttering behaviour at final follow up was by this time diagnosed as having a severe thyroid problem and was taking medication to counter hyperactivity.

At present, no external validation has been provided that these children are considered stuttering by other measures. The criteria used to define persistent stuttering at final follow up are supported by the responses given to questionnaires presented to parents of the children. The questionnaires were specifically designed to elicit information about the “whole child” rather than concentrating on speech performance. Topics such as confidence, coping strategies etc were addressed (see Appendix XX). The parents of the children categorised as persistent stutterers were more negative in their responses than were the parents of those children categorised as recovered. The children categorised as persistent stutterers were less negative in their response than their parents but were more pessimistic than the children who had recovered. All of the parents and three out of the four children categorised as having persisted in their stutter answered “yes” to the question Do you think you/your child requires further therapy? This
compares to a similar response from only 17% of the children and 21% of the parents in the recovered group.

Returning to the speech analyses, examination of the overall stuttering rate alone at initial assessment would not have revealed these two groups and would not have allowed such an accurate prediction of outcome. Eight of the thirty children in the group designated as non-stuttering had an overall stuttering rate of over 10% at initial assessment, four had an overall rate of over 20% and one child had an overall stuttering rate of over 30%. Therefore 8+4+1 = 13/30 (nearly 45%) of the group defined as non-stuttering by phonological word analysis would have been diagnosed as stuttering based on overall stuttering frequency (Conture, 1990). There were also indications of recovery in the group of 30 designated as non-stuttering. Twenty-five children in the group (83%) showed a reduction in overall stuttering rate between initial and final assessment. In fourteen of those cases (47%) the final dysfluency rates was below 3%, a rate that is regarded by some clinicians as within normal fluency limits.

The research literature quotes various rates of spontaneous recovery from stuttering in children. The identification of 5/35 cases as stutterers at outset is close to Yairi and Ambrose’s (1992) estimate of recovery. Thus, a high rate of spontaneous recovery may be explained to some extent by the findings of this study. As indicated above, examination of the overall stuttering rate at initial assessment would not have produced the same stutterer/non stutterer categorisations as was indicated by phonological word analysis. Although speech and language clinicians take other family and behavioural factors into consideration when assessing children referred to them by primary health care workers, overall stuttering rate is a major component of most stuttering assessment instruments. This could result in children who are producing only or predominantly function word repetitions, a normal non-fluent delaying tactic, being diagnosed as stuttering. By using phonological word analysis as a diagnostic factor 30 of the 35 children diagnosed as stuttering that participated in this study were designated as not stuttering. This figure of 85% of the children said to be stuttering by speech and language clinicians is around the top end of spontaneous recovery rates quoted by the
research literature. It is possible that the cases of spontaneous recovery are not recoveries but are a result of initial misdiagnosis.

A study of the speech patterns exhibited by the CWS may assist speech and language therapist in their planning of therapeutic intervention. If children present for therapy predominantly dysfluent on function words then therapy could be initiated that would prevent the change described above that predict persistent stuttering. This could take the form of slowing speech rate in areas of phonological difficulty. However, if a child makes the transition to being predominantly dysfluent on content words then a different form of intervention would be required. Howell et al (2001) have reported a study in which operant conditioning was used in an attempt to reverse this transition. Children were reinforced if they produced function word repetitions and were stopped from speaking if they started content words with concomitant evidence of stuttering. The study was small in scale and it is too early for an indication whether the operant procedure outlined above, is effective or not. Nevertheless, it is interesting to contrast this approach with another, currently popular, operant treatment - the "Lidcombe Program" (Onslow, Packman, Stocker, van Doorn and Siegel, 1997).

It is important to note that all of the children involved in this study have undergone varying amounts of speech therapy (including the operant therapy mentioned above). Some of the recovery may be attributable to these interventions. In the cases where the child was designated as non stuttering, it can not be definitely asserted that the children who were exhibiting predominantly function word repetitions were not stuttering at initial assessment and would have spontaneously recovered without the intervention they received.

The small number of children in this study that were found to have persisted in their stutter limited the scope for investigating the relationship between patterns of dysfluency and the performance on cerebellar tasks reported in Chapter 4. The statistical analysis allows for a tenuous connection to be made between deficits in performance on a battery of tasks designed to measure the function of the cerebellum and content word
stuttering rate. Children that persisted in stuttering demonstrated performance deficits in two complex movement tasks (finger to thumb and past pointing) when compared to children that had recovered. However a large proportion of the deficit shown by the persistent group was accounted for by the performance of one child, this could argue for a sub-group of persistent stutterers that demonstrate cerebellar deficits. The Speech Research Group at UCL is currently running a study that is examining the performance of adults who stutter on a battery of cerebellar tasks. Adults who stutter are, by definition, persistent stutterers and this study should give a clearer indication of the role of the cerebellum in speech timing.

In conclusion, this study examined the speech of a group of 35 children who had been diagnosed as stuttering and had subsequently received treatment. Phonetic transcriptions and phonological word analysis (carried out by my colleagues Dr James Au-Yeung and Isabel Vallejo-Gomez) of speech samples taken at initial assessment identified 5 children who were stuttering predominantly on content words. Analysis of the speech of the same 5 children at follow up (approximately 3 years later) indicated that 4 of the children had persisted with their stutter. This pattern of speech performance changing from being predominantly repetitions of whole function words to stutterings involving parts of content words at around early teenage replicates the findings of Au-Yeung and Sackin (1999). As noted in the previous chapter it at this age that there is also a change in the pattern of performance of CWS on certain cerebellar tasks. The data presented in the previous chapter suggests that before the early teenage years CWS have a problem with balance and posture tasks but after that age the problem changes to one on complex movement tasks. The combination of the findings of chapters 5 and 6 (performance on cerebellar tasks and speech analysis) point toward overall motor-based deficiencies in children who persist with their stuttering behaviour.

So if EXPLAN can help to identify these children, the next goal must be to develop more effective treatments for the children in this target group who constitute the majority of children with on-going problems. EXPLAN provides a useful initial tool to investigate this by screening children believed to be stuttering early in the course of the disorder.
Chapter 6.
General discussion

This thesis developed from a review of the literature and discussions with speech and language therapists that indicated a need for a reliable and efficient method of diagnosing stuttering in young children and to indicate prognosis once diagnosis has been confirmed. The review, and a subsequent survey of speech and language therapists, indicated ten factors that were relevant to this task. Those factors were; social skills, attitude to speech, motor skills, speech scores, family history of stuttering (genetics), cerebral dominance/handedness, language development, parental attitude, general health and auditory skills. This thesis investigated four of those factors, three of which have been reported in full. Those three were social skills, motor skills and speech and language scores. The choice of these factors were based on three criteria:

1) They were relevant to the EXPLAN model of fluency failure and could be examined from that perspective.

2) They could be examined in a systematic way given the limited time available in speech and language therapy clinics for these activities.

3) The factors could investigated in a manner that would elicit a reliable numeric measure suitable for use in diagnosis and treatment.

In this chapter the results of the three experiments that investigated these factors are summarised and immediately after the summary of each experiment, the implications for diagnosis of the disorder is given. Following this, the potential implications for treatment of stuttering that were raised in Chapter 1 are reviewed with emphasis on the findings reported in this thesis. This is done after the summary and the diagnostic implications are drawn out as the application of the findings to treatment is somewhat more remote than for diagnosis where the implications are immediate. The diagnostic and therapeutic implications of the experimental work carried out in this thesis are discussed with the respect to the EXPLAN model of fluency failure outlined in Chapter 2. Finally, the ways in which the studies reported in this thesis could be extended will be discussed.
Summary of the results of the experimental chapters and implications for diagnosis.

Sociodynamic Relationships
Measures of social preference, social impact and the assignment of children to behavioural categories were used to explore the sociodynamic relationships between CWS and their fluent peers. The findings show that compared to their fluent peers, CWS are more likely to experience peer rejection, bullying, to seek help and to be placed in the class’ average social group. However, they are less likely than their fluent contemporaries to be popular and to be regarded as leaders. It is suggested that the difference in social behaviour between the two groups could be explained by the coping strategies adopted by the children concerned. The study found no significant relationship between social status and stuttering severity. Teacher ratings of social status showed a significant relationship with the ratings produced by peer nomination. However inspection of the data revealed that caution should be exercised in using teacher ratings as an accurate indication of a child’s social position. A simple and quick method of obtaining such an indication is essential if social status is to be of practical value to speech and language therapists in their identification of CWS. The knowledge that CWS are significantly more at risk of being bullied than are their peers and that they are at risk of being rejected or neglected in a social environment could be of assistance in designing therapeutic techniques for CWS. Specific social skills training and advice on coping with bullying would prevent CWS from being excluded from normal social interaction.

Implications of sociodynamic relationships for diagnosis
The utility of social status as a factor in the identification of stuttering was found to be limited. The EXPLAN model of fluency failure suggests that fluency failures are a result of a combination of phonological complexity and speech rate. It could be argued that children who are less well placed socially would be less able to cope with the time pressures placed upon conversational speech. They would feel constrained to maintain a fast speech rate even during areas of phonological complexity that would require a slower speech rate in order to maintain fluency. If this were the case, social status would be a useful indicator of those CWS that were at risk of persistent stuttering. However data from the study reported no significant relationship between the sociometric scores of the CWS and their stuttering rate.
The fact that their peers regard some CWS in a negative manner could prove useful to therapists in the identification of CWS who are need of social skills training. The study found that a reliable measure of the social status of a CWS could be obtained efficiently by means of the Social Behaviour at School Questionnaire when completed by the class teacher.

**Motor skills**
Data from this study has shown that the performance of CWS on a battery of cerebellar tasks, changes across age groups. Young CWS perform less well than fluent control children on a balance/posture group of tasks that research has suggested involve peripheral auditory processes. As CWS become older this performance deficit on balance/posture tasks diminishes and is replaced by a performance deficit on complex movement tasks. Research on adults has shown that complex movement tasks reflect cerebellar output processing (Howell, Davis and Williams, revision under review). This change in performance occurs at an age when CWS often change to a fluency pattern, part word repetitions on more complex content words, that predicts persistent stuttering. These results from this study, when combined with those from the following chapter, point toward overall motor-based deficiencies in children who are at risk of persisting with their stuttering behaviour.

**Implication of motor skills for diagnosis**
Results from this study, allied to those from the following study, indicate that CWS change the pattern of performance levels on motor skills and timing tasks at a critical time during fluency development. The combined data from both studies also shows that children who persist in their stuttering perform less well on a subset of these tasks than do children that recover. Research has indicated the role of the cerebellum as a general-purpose timekeeper. In this respect, performance on a battery of tasks validated to measure cerebellar function could prove to be useful to speech and language therapists for the identification of those CWS that are at risk of changing their pattern of fluency and therefore of persistent stuttering.
Speech
Linguistic analysis of samples of speech that were taken at initial assessment and at follow up visits (between three and five years later) from 35 children who had been diagnosed as stuttering indicated that changes in speech patterns were predictive of persistent stuttering. The use of phonological word analysis enabled separate stuttering rates for function and content words to be established. Analysis of speech at initial assessment identified five children that had abandoned a technique of whole word repetitions on function words and were producing part word repetitions and prolongations on content words. This change of strategy is explained with reference to the EXPLAN model of fluency failure. The EXPLAN theory puts these children at risk of persistent stuttering and indicates that the remaining 30 children in the group were not stuttering. Analysis of the speech samples taken at follow up visits confirms this prediction. Four of the five children were reported by therapists and parents to be persisting in their stuttering. Of the remaining 30 children, 29 were considered not to be stuttering at follow up.

Implications of speech analysis for diagnosis
This study found that linguistic analysis of stuttered incidences could prove useful in the identification of those CWS that are risk of persistent stuttering. The hypothesis implicit in EXPLAN suggests that CWS who exchange whole word repetitions on function words for a pattern of part word repetitions or prolongations on content words are at risk of severe, persistent stuttering. As stated above five out of the 35 children investigated were found to be stuttering predominantly on parts of content word at the time of initial assessment. Four of these five children were found to have persisted in their stuttering behaviour when followed up between three and five years later. Children with high overall dysfluency rates but producing predominantly function word repetitions at initial assessment were found not to be stuttering at follow up. It could be argued that the children whose dysfluencies were predominantly function word repetitions were producing normal non-fluencies and should not have been diagnosed as CWS. This would indicate that linguistic analysis of stuttered incidences, as opposed to only
counting the stuttered incidences, would be a useful method of identifying those children who are exhibiting true stuttering behaviour.

**The identification and diagnosis of stuttering**

It is the role of the SLT to identify, quantify (prognosis) and to plan remedial action for any child referred to them for assessment. The problems facing speech and language therapists when the referral concerns a child who is dysfluent were reviewed in Chapter 1 and are briefly summarised again here.

The importance of early and accurate diagnosis is underscored by the high recovery rate of children diagnosed as stuttering reported in the literature. Recovery rates as high as 80% have been suggested, often without formal therapy (this fits with the rate for the children diagnosed as stuttering that investigated in this thesis, where 30 out of 35 children were reported to have recovered, approximately 86%). It follows that if the children who are likely to recover could be identified at initial referral, valuable time and resources could be re-directed to those children at risk of persistent stuttering.

Many of the assessment techniques available to speech and language therapists use speech scores as the prime criterion for diagnosis. That is the number, and in some cases the type, of dysfluency recorded determine the diagnosis and prognosis. The dangers of using speech data alone are twofold – the unreliability of the human judgment of stuttering behaviour (Kully and Boberg, 1988) and the dismissal of other factors that may be important. Those assessments that do utilise other factors in the diagnosis of stuttering do so without theoretical support and are often merely a guide for commercially-oriented therapeutic instruments.

The EXPLAN model proposes that the critical age range when the diagnostic signs that indicate persistent stuttering become apparent is from eight to twelve years old – a period when other changes are occurring. The onset of puberty usually occurs within this age range and children in the UK often change schools at 11 or 12 years of age. The CWS that participated in the experimental work in this thesis are in this age range or are
older. This allows for the developmental and social changes that are proposed for this age group to be monitored and for subsequent recovery patterns to be assessed.

The work that is reported in this thesis is the first stage in the construction of a multifactor model designed to aid the process of diagnosis. The multifactor model is given perspective by the theoretical structure of the EXPLAN model of fluency failure. The EXPLAN model suggests that a combination of speech rate and phonological complexity places children at risk of fluency failure. It is how children deal with those fluency failures that determine the likelihood of persistent stuttering. In this respect the thesis looked at three factors that could conceivably influence responses to these communication situations – social status, motor and timing skills and linguistic analysis of stuttered incidences.

The results from the experiments in this thesis indicate that measures of performance on a battery of tasks measuring cerebellar function, together with a linguistic analysis of stuttered incidences, would provide speech and language therapists with an indication of those children at risk of persistent stuttering. Data from the study investigating the sociodynamic relationships of CWS indicated that social status was not a reliable indicator of those children at risk of persistent stuttering.

**The treatment of CWS**

How the findings of the experimental chapters in this thesis could assist speech and language therapists in the planning of therapy for CWS is now reviewed. It should be pointed out that the provision of speech therapy services for CWS in the UK in the age range studied in this thesis is very limited. For example, in some London NHS Health Authority areas there is no provision for speech therapy for CWS over five years old. The majority of NHS Health Authority areas in London do not provide speech therapy services for CWS over twelve years old. The need for therapeutic provision for older CWS is emphasised by the findings of this thesis. The results from all three experimental chapters indicate that CWS aged eight years and older are going through a critical period with regard to their social life at school and changes in their motor and timing skills and their pattern of fluency.
Sociodynamic Relationships
Though the findings are not given high priority as a diagnostic indicator of stuttering, they have, nevertheless, implications for children in therapy. It should be emphasised that the small numbers of CWS observed in this study prevent any firm general conclusions being drawn about the social status and behavioural strategies of such children. However, if the finding for children who stutter to adopt the prevailing social profile stands up to further inspection on a larger group of participants there would be implications for therapeutic practice.

Data from the study indicated that CWS adopt different behavioural strategies in order to cope with perceived peer pressure in the school environment. Some CWS assume a disruptive behavioural style, possibly in order to gain favour or to deflect attention from their dysfluency whilst other CWS use a more co-operative, low-key approach in attempt to achieve the same objective. Although data from this study would indicate that both strategies have the potential to create a positive effective on how CWS are regarded within classroom social groups, speech and language therapists would be concerned that CWS are subsuming their true personality. Discussion with speech and language therapists indicates that there are no therapeutic techniques available that are designed to specifically address this type of avoidance behaviour in CWS. As indicated previously, there is limited ongoing speech therapy available for CWS after school age. However, some speech therapy centres run one-off, intensive courses for groups of older CWS that would provide an opportunity to address this area using role play or group discussion.

Perhaps more importantly the knowledge that CWS are significantly more at risk of being bullied than are their peers and that they are at risk of being rejected or neglected in a social environment could influence therapeutic techniques. Within clinics, specific social skills training and advice on coping with bullying could prevent the possibility CWS from being excluded from normal social interaction. However, it would be also important that intervention is extended to the school environment. The problem of bullying in school has received considerable attention in the last decade and is now
investigated during inspections of schools by the Office for Standards in Education (OFSTED). Schemes such as the DFE Sheffield Anti-Bullying Project have demonstrated that incidences of bullying can be reduced by implementing whole-school anti-bullying polices, environmental improvements and individual work with bullies and victims. So there is reason to believe that the level of bullying in schools generally is decreasing. However, there is little evidence that the particular problems of CWS in schools, as indicated by the results of this study, are being fully recognized. The British Stammering Association has produced a pack for schools and teachers – Bullying and the dysfluent child in primary school – and has appointed a full-time Education Liaison Officer. But it is apparent that more needs to be done to support teachers and schools in addressing the problems faced by CWS in mainstream education. This study found that children who stutter were more likely to be rejected and to be victims of bullying than were their peers. This would indicate that difficulties in establishing and maintaining friendships are an important factor in the problems experienced by CWS. As children are often reluctant to involve adults when bullying occurs, a peer support system (e.g. Cowie and Sharp, 1996) may assist those children who stutter that are rejected or bullied by their classmates.

**Motor skills**

Treatment of a speech disorder often includes techniques designed to revert the dysfluent patterns to fluent ones. The EXPLAN model stresses that motor levels are as important as the linguistic planning levels in leading to fluency failure, giving an idea about the dysfluent patterns and how they might be reversed. The model proposes that two types of fluency failure, stalling and advancing (or, more precisely, part-word) fluency failures, both arise as a consequence of a complete speech plan not being available in time for execution. The EXPLAN model suggests that when there is an asynchrony between speech planning and execution an alert to slow speech rate is triggered through an external timekeeper located in the cerebellum. Furthermore the model suggests that stuttering persists because no adjustment is made to speech rate when the alerts occur. No fluency group is precluded from producing any type of fluency failure. However, persistent stuttering is characterized by frequent use of advancing fluency failures rather than stalling ones so this type becomes habitual and once acquired is very hard to lose.
Note that though persistent stuttering is not easy to treat, it should be reversible, as people who stutter do not have defective brain or articulatory structures.

Evidence from Howell, Au-Yeung and Pilgrim (1999) suggests that a local effect of speech rate in spontaneous production is linked in with fluency failure. This finding also carries an implication for treatment: Although a global change can lead to improvement in fluency (Perkins, Kent and Curlee 1991; Starkweather 1985; Wingate 1976), a local change in these regions should be sufficient to bring about improvement. One method that could be used to achieve slowing of speech rate in critical areas would the use of altered auditory feedback (AAF). It is well known that certain forms of altered auditory feedback (delayed auditory feedback, DAF) have the effect of enhancing fluency in people who stutter. DAF also slows down overall speech rate of fluent speakers (Lee, 1950) and this also happens in speakers who stutter. Under DAF, a speaker’s voice is relayed back to the speaker via headphones after a short delay. Delays of around 130 – 200 milliseconds have been found to be most effective in enhancing fluency. The issues with regard to treatment are how this slowing comes about in all speakers, why people who stutter become fluent and whether such gross slowing is necessary to achieve this fluency enhancement.

Howell and Sackin (2002) outlined a theory that accounts for why DAF slows speech. They proposed that spontaneous speech produced at a rate that fluency can be maintained and with no alteration to feedback has its timing intrinsically determined (Fowler, 1980). The theory assumes speech planning processes are independent of execution and that the plan for one speech segment is planned so it is ready immediately after the prior one is being executed. DAF affects one component of execution - the operation of a general purpose, independent timing process that is involved in speech production as well as other motor tasks (Wing and Kristofferson, 1973). Disruption due to DAF is effective because it produces an extra input that is asynchronized relative to the input due to voice. Faced with the disruption caused by the additional sensory input arising because of the delayed sound, the speaker slows down response rate.
The explanation why people who stutter become fluent under alterations like DAF is that only execution (response) rate is slowed, not the timing of planning processes. If execution rate is reduced, there is less chance of it getting ahead of planning that is proceeding at its own rate regardless of what is occurring at execution. Consequently, fluency breakdown occurs less frequently.

There are other forms of alteration that do not involve a temporally separate sound that have also been found to be effective in alleviating stuttering in the short term. The principal one is frequency-shifted feedback (FSF) that involves a time synchronous shift in pitch to the voice (Howell, El-Yaniv and Powell, 1987). As with DAF, the effects are an immediate improvement in fluency that is more-or-less restricted to the period during which FSF is administered. The effects on speech timing are more subtle and less apparent than the gross effects of DAF. For fluency to be achieved in people who stutter according to the EXPLAN model, speech rate only needs to be reduced in the problematic sections that are usually those spoken very fast. FSF may have its effects by enhancing the beat synchronised to that of the voice (by the addition of an in-synchrony second sound source) allowing the speaker to time speech more precisely as occurs when speaking in time with a metronome. Speech can be spoken at the same rate but timed more precisely (with less variation). A reduction of variance about the same mean rate would lose some of the very fast sections (and also, of less importance here, lose some of the very slow section too). If as proposed earlier, the fast sections are the ones likely to cause fluency failure, their removal will improve speech control.

The advantage of altered auditory feedback is that it allows direct control of the timing processes that controls fluency indirectly. When altered feedback is administered, it immediately affects the timing process and fluency improves. When the alteration ceases, control of the timing processes is relinquished and stuttering returns. The effects of altered auditory feedback occur rapidly and can be precisely targeted on episodes where the speaker or his or her therapist wants to induce a fluent response. The control this allows should not be underestimated merely because the effects are short lived.
In the next section, another important technique that is effective with young children who stutter is considered (operant procedures).

**Speech skills**
The linguistic analysis of the developmental pathway of the speech of children who have persisted in their stuttering through early teenage years has indicated that these children have changed the type and location of their dysfluency. They have exchanged a pattern of predominantly whole word repetitions on function words (stalling) to one of mainly part word repetitions and prolongations on content words (advancing). It could be argued that therapeutic intervention aimed at inhibiting or preventing this exchange pattern would minimise the risk of these children becoming persistent in their stuttering.

One possible method of therapy would be to attempt to change the pattern of stutters directly by operant procedures that has the effect of preventing fluency failure due to planning getting out of synchrony with execution. These operant processes could be regarded as a way of keeping planning and execution processes in synchrony. The EXPLAN model suggests that function word dysfluencies (e.g. repetition of the function word) are delaying strategies that prevent speakers from embarking on a word before its plan is ready. If premature attempts on part planned words can be avoided, timing control remains intrinsic and the external timing mechanism is not engaged. Function word repetition, pauses before content word etc. prevent this problem and should be encouraged. Content word dysfluencies reflecting situations where execution is ahead of planning (e.g., prolongation of the first part of a content word) can then be avoided which would then prevent the engagement of the timing mechanism.

The Speech Research Group at UCL are using operant conditioning to reinforce children when they use function word repetitions and stopping them speaking when they start content words with concomitant evidence of stuttering (Howell et al., 2001). It is assumed that function word repetitions serve the role of reducing execution rate of speech by allowing speakers to reuse words already said. As their plan is still available, they do
not require replanning so planning of the next word can proceed independently (this proposal was also made by Blackmer and Mitton, 1991).

The study was conducted with three CWS aged between 8 and 12 years that were stuttering predominantly on content words. A speech and language therapist visited the children in their home once a week for 10 weeks. Each therapy session lasted for about an hour. If the child was "stuck" on a function word, for example repeating it or pausing in the vicinity of a function word, that was considered appropriate and the therapist gave indications of encouragement. If the child experienced a problem on a content word like those described earlier, the therapist used a “time-out” technique often used in operant therapy and the child was asked to stop for a few seconds.

It is too early for an indication whether this operant procedure just outlined is generally effective or not. Nevertheless, it is interesting to contrast this study with another currently popular operant treatment - the Lidcombe program (Onslow, Packman, Stocker, van Doorn and Siegel, 1997). Onslow et al. (1997) used their operant procedure to control three children's stuttering. When a child was judged to have stuttered, they were given time-out from speaking. It is not clear from the Onslow et al. (1997) report how accurate investigators were at deciding what events to time out and how consistent this is for different judges. Furthermore, details of what is considered a "perceptible stuttering" are not given. All these facts make it impossible to establish whether time out punishment in the Lidcombe program tends to be targeted on the content words or on both content and function words as this will depend on what is considered a stuttering. The children treated were between 8 and 13, so they are in the same age range as those investigated in our study. Onslow et al. (1997) found two of the three children investigated showed signs of improvement. The pattern of the child who did not respond is described as showing "signs of effortful speech, such as frequent sound prolongations, blocks and grimacing" (p.130). It might be supposed from this description, in contrast with the other two subjects, that he has a higher frequency of stuttering on content words (a characteristic that we have found for our non-improved, persistent stutters).
According to our selection criteria, then, he would be the only child we would admit into our form of therapy.

Finally, there is another operant study that lends support to the EXPLAN model and offers some interesting possibilities for future treatments. In a study in fluent speakers, Beattie and Bradbury (1979) used an operant procedure to modify the temporal structure of spontaneous speech. They found that if unfilled pauses are reduced by operant procedures, speakers make up the pause time by repetition of sound. They stress that though pauses are lost, no change in speech rate ensues. The EXPLAN model predicts that if a speaker is to remain fluent, pauses are one way of preventing speakers attempting a subsequent word before it is ready for execution. In this way, pauses have an equivalent role to function word repetition and Beattie and Bradbury’s (1979) study shows this directly (pauses are traded for word repetitions so overall speech rate remains constant). The technique that Beattie and Bradbury (1979) use may also provide a convenient way of inducing word repetitions that are regarded here as preventing stuttering. However, before investigation with this procedure commences, it is necessary to confirm that the repetitions induced occur specifically on function words.

Future directions
The three experimental chapters in this thesis will now be examined for ways in which this research can be developed. Future research that extends the multifactor approach to the identification and treatment of stuttering based on the EXPLAN model of fluency failure will also be proposed.

Social skills
The method used to assess the social status of CWS, using a semi-structured interview format to administer a sociogram, limited the number of CWS that could be investigated in this study. The sociogram required children to nominate three children from their classroom group that they liked and three children that they did not like. The small number of subjects restricted the scope and power of statistical analysis. In order to
expand the research it may be necessary to change the method of collecting sociometric data to a forced choice questionnaire format.

The Forced Choice Probability (FCP) method was developed to assess the social status of children with learning disabilities in mainstream education and would be suitable for a similar use with CWS in mainstream education. An example of the FCP method is the How I Feel Toward Others measure (HIFTO; Agard, Veldman, Kaufman and Semmel, 1987). The HIFTO form has the names of all the children in the group in a column on the left of the form together with three columns of faces and a question mark - the expressions on the faces are intended to show how the child feels toward each classmate. The technique requires each child to respond to every other child in the classroom group. Children are asked to use the question mark category to indicate the children they do not know well enough to classify, the smiling face to indicate which classmates are friends, the straight mouthed face to indicate the classmates they know well but do not particularly care about, and the frowning face to indicate classmates they do not want to have as friends.

The FCP offers two advantages in the expansion of research into the social status of CWS. Firstly, the ability to collect data without recourse to labour-intensive interviews. Frederickson and Furnham (1998b) describe a study where a variation of the HIFTO instrument was administered to whole classroom groups under the supervision of the class teacher. The children were told that the questionnaires were part of a friendship project and that there were not any right or wrong answers. They were assured that the questionnaires would be kept confidential and were asked not to discuss them. Such methodology would ensure that the responses from the children would be as honest and as accurate as possible. Secondly, in comparison to the limited nomination method used in this thesis, the FCP method could provide a more accurate estimate of the social status of CWS. There is no theoretical or empirical basis for expecting a child to have an exact number of friends as is requested by the limited choice format. Using a free-choice format, Hallinan (1979) found that the mean number of number nominations for best friends from 62 classes of 10-13 year olds was 5.5 with a range from 2 to 8. Other
research has indicated that increasing the number of nominations allowed has a positive effect on the social assessment of socially vulnerable children. For example Gronlund (1959) found that increasing the nominations allowed from three to five decreased the number of apparently neglected and isolated children in the study. Taylor, Asher and Williams (1987) argued for the use of unlimited nominations when assessing children with learning disabilities in mainstream education because this would maximise the possibility that they would receive some nominations.

It would therefore seem advisable to use the FCP method for future research investigating the social status of CWS. By allowing unlimited nominations, such a method will provide a more accurate assessment of the social position of CWS. The FCP method also offers the possibility of obtaining a wider range of sociometric data on CWS without the expenditure of valuable research resources.

It is apparent that the method used in this thesis to quantify the social status of CWS provides at best only a “snapshot” of the child’s social environment. For example, the three “liked most” children nominated by a child interviewed in the morning could radically altered by a lunchtime argument. However, there is evidence from research which indicates that some of the social status groups derived from limited choice peer nominations, in particular the popular and rejected groups (Asher and Dodge, 1986; Coie and Dodge, 1983), are stable over time. Frederickson and Furnham (2001) also report similar stability over a two-year period for social status groups derived from forced choice nominations. Longitudinal research on the sociometric status of CWS would serve two purposes. Firstly, it would establish the long-term stability of social status classification of CWS in mainstream education. Secondly it would allow the effectiveness of the therapeutic intervention recommended above to be monitored.

**Motor skills**
The experimental work in this thesis investigated the performance of CWS and controls on a battery of motor skills tasks designed to measure the function of the cerebellum. The EXPLAN model of fluency failure implicates the involvement of the cerebellum in stuttering by proposing that speech timing is regulated by a general purpose, independent
timing process that is involved in speech production as well as other motor tasks (Wing and Kristofferson, 1973). Further evidence for the involvement of the cerebellum in stuttering comes from PET scan studies (Fox et al. 2000; de Nil and Bosshardy, 2000).

The battery of tasks used to measure cerebellar function in this thesis lacked the technique that has been most extensively used for assessing cerebellar timing control. This is a tapping task devised by Wing and Kristofferson (1973). This task was described fully in Chapter 4 and will only briefly be summarised here. Wing and Kristofferson (1973) required subjects to repeat manual responses at a precisely-timed interval and variability in performance was measured. The overall variance in performance was decomposed into variance associated with timekeeping (Cv) and that associated with motor (Mv) processes. Ivry (1997) has established that Mv and Cv reflect processing in the cerebellum using the tapping version of the Wing-Kristofferson task by working with patients who were known to have lesions in different parts of the cerebellum. It was found that Mv was selectively affected in patients with lesions to the medial areas of the cerebellum and Cv was selectively affected in patients with lesions to the lateral areas of the cerebellum. These data support the view that anatomically different structures in the cerebellum fulfil motor control and timing functions and that the Wing-Kristofferson analysis procedure indexes them.

The Speech Research Group at UCL have included a version of the Wing-Kristofferson task in an ongoing study involving adult stutterers. Further research investigating the motor skills performance of CWS could include a version of the task, adapted for use with children, in the battery of assessment instruments. If CWS have a cerebellar deficit, then this should be evident in the Wing and Kristofferson task that is a validated technique for assessing function of this central nervous system structure.

This thesis used a cross-sectional method to investigate differences in age and fluency groups. Although this study (and the speech skills study reported in Chapter 5) form the start of an intended longitudinal project, at the time of writing this thesis insufficient time had elapsed to report data longitudinally. Therefore children were assigned discretely to each age group, leaving the possibility that the statistical analysis
may have be affected by sampling error. The parents and children involved in this project have consented to ongoing participation (consent is renewed annually) and this provides the potential to obtain longitudinal data on this group of children. This would enable the developmental configuration of the performance of CWS and children who do not stutter on motor and timing tasks to be tracked through the period between eight and twelve years that has been identified by EXPLAN as critical in the development of fluent speech.

Speech skills
The EXPLAN model of fluency failure takes the view that stuttering arises out of the early childhood nonfluencies that all children show. This view, plus the advent of therapeutic techniques that are designed for early intervention with CWS, argues for future research to investigate speech patterns in children younger than those that participated in the work reported in this thesis. The Lidcombe program (Onslow, Packman, Stocker, van Doorn and Siegel, 1997) can be used with CWS as young as three years. By implication, this means that children of this age must also be diagnosed as stuttering before therapy can begin.

The EXPLAN model was based on data drawn primarily from CWS aged eight years and older and speech data from children diagnosed as stuttering in the three to eight years age range has the potential to further validate the model. The model would predict that these children would be producing principally whole word repetitions on function words, a normal nonfluent stalling strategy that the EXPLAN model would not describe as stuttering. The model implies that the exchange to stuttering mainly on content words (when it does occur) does not happen until the child is aged about 8 years to early teenage. The results of the phonological word analysis that was reported in Chapter 5 indicated that 5 out of 35 children participating in the study had already developed an advancing pattern of fluency failure at the time of initial assessment. Four out of these five had persisted in their stuttering behaviour at follow up assessments. These children were aged nine and ten years old at the time of these initial assessments and as there is no speech data available on these children prior to this point it is not possible to determine when the change from stalling to advancing took place. The Speech Research Group at
UCL has access to children that have been diagnosed as stuttering at a young age (from three years old) from several clinics in London. It is intended to commence a longitudinal study of the fluency of a group of these children with speech being analysed initially at three-month intervals. This study would enable the fluency patterns of a young group of children diagnosed as stuttering to be monitored as they approach the critical age for changes in fluency that predict persistent stuttering outlined above.

The five children described above as persistent stutterers were aged between twelve and fifteen years at the time of the final speech analysis. However the time between initial and final speech analysis was between three and five years and speech data available for analysis on these children during that time was sporadic. Therefore, it cannot be stated with any certainty that these children were consistent in their fluency pattern during this period. A longitudinal approach (as recommended for the motor and timing skills study discussed above), using regularly obtained speech samples, would enable fluency patterns to be monitored for individual children following their change.

Finally, it should be said that the procedure required to produce the phonological word analysis reported in Chapter 5 and reviewed here is both labour-intensive and slow. Each recording has to be orthographically and then phonetically transcribed. Following the phonetic transcription, phonological words are coded and finally stuttered incidences are identified and allocated. This process can take up to four hours for each minute of speech being transcribed and the analysis will usually be duplicated to ensure inter (and also intra) rater reliability. In view of the time and training that would be required phonological word analysis, in the present format, would be of little use to speech and language therapists as an instrument to identify children at risk of persistent stuttering. Future research should be directed at an attempt to devise an automated system that would speed the analysis process. An automatic recognition system designed to locate and assess stuttered incidences (Howell et al, 1997) was reported in Chapter 1, a similar system also capable of phonological word analysis would simplify the identification of those children at risk of persistent stuttering.
**Concluding summary**
Preliminary work indicated ten factors that were relevant to the identification and treatment of stuttering. This thesis then investigated the utility of three of those factors. Experimental work discovered that social status was of limited use in the identification of CWS but had important implications for therapeutic practice. Changes in performance deficiencies on motor and timing tasks were found to coincide with the age at which those CWS that are risk of persistent stuttering change their pattern of fluency. Linguistic analysis of stuttered incidences that identified those CWS that were showing predominantly part word repetitions also indicated that those children were at risk of persistent stuttering.

This final chapter has indicated ways in which the above techniques could be extended and validated. However, it should also be borne in mind that this thesis has only investigated three of the ten factors that were identified in Chapter 1 as being pertinent to the identification and treatment of stuttering. In addition to this, during the course of this thesis other factors have emerged as possibly being relevant. For example, research has indicated a possible relationship between behavioural and social/emotional development and communication disorders in children. Prizant and Meyer (1993) emphasised the high co-occurrence rates of communication and emotional/behavioural disorders in children. Baker and Cantwell (1982) found that 44% of children with speech and language problems also qualified for some psychiatric diagnosis. A study of Canadian children showed that nearly half of those with a communication disorder also had psychiatric disorders. This compares to the prevalence of psychiatric problems for children with normal communication was 12% (Beitchman, Nair, Clegg, Ferguson, and Patel, 1986). With particular relevance to stuttering, Lewis and Goldberg (1997) found that children at risk for stuttering differed significantly from a group of age and gender matched controls on three dimensions of a parental report childhood temperament questionnaire. The children at risk for stuttering were reported in a more positive manner to the controls in terms of ‘Mood’, ‘Adaptability’ and ‘Rhythmicity’. Conture (2001) suggests that temperamental characteristics at the very least exacerbate instances of stuttering but at the moment (my italics) they are a less than robust vehicle for explaining the relationship between linguistic processes and childhood stuttering.
One thing that this thesis demonstrates is the need for more extensive validated
techniques examining factors important for diagnosis and treatment and the need for
measures that converge on specific attributes (for example, the Dow and Moruzzi and
Wing and Kristofferson tasks). Only when such techniques are available for all relevant
factors can work commence on a multifactor model for use in assisting speech and
language therapists in providing a diagnosis and in assessing the prognosis of CWS.
However, an instrument that has been validated for the measurement of a specific
attribute does not necessarily mean that it will have predictive value for the purposes of
this project. When measures for all topics are validated and introduced into the statistical
model, all the scores will need several rounds of validation, this will involve the use of
Principal Components Analysis and Cluster Analysis. As this thesis has described, work
on the development of suitable assessment techniques designed to elicit measures
appropriate for use by speech and language therapists has begun, but is by no means
complete.
Appendices
APPENDIX A

A report of the initial stages of the development and validation of a communication attitude assessment instrument for use with young children.

Abstract
Studies have indicated that communication attitudes are an important factor in CWS before, during and after therapy (Bloodstein, 1971; Shearer, 1961; Erikson, 1969). However there are no validated instruments available to measure communication attitudes that are suitable for use with children younger than 7 years. This study reports the development of a computer-based instrument designed to measure communication attitudes in young children. The instrument was administered to 19 CWS and 148 fluent control children. The age range in both groups was 3 years 6 months – 10 years 11 months. Results replicated previous studies (Vanrykegham et al, 2001) that indicated the communication attitudes of CWS become more negative with age. Results also indicated that the instrument would require a further round of validation to establish reliability.

Introduction.
For nearly 50 years there has been recognition that a stutterer’s attitudes and reactions to interpersonal verbal communication (hereafter referred to as communication attitudes) constitute a basic component of the stuttering problem (van Riper, 1948; Johnson, Brown, Curtis, Edney and Keaster, 1956; Travis, 1957; Sheehan, 1970; De Nil and Brutten, 1991; Vanrykegham and Brutten, 1996). Research in this area has been directed primarily at adults and research with children has been restricted to those aged 6 years and older. This study explores the measurement of communication attitudes of young children (under 7 years). Past research that demonstrates the need for an assessment instrument that would measure the communication attitudes of young children is reviewed.

Research findings are unclear as to the exact role of communication attitudes in stuttering. There have been proposals that the onset of stuttering is a result of the belief that speech is difficult (Bloodstein, 1987). Diametrically opposed to these viewpoints are theories which have proposed that the negative beliefs that people who stutter have about
speech is a product of, rather than a cause of their dysfluency (Guitar, 1976; Peters and Guitar, 1991).

Bloodstein’s (1987) suggestion implies that negative communication attitudes could be a cause of stuttering and highlights the importance of investigating the communication attitudes of young children close to the onset of stuttering. If young CWS (CWS) do have a more negative communication attitude than their fluent counterparts then this may suggest that the more negative attitude is present at onset and could possibly be a causative factor in the disorder. However if no significant difference is found between the communication attitudes of young CWS and their peers that do not stutter this may suggest that the more negative communication attitudes found in older CWS may result from (rather than cause) the stutter. Whatever the direction of causation, communication attitude may be an important indicator for the diagnosis and treatment of stuttering.

Whether a negative communication attitude is the cause or the effect, there appears to be a relationship between negative communication attitude and stuttering. Therefore it is important to have reliable ways of measuring communication attitudes. Research by Shearer (1961) and Erikson (1969) has shown that changes in the self-concept of someone who stutters is one important aspect of success both during and following treatment. Therefore communication attitudes may be important factor in the efficacy of therapy, as well as the diagnosis of stuttering.

In one of the earliest studies of the communication attitudes of people who stutter, Brown and Hull (1942) administered the Knowler Speech Attitude Scale to group of 59 adults who stuttered. The average score of these subjects who stuttered fell significantly below the test norms for nonstutterers. This finding led the researchers to conclude that the communication attitudes of people who stutter are poorer than those of people who do not stutter. Despite the potential clinical importance of Brown and Hull’s study, little in the way of follow-up studies have been conducted in the following years. The scale developed by Lanyon (1967) and the Behavior Analysis Battery devised by Brutten
(1972) were primarily behavioural measures of stuttering and were only marginally concerned with communication attitudes. Woolfe (1967) constructed the Perceptions of Stuttering Inventory that moved away from the behavioural perspective in an attempt to measure the anticipatory reactions of stutterers. The instrument used a self-administered questionnaire to measure a person who stutters' attitude to their stuttering that measures severity indirectly (Andrews and Cutler, 1974).

Erickson (1969) developed an instrument that would produce objective measures of communication attitudes – the Communication Attitude Scale (the S-scale). His underlying assumption, based on previous research findings (see Brown and Hull, above) and evidence from clinical practice, was that people who stutter would have more negative attitudes toward verbal communication than people who do not stutter. The final form of the S-scale supported this assumption. The responses of the persons who stutter to the 39 items about interpersonal communication differed from those of the persons who did not stutter. An individual's score on the S-scale supplies a measure of the extent to which his or her communication attitude differs from "normal" attitudes. The scores of people who stutter were found to be significantly higher than those of their fluent peers, indicating a more negative communication attitude.

Andrews and Cutler (1974) assessed the reliability of the S-scale when administered repeatedly, for example when attitudes were measured before and after therapy. They found that the S-scale was unsuitable for this task. Five of the items on the 39-item scale demonstrated poor test-retest reliability. Five items showed no change when administered before and after therapy, this could have indicated that therapy had not changed the communication attitude of the person under review. However, the researchers concluded that as the remaining items on the scale had indicated a change to more positive communication attitude post therapy these five items did not measure communication attitude change. A further five items were couched in the past tense and were deemed unsuitable for repeated administration. The study produced a revised short form of the S-scale (the S-24) which contained 24 items and which the researchers
reported as a reliable and valid measure of communication attitude change when working with young adult males.

The majority of the research on the communication attitudes of people who stutter up to this time was with adults. Little attempt was made to assess the attitudes of CWS. Therefore there was no conclusive evidence that showed whether communication attitudes differed between CWS and their peers (Costello 1984).

Consequently, Brutten (1985) developed the Communication Attitude Test (CAT) in order to determine if the speech-related attitudes of CWS differed from those of children who do not stutter. The CAT was subsequently normed (Brutten and Dunham, 1989) using 518 children who did not stutter aged 6-13 years. A Dutch version of the CAT (CAT-D) was developed in a series of studies that aimed to establish if the communication attitudes of CWS were significantly different to those of children who do not stutter for speakers of this language (De Nil and Brutten, 1986, 1991). The study revealed that CWS scored significantly higher on the CAT-D that their peers who did not stutter, indicating that their speech-related attitudes were more negative. Similar between group differences were found with a group of American children by Boutsen and Boutsen, (1989). Brutten and Dunham (1989) and Vanryckeghem and Brutten (1992) assessed the internal and test-retest reliability of the CAT and CAT-D. Both studies reported reliability coefficients of +.7 and above for the respondent’s test scores, indicating that the instrument was a reliable measure of communication attitude. Vanryckeghem and Brutten (1992) also administered the CAT-D to a group of CWS aged 7 – 13 years on three separate occasions with intervals of one, eleven and twelve weeks. They reported reliability coefficients of +.83, +.81 and +.76 respectively, indicating that the communication attitudes of the participants were positionally stable. However there were absolute mean differences following the 11 –12 week time period which the researcher’s suggested indicated that the test was sensitive enough to reflect changes in communication attitude.
Vanryckeghem (1995) proposed that the CAT and CAT-D are useful clinical and research tools for evaluating between group differences when investigating communication attitudes. However, she conceded that the scope of the CAT is limited in that it requires a child to have the ability to read and understand the concepts covered by the test items and consequently it is not generally accurate when used with children younger than 7 years of age. Vanryckeghem (1995) proposed that a possible way to obtain accurate information regarding the communication attitudes of young children was to question the parents of children being assessed. (a standard practice in clinics). The relationship between CAT-D scores of children (aged 6 – 13 years) who do and do not stutter and their parents was separately examined to in order to determine agreement and, thus, if parents could generally serve as a surrogate source of information about the communication attitude of their young children. Analyses of the responses showed significant differences between parents and children on scores measured by the CAT-D indicating that parental report about their child’s speech related attitudes may not be an accurate predictor of the child’s own attitude.

As Ingham (1997) noted, the relationship between attitudes and stuttering has been debated for many years and the debate on whether stuttering causes or results from negative attitudes has not been resolved as yet. Brutten et al.’s (1989) view was that stutterers’ negative communication attitudes caused and maintained stuttering. On the other hand, others have proposed negative communication beliefs are a result of dysfluency (Guitar, 1976 and Peters and Guitar, 1991). It is important to investigate whether negative communication attitudes existed close to stammering onset when determining the cause and effect relationship between stammering and communication attitudes. The work reported in this study attempts to assess the communication attitudes of young CWS near stuttering onset. If the new instrument reveals that communication attitudes of young CWS are more negative than those of young children who do not stutter, it would provide a basis for diagnosing stuttering and might help assess whether attitudes lead to stuttering. However, if the attitudes of CWS are similar to their fluent controls, then the negative communication attitudes found in older children and adults
who stutter may result from extended experience of dysfluency (i.e. stuttering causes negative communication attitudes.

The need for an instrument to measure the communication attitude of children under 7 years is also highlighted by research findings (Dalton and Hardcastle, 1977) that indicate the onset of stuttering usually occurs between 3 and 5 years of age. Another factor that highlights the need for such an instrument is the oft-voiced call for early diagnosis and intervention for CWS (Yairi and Ambrose, 1992; Onslow, 1994). Taking into account the above, it would seem to be worthwhile to design a test procedure that can be used to measure the attitude toward speech of children aged 7 years and under. This would enable a clinician to assess their communication attitude for use both as a diagnostic tool and as an estimate of treatment efficacy.

Bearing in mind the age of the children the test is designed for, it would be undesirable to use paper-and-pencil or parental-report methods that have been employed in previous communication attitude instruments. Instead a computer-based test was designed. Lap top computers, touch screens and computer-generated sound have been used successfully to assess the language development of pre-school children. Au-Yeung, Howell, Davis, Sackin, and Cunniffe (2001) demonstrated that children as young as 2 years were successfully able to complete a language assessment that contained up to 70 test items when the test was controlled by a lap top computer. In Au-Yeung et al. (2001), children were required to respond a computer-generated audible statement by touching the relevant picture on the computer screen. This is a natural response for a child and aids in keeping its attention. Sound presentation is standardized and response collection and statistical analysis are automated (ruling out the possibility of error in obtaining results and allowing the person administering the test to concentrate on monitoring the child).

The main aim of this study was to design and develop a computer-based instrument to measure the communication attitudes of young children for similar reasons to Au-Yeung et al. (2001). The instrument was administered to a sample of CWS and their peers who do not stutter in attempt to assess its reliability and validity. In view of
the fact that there are no validated instruments available for the measurement of communication attitude in young children, concurrent validity was assessed against the grammar test of Au-Yeung et al. (2001). The concurrent validity assessment is based on the hypothesis that children with a restricted understanding of grammatical constructs should have a more negative attitude toward speech than their peers with better linguistic ability. This hypothesis is derived from anecdotal evidence received from teachers and speech and language therapists whilst working on other speech-related projects. There is also evidence from the research literature of measures of grammatical ability being used successfully to predict other, non-speech factors. Cole (2001) reported that aggressive boys, as defined by teacher and peer ratings, differed significantly from a comparison group in mean length of utterance (MLU). MLU is a measure of syntactic complexity and in this study the aggressive boys (aged 8.5 – 13 years) provided less information in their spoken utterances than their non-aggressive peers. Another study with younger children (aged 5 – 7 years) used MLU as a correlate for the social/cognitive aspects of play. Lim (1998) found that MLU scores were significantly correlated with the solitary play subscore on the Parten/Piaget scale. The data indicated that children with reduced MLU scores were more like to engage in solitary play.

The rationale and methods employed in the design and administration of the instrument to measure the communication attitudes of young children are detailed in the next section.

**Design and construction of the Young Children’s Communication Attitude Test**

**Question design.** This section briefly reviews previous attempts to measure the communication attitudes of young children and then goes on to describe the rationale and development of the instrument designed here to measure these attitudes.

Silverman (1970) investigated the speech attitudes of CWS by asking primary school children to make three wishes. Only four children made speech-related wishes, so he concluded that CWS were not concerned about their speech. However, more direct measures have been employed that suggest different conclusions: Woods (1974),
challenged Silverman’s (1970) findings. He demonstrated that 3rd and 6th grade CWS had more negative communication attitudes than their peers who did not stutter when a direct attitude assessment was used. This finding initiated the development of another assessment instrument designed to compare the communication attitudes of children who do and do not stutter. Guitar and Grims’ (1979) A19 attitude scale consisted of 19 questions with yes/no responses. The use of yes/no responses is a limitation, as Oppenheim (1992) observed, as they fail “to do justice to the complex images in the respondents mind”. Even though the attitude assessment being developed in this study is specifically intended for young children, a scale was used rather than yes/no or true/false responses. It is intended that this will provide a more detailed picture of the communication attitudes of young people. With short, simple statements, it should be possible to elicit informative responses from young children. Another issue considered in the design of the scale was the length of the test. Young children have a relatively short attention span and would not be able to concentrate on a long test.

**Content of the Young Children’s Communication Attitude Test.** Attitudes, like many other determinants of behaviour, are abstractions – though they seem real enough to the person who holds them. Oppenheim (1992) proposed that attitudes are reinforced by beliefs (the cognitive factor) and attract strong feelings (the emotional or affective factor) which may lead to particular intents (the behavioural component). Ulliana and Ingham (1984) and Watson (1987) proposed that communication attitude is not a single dimension but is, in fact, made up of several different factors. An accurate measure of attitude can only be obtained if all these aspects are measured. Watson (1987) tackled this issue by developing a communication inventory based on the tripartite model suggested by Ulliana and Ingham (1984). The tripartite model contained behavioral, affective and cognitive factors.

The Young Children’s Communication Attitude Test builds on research findings that communication attitudes are multifaceted by investigating four factors that may influence communication attitudes. These factors are 1) the way children feel about their own speech - *affective* 2) the way they think others perceive their speech – *cognitive*, and
the two *behavioral* components, 3) their attitude to specified speech situations and 4) their attitude to speaking under time pressure. These factors are derived from the tripartite model developed by Ulliana and Ingham (1984) and utilised by Watson (1987) in her communication inventory. Because the Young Children’s Communication Attitude Test was specifically designed to investigate the communication attitudes of CWS, an extra behavioural component was included to look into the attitudes of young people to talking when time for speech is limited. Research with children (Jones and Ryan, 2001) and adults who stutter (Kalinowski, Armson and Stuart, 1995) has indicated that an increase in speech rate often increases the frequency of stuttering. This complementary increase in speech rate and stuttering was explored further in Chapter 2 where the EXPLAN model of fluency failure was introduced. Five statements are used to investigate each factor. The statements, together with the factors that they are investigating are listed at the end of this report.

As Oppenheim (1992) recommended, the order of presentation of the statements is randomised, and half the statements are worded in a negative manner and half in a positive manner. There are 20 attitude-statements in total, which is sufficient for reliable measurement, but is short enough to maintain young children’s attention. The statements were designed to be relevant to the activities of young children and to maintain their interest in the assessment. Precise and simple language is used to accommodate the stage of language development attained by children in the target age group. Lewis and Lindsay (2000) indicate that this approach reduces the risk of children not understanding the statement.

**Attitude-scaling.** Oppenheim (1992) proposed that there are 5 important criteria that need to be met by a scale designed to measure attitudes. (1) The scale should be unidimensional, that is measuring only one thing. This means the statements should be internally cohesive and “hang together” to measure the same factor with as little extraneous variance as possible. (2) The scale should be reliable. Traditional scaling methods are strong in this respect. (3) The scale should be valid, it should measure what it sets out to measure. It is often difficult to find external criteria against which to validate
an attitude scale, as is the case for a scale designed to measure the communication attitude of young children. (4) The scale should have linearity, it should equal or appearing equal, intervals – to make quantitative scoring possible. (5) The scale should have reproducibility. A scale should show, by a single figure, a respondents place on the attitude continuum. That is, which statements the respondent agreed or disagreed with. In practice this is difficult to achieve, as many attitudes are not uni-dimensional. Breakwell, Hammond and Fife-Schaw (1995) highlighted that there is little consensus on the most appropriate method for measuring attitudes. The most popular methods of attitude measurement are briefly reviewed here.

Social-distance scales are, as the name implies, primarily used to measure attitudes to certain ethnic groups and social categories. Respondents are required to indicate at what level they would willingly admit groups or categories. For example “To close kinship by marriage”, “To my street as neighbors”. There could be doubt that the scale has linearity in respect of equal intervals. With regard to this current study the scale has little relevance to the measurement of communication attitudes and the procedure would also be too complex for young children. Thurstone scales tackle the problem of equal appearing intervals by asking judges to rank a pool of statements about a certain topic on a scale from the most favourable through a neutral point to the least favourable. The judges’ responses are then analysed and statements are chosen from the pool on the basis of the amount of agreement between the judges. If care is taken in the compilation of the original pool of statements, this, combined with removal of the more ambiguous statements would ensure a reasonable degree of uni-dimensionality. Further analysis of the judges scores are then used to allocated scale points to the statements chosen for inclusion in the assessment instrument. Respondents are then required to indicate “agree” or “disagree” to each statement and the allocated scale points are summed to provide a final score. Thurstone scales could not be used in the assessment of communication attitudes of young children in this thesis for the following reason. One of the main points underpinning the process is that people who are similar to those to whom the finished instrument will be applied should make the judgements on the initial pool of statements. The construction of Thurstone scales means a lot of work. The minimum
number of judges required for the initial ranking procedure is recommended to be at least 40, with as many as 300 being used in some studies (Oppenheim, 1992). Likert scales are considerably less laborious to construct and this, combined with experimental findings that demonstrate that Likert scales correlate well with Thurstone scales, make them an extremely popular method of attitude scaling. Likert scales remove the need for judges by asking respondents to place themselves on an attitude continuum for each statement. The continuum usually runs from "strongly agree" to "agree", "uncertain", "disagree" and "strongly disagree". These 5 positions are allocated weights of 5,4,3,2 and 1 for scoring purposes. This enables a score for each statement to be obtained together with a total score. Initially a sample of respondents (again similar to those on whom the finished instrument will be used) is asked to try out a pool of statements chosen to measure the attitude under investigation. Item analysis can then be used to select the appropriate statements for use in the assessment instrument. There are several methods of item analysis, probably the most widely used is the internal consistency method. This involves examining the relationship of each statement to the total score (minus the score for the statement under examination). If there is a strong correlation between the two the statement should be retained in the assessment instrument.

Previous studies investigating communication attitude have used different methods for collecting responses to this. The Erickson S-24 (Andrews and Cutler, 1974) used Thurstone scaling and required the respondent to answer "true" or "false" to a series of statements. Brutten et al (1985) added an additional "don't know" response for their Communication Attitude Test. More recently, studies of communication attitudes have used Likert scales. For example Watson (1987) used a seven-point Likert scale in her communication attitude test. Besides allowing an uninformative neutral response, the high number of response options would be confusing for a young child. The Young Children’s Communication Attitude Test will use a Likert Scale. The Young Children’s Communication Attitude Test has four responses on the Likert scale because an odd number includes a neutral point that is not informative about attitude. A neutral response from a young child could mean the child has not understood the statement or that they do not know what their attitude in response to the statement.
The next question raised was how to represent the four points of the scale. Previous research has traditionally used numbers (this would be here, 1 – 4) that reflect “strongly agree”, “agree”, “disagree” and “strongly disagree”. However the use of numbers or words for scale responses was not considered appropriate for the age of the children in this test. A pictorial format was designed that was easy to use that also maintained the attention of the child. This consisted of computer generated animated response panels that are fully described below.

Reliability. External reliability was assessed by repeated administration of the Young Children’s Communication Attitude Test to a randomly selected subset of 20 children who do not stutter. The children were tested twice and the interval between tests was 2 weeks.

Validity. As reviewed above, there is no validated instrument currently available to measure the communication attitude of young children with which the responses from Young Children’s Communication Attitude Test could be compared. Young Children’s Communication Attitude Test was compared with scores by the same children on an assessment of receptive grammar. It is reasonable to suppose that children with delayed or disordered understanding of language would hold a less positive attitude toward speech than their peers. The Test of Receptive Grammar (TROG, Bishop, 1989) was chosen as a suitable instrument. It is a reliable and valid measure of receptive grammar and was suited to computer presentation in the manner adopted in this study.

Mode of presentation In order to make the assessment interesting and stimulating for young children it was decided to present the Young Children’s Communication Attitude Test on a laptop computer. The software was written by Dr Richard Baker using Borland C++ Builder 4.0 to operate in a 32-bit MS Windows environment. A general-purpose program was created for running a text-based questionnaire with four animated response buttons. The program took a list of statements that it presented one at a time in a 'text' box at the top of the window. Presentation of each statement individually reduced the amount
of information that the child had to process at any one time. The four animated buttons appeared below the text box. A response was made when the child 'pressed' one of the buttons (clicked on the respective picture). This caused the response to be written to a result file (ASCII text format) and the program then displayed the next question, if available. The pictures in the button-windows were in *.avi format animation format, each 150x123 pixels in size.

The pictures in the button windows were animated pictures of a female Psychology undergraduate student waving here head at different rates (to signify degree of agreement or disagreement) and in different directions (to signify agree or disagree) obtained with a digital video camera. Thus, the student made four distinct head-movements (one for each button) as follows: vigorous nodding (i.e. up-down motion), slight nodding, slight shaking (i.e. side-to-side motion), vigorous shaking. These corresponded to the categories 'strongly agree', 'moderately agree', 'moderately disagree' and 'strongly disagree'. The videos were transferred to computer and 'looped' so the motion was continuous.

Method

Subjects There were 19 CWS whose ages ranged from 3 years 5 months to 10 years 11 months, with mean age 7 years, 4 months. There were five female and 14 male. The 148 children who do not stutter were aged from 3 years 5 months to 10 years 11 months with mean age 6 years 8 months. There were 75 boys and 73 girls. Subjects were allocated to one of four groups displayed in Table 1.

Table 1: The Four Subject Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Group Number</th>
<th>Age Range (year;month)</th>
<th>Mean Age (year;month)</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Young CWS</td>
<td>10</td>
<td>3;5 – 6;6</td>
<td>4;6</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2 Old CWS</td>
<td>9</td>
<td>6;7 – 10;11</td>
<td>9;10</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>3 Young Controls</td>
<td>85</td>
<td>3;5 – 6;6</td>
<td>5;10</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>4 Old Controls</td>
<td>63</td>
<td>6;7 – 10;11</td>
<td>7;9</td>
<td>28</td>
<td>35</td>
</tr>
</tbody>
</table>
Group one consisted of five children pre-speech therapy, and five children currently having Lidcombe treatment. From group two, three were currently having intensive treatment, five had previously received intensive treatment and one had previously had Lidcombe treatment.

All the fluent control children were recruited from two inner London mainstream primary schools and the CWS from inner London speech and language therapy clinics. All control subjects satisfied the following criteria:

• aged between 3 years and 11 years
• normal hearing
• no visual impairments
• no history of speech and language problems
• English as first language
• no special educational needs

The selection criteria for CWS was identical, except that the children in this group had been diagnosed as stuttering by a qualified speech and language therapist. Three controls and one child who stuttered were also seen who did not have English as their first language. They were tested to prevent them feeling excluded, but their data was not used in the study.

Procedure
With older children and adults it is appropriate to have a test that can be self-administered where the interviewer explains what to do and then leaves the respondents alone to complete it themselves. Oppenheim (1992) claimed that the advantages of self-administration are high response rates, accurate sampling and a minimum of interviewer bias. However this did not seem appropriate to use when testing young children, as they might need someone to assist them if they have difficulty with reading or understanding any of the attitude statements. It was also considered that the presence of an interviewer might help to maintain the child’s attention throughout the test. Therefore it was decided
that the interviewer would assist the child by reading out the statement to them, clarifying it if they were unsure about the meaning and ensuring that a valid response was given to each statement.

The laptop computer containing the communication attitude test was set up in a quiet room. In the case of the controls the test was carried out while they were at school. For the stuttering children it was either done at the clinic incorporated into their visit with the speech and language therapist or in their home. Prior to the test, essential information was gathered regarding the speech and language of the CWS. This data included age of child, date of onset of the stutter and any intervention to date.

The presenter and subject sat at the laptop whilst the presenter explained the procedure to the subject. The child was made familiar with the laptop, their full name entered and then they were introduced to the computer program. This was accomplished by showing them the moving faces on the computer screen and telling them that two of them represented “yes” responses and two of them represented “no” responses. They were then told a short story to indicate the exact meaning of each face:

“A class of children were talking about their favourite foods. One little boy was asked whether he liked chips. He answered Yes, they were his favourite food (response 1). He was also asked whether he liked cabbage and he said No he hated it (response 4). When he was asked if he eats fruit, he said yes sometimes (response 2) but only because his mum says it is good for him. Lastly he was asked whether he liked yoghurt and he said no (response 3) but hadn’t tried it many times.”

After the story further information was given to the child, “So you can see that the boy liked some things more than others and he showed this by choosing different faces.” Then the presenter read the child some statements to ensure that they were able to distinguish between the responses. The child was told to pick the face that showed whether they agreed or disagreed with what the presenter was saying:
So if I say to you “I like chips” which face would you pick?
And “I like cabbage”
“I eat fruit”
“I don’t like yoghurt.”
If I said “I am at school today” which face would you pick?
And “I like school”

After this the presenter told the subject that they were going to look at some more statements about talking on the computer. The child was told that he or she should read the statement and either point or use the mouse to indicate the picture that illustrated how they felt about it.

The child was presented with the twenty questions one by one. The order in which the questions were presented was fixed. The children were encouraged to read the attitude statements to themselves. However if the young children had difficulty reading the statements, they were read aloud to them. The assessment took between 3 and 10 minutes, depending on the age of the child.

Following the completion of the Young Children’s Communication Attitude Test assessment the children completed the computer version of TROG. The TROG assessment took a further 15-20 minutes.

Results
Scoring. The Young Children’s Communication Attitude Test was scored by allocating a score of 0 to responses that reflected an extremely positive attitude toward speech, 1 to those responses that indicated a moderately positive attitude, 2 to those indicating a moderately negative attitude and 3 to those indicating an extremely negative attitude. Thus, the higher the score on the 20-item scale the less positive the attitude toward speech. The computerised version of the Test of Receptive Grammar (TROG) was scored in accordance with the user’s manual (Bishop, 1989).

Reliability. Internal reliability or consistency was investigated, by determining whether the instrument measured a single underlying continuum, in this instance the
communication attitude of children. If it is, then the test items should have a strong relationship with both that continuum and with each other. This analysis was undertaken using Young Children’s Communication Attitude Test data from all children. The statistic used to investigate this relationship was Cronbach’s Alpha coefficient. The result of the analysis on all of the data and all of the subjects (196 children) was as follows;

Cronbach’s coefficient alpha = .3746

This result estimates that the error component of the instrument is nearly 90% indicating that there is no single underlying continuum being measured and that the test items do not have a strong relationship with each other.

External reliability was assessed by repeated administration of the instrument to a sub-group of children (test – retest). Twenty children who do not stutter were selected at random from years 1 to 4 (5 children from each year group - ages needed) in a London primary school. The Young Children’s Communication Attitude Test was administered to each child twice within 14 days. The scores recorded by each child for the two tests did not correlate significantly (r = .233, ns) indicating that there was not a significant relationship between the scores.

Validity. As stated earlier, there are currently no instruments available for assessing the communication attitude of young children. In this event concurrent validity was assessed by examining the relationship between Young Children’s Communication Attitude Test scores and scores on the Test of Reception of Grammar (TROG) (Bishop, 1989). This was based on the hypothesis that children with a restricted understanding of grammatical constructs would have a more negative attitude toward speech than would their peers with better linguistic ability. The results of the analysis indicated that the relationship between the Young Children’s Communication Attitude Test scores and the number of blocks passes in the TROG assessment was not significant; (r = .04).

In order to examine the discriminant validity of the instrument the Young Children’s Communication Attitude Test scores of CWS and children who do not stutter were compared. Previous research indicated that CWS have more negative attitudes
toward speaking than their fluent peers (De Nil and Brutten, 1991; Vanryckeghem and Brutten, 1996). This would suggest that scores on the Young Children’s Communication Attitude Test recorded by CWS should be significantly higher than for those children who do not stutter. The scores of 19 CWS (age range 3 years 6 months – 10 years 6 months, mean age 7 years) were compared with those from 148 children who do not stutter (age range 5 years – 9 years 4 months, mean age 6 years 8 months). The results are shown in table 2 below.

Table 2. Mean scores on Young Children’s Communication Attitude Test – all children

<table>
<thead>
<tr>
<th></th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWS (all n=19)</td>
<td>22.79</td>
</tr>
<tr>
<td>Children who do not stutter (all n=148)</td>
<td>23.44</td>
</tr>
</tbody>
</table>

Although the CWS demonstrated more positive communication attitudes as measured by the young children’s communication attitude test, statistical analysis comparing the means indicated that there was no significant difference between the scores (t (165) = -.456, ns). This may be a function of the small number of children in the experimental group.

Vanryckeghem, Hylebos, Brutten and Peleman (2001) demonstrated attitude to communication becomes more negative as CWS become older. In a further attempt to show construct validity of the Young Children’s Communication Attitude Test the relationship between the ages of the group of 19 children who and their score on Young Children’s Communication Attitude Test was explored. The relationship of the scores of the two groups was positive (indicating an increase in negative communication attitudes with age). However, it was not significant (r = .312, ns). When the CWS were divided into the young and old age groups (as defined above) the older CWS were found to have a significantly more negative attitude to communication (see table 3.). Analysis showed that the difference between young and old groups of CWS was significant – t(17) = -3.106, sig p<.05
Table 3. Mean scores on Young Children’s Communication Attitude Test – CWS.

<table>
<thead>
<tr>
<th></th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young CWS (n=10)</td>
<td>18.22</td>
</tr>
<tr>
<td>Old CWS (n=9)</td>
<td>25.67</td>
</tr>
</tbody>
</table>

The Young Children’s Communication Attitude Test scores of the two older groups (as defined above) were compared and the older CWS were found to have more negative communication attitudes than their peers (see table 4.). However the difference was not significant – t(70) = .731, ns.

Table 4. Mean scores on Young Children’s Communication Attitude Test – older children only.

<table>
<thead>
<tr>
<th></th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old CWS (n=9)</td>
<td>25.67</td>
</tr>
<tr>
<td>Old children who do not stutter (n=63)</td>
<td>24.14</td>
</tr>
</tbody>
</table>

To determine if there is an interaction between age and fluency group, a two-way ANOVA was conducted. There was a significant main effect of age, F (1, 165) = 9.501, p<.01 but not of fluency, F (1, 165) = 1.271, ns. There was also a significant interaction between age and fluency F (1,165) = 4.887, p<.05. This interaction shows that negative communication attitudes increases more with age in CWS than with their fluent peers (Figure 1).
Exploratory Factor Analysis. Principal components analysis using data from all of the control children (n = 148) with orthogonal (varimax) rotation revealed 7 factors with eigenvalues greater than 1.0. These factors accounted for 55% of the variance. None of the factors allowed any meaningful interpretation in respect of the four categories that the Young Children’s Communication Attitude Test was attempting to measure (affective, cognitive and the two behavioral components). Subjective interpretation of the factors indicated that items loading onto the first two factors (which together accounted for over 25% of the total variance) were items worded in a positive manner. For example, item 5 (I find it easy to answer a question in class) and item 11 (I enjoy talking with a small group of friends). Further exploratory factor analysis was then carried out on seven of the most positive items in the Young Children’s Communication Attitude Test (items 1, 3, 5, 11, 13, 17 and 20). This revealed 2 factors that together accounted for 45% of the total variance. Five of the items (1, 5, 11, 13 and 17) loaded onto the first factor.

Discussion
This study primarily aimed to determine the reliability and validity of the Young Children’s Communication Attitude Test as an instrument for measuring the communication attitudes of children 7 years of age and younger. This involved testing 19 CWS and 148 children who do not stutter on the Young Children’s Communication Attitude Test. This section will discuss the effectiveness and reliability of the test as a measure of young children’s communication attitudes. The practical, clinical and research implications of the Young Children’s Communication Attitude Test will be summarized.
The results indicate that the Young Children’s Communication Attitude Test failed to demonstrate internal and external reliability, thereby proving unsuitable for repeated administration. This would effectively preclude the use of the Young Children’s Communication Attitude Test as a measure of change in communication attitude when, for example, assessing the efficacy of therapy. The Young Children’s Communication Attitude Test also failed to display concurrent and content validity. Although the lack of reliability and validity of the Young Children’s Communication Attitude Test deemed it inappropriate as a measure of young children’s communication attitudes in its present form, a new instrument designed to measure attitudes will invariably require several amendments before it becomes the finished article (Oppenheim, 1992). The computer presentation format of the Young Children’s Communication Attitude Test was well received by the children involved in the study. They attended well throughout the assessment were happy to interact and to respond to the computer prompts. It would seem, then amendments are needed to the statements that were presented to the children. Following these amendments, further rounds of validation will be required to develop a satisfactory communication attitude assessment instrument for young children.

The Young Children’s Communication Attitude Test failed to demonstrate concurrent validity when the scores on the instrument were compared to the number of blocks passed on a computerised version of TROG (Bishop, 1989). The reason for this lack of validity may not involve Young Children’s Communication Attitude Test, but TROG that was designed for school age children (4 years to 11 years). A number of children in this study were pre-school and therefore younger than the minimum age for which the test was designed. To investigate the construct validity of the Young Children’s Communication Attitude Test further, scores could be correlated with the scores from the grammatical understanding sections of another test. For example, the Clinical Evaluation of Linguistic Functions (CELF) (Semel and Wiig, 1987) could be used for school aged children, and the preschool version of CELF for children under 6 years of age (Wiig, Secord and Semel, 1992).
Another possible explanation for the lack of concurrent validity could be related to Oppenheim's (1992) proposal that good theoretical grounds are required for making predictions when investigating construct validity. There may be weak underpinning between children’s grammatical understanding and communication attitude. Grammatical understanding involves the comprehension of an area of language that, unless very severely impaired, might not interfere with young children’s ability to understand at a functional level. Young children are more likely to be aware of their expressive abilities, therefore construct validity of the Young Children’s Communication Attitude Test could be better demonstrated by predicting communication attitude will be related to how much, and how well children express themselves verbally. This could be investigated by comparing the scores on the Young Children’s Communication Attitude Test and the Action Picture Test (Renfrew, 1991).

Content validity, as demonstrated by exploratory factor analysis, indicated that the instrument was not measuring a single, underlying factor. The four areas of communication attitude that were incorporated into the Young Children’s Communication Attitude Test were also not represented by any of the factors. However, subjective analysis of the factors indicated that the positive statements loaded onto the same factors. It was also apparent that the positive statements were also grammatically more simple than other statements. This would indicate that future versions of the Young Children’s Communication Attitude Test should incorporate positive, simple statements to ensure accurate responses from young children.

The Young Children’s Communication Attitude Test demonstrated partial construct validity in that it showed older CWS scored significantly higher than the younger CWS. This supports the findings of Vanrykenghem et al (2001) that indicates negative attitude to communication increases as CWS become older. However, contrary to previous research the Young Children’s Communication Attitude Test failed to find a difference in communication attitudes between CWS and their fluent peers (De Nil and Brutten, 1991; Vanryckeghem and Brutten, 1996). The therapeutic status of the CWS should be considered when interpreting these results. Young CWS showed a more
positive attitude toward communication than their peers. This may be because 50% of the children were pre-therapy and had no yet become aware of their dysfluency. The remaining 50% were receiving Lidcombe Therapy. The majority of the older group of CWS were post therapy.

Children generally liked the test (many asked if they could do it again), and overall the computer format was user-friendly for young children. It was short, interactive and “fun” to do. However, qualitative feedback from parents and teachers indicated that some of the items are unsuitable for the age group under review. In some instances, it became obvious that the cognitive skills of the children had been overestimated which, as Lewis et al (2000) highlights, is often the reason for inaccurate responses. This happened with the negative statements, “don’t” (statements 19,7,12, 10), “wouldn’t” (statement 9) “never” (statement 15) and “nobody (statement 18). Despite agreeing with the statement, it became apparent that many children focused on the negative aspect, and pressed one of the sideways-shaking heads. Qualitative feedback from parents and teachers also indicated that, despite efforts, some of the vocabulary was too complex for the younger children. Researchers also noticed that many children queried the meaning of “prefer” (statement 2) and “correct” (statement 4). There was also ambiguity with the meaning of “The other children would like to talk like me” (statement 3). Here the other children’s response could be interpreted as stemming from the desire to have the speaker’s accent or their fluency status. Ambiguity may also have arisen in “I find it easy to answer in class” (statement 5), whereby children may be responding to their level of knowledge, rather than how they feel about speaking in this situation.

Although there are obvious benefits from using scaling in an instrument designed to measure communication attitude in that it gives more precise information this method may not be suitable for children under 7 years of age. It is possible that children at this age do not have the level of understanding of their own attitudes to enable them to accurately rate them on a scale. Harter (1984) suggests that we cannot expect the self-judgements of young children to be accurate. Young children often confuse the wish to
be competent with reality, they are unable to make the distinction between their ideal self-image and the real self (Stipek, 1981).

The growth in early diagnosis and therapeutic intervention with CWS emphasises the need for an instrument that will accurately assess communication attitudes in young children. This study has pioneered the use of computer technology in obtaining such an assessment. The use of computer generated prompts and response panels as a method of assessment with young children would appear to have been successful. The children eagerly responded to animated format and attended well throughout the assessment. The interactive and tactile nature of the instrument enabled children as young as 3 years old to complete the assessment without any loss of attention. The instrument did not demonstrate reliability or validity but was successful in differentiating between younger and older CWS. Most assessment instruments require extensive piloting with numerous revisions in terms of scale structure, statement content and question format. The investigation of the communication attitude of young children constituted only part of this thesis and in this respect a large-scale validation study was not possible. With suitable revisions the Young Children’s Communication Attitude Test could prove capable of accurately measuring the speech-related attitudes of young children.
**Communication Attitude Statements**

1. I feel comfortable talking with my family at home.
2. I prefer it when I do not have to talk.
3. The other children would like to talk like me.
4. I get scared if I have to talk to someone I don’t know.
5. I find it easy to answer a question in class.
6. People laugh at the way I talk.
7. I don’t like telling the dinner lady what I want for lunch.
8. I worry if I have to read out loud in the classroom.
9. I wouldn’t want to change the way I talk.
10. I don’t like having to explain why I have done something wrong.
11. I enjoy talking with a small group of friends.
12. I don’t like it when I find it hard to say a word.
13. I am good at talking.
15. I never think about the way I talk.
16. People try and help me if I am having difficulty talking.
17. I feel happy asking my teacher questions.
18. Nobody says anything about the way I talk.
19. I don’t like explaining something if I have to hurry.
20. I like going into a shop and asking for some sweets.
Dear colleague,

We are currently working on a project to identify and assess a variety of measures for the diagnosis and prognosis of child stutterers (i.e. does a child stutter, and if so, is the treatment likely to be successful?). Our preliminary investigations have identified 10 measures that may be important.

We are writing to you to ask if you would be willing to take a look at these measures and to rank them in order of importance, for both diagnosis and prognosis. If there are any others you think should be included please add them in the space at the end.

When you have finished we would be grateful if you could return your responses to me (steve@banana.psychol.ucl.ac.uk). The easiest thing would be to include the whole of this message in your reply and just fill in the blanks.

Here is a brief description of the measures:

CLIENT ATTITUDE - measures of affective, behavioural and cognitive responses to speech situations.

INTELLECTUAL AND SOCIAL SKILLS - a general picture of the child’s performance in and out of school, measures of social, cognitive and physical competence.

FAMILY HISTORY OF STUTTERING (GENETICS) - frequency score of stuttering occurrences in 1st., 2nd. and 3rd. degree relatives.

CEREBRAL DOMINANCE - an average handedness score derived from a 28 item questionnaire.

LANGUAGE DEVELOPMENT - standardised score from a picture based vocabulary test

PARENTAL ATTITUDE - measure from a 45 item attitude inventory.

GENERAL HEALTH - score from an adapted general health questionnaire.

MOTOR SKILLS - motor co-ordination index from a balance task with a selective choice reaction time task.

AUDITORY SKILLS - score from a computer generated test measuring word discrimination threshold.

SPEECH SCORES - stuttering frequency scores from computer based psychometric procedures.

Please rank the measures 1 - 10 (where 1 = most important and 10 = least important)
APPENDIX B. Chapter 1 – Survey Documents

<table>
<thead>
<tr>
<th>Measure</th>
<th>Diagnosis</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT ATTITUDE</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>INTELLECTUAL AND SOCIAL SKILLS</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>FAMILY HISTORY (GENETICS)</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>CERBRAL DOMINANCE</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>LANGUAGE DEVELOPMENT</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>PARENTAL ATTITUDE</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>GENERAL HEALTH</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>MOTOR SKILLS</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>AUDITORY SKILLS</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>SPEECH SCORES</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

If there is a measure you consider to be important, that is not listed above, please indicate in the space provided below, together with the position in rank. e.g. If the new measure is ranked between the third and fourth in the above list, rank it 3-4. If the new measure is more important than all those in the list, rank it 0-1 etc., etc.

**MEASURE:**

<table>
<thead>
<tr>
<th>RANK</th>
<th>DIAGNOSIS</th>
<th>PROGNOSIS</th>
</tr>
</thead>
</table>

Thank you in advance for taking the time to complete this survey. We will keep you updated on the progress of our research.

Yours faithfully

Steve Davis (in collaboration with Peter Howell)
<table>
<thead>
<tr>
<th>Name of School</th>
<th>LEA</th>
<th>Type of School</th>
<th>Age Range</th>
<th>Sex</th>
<th>Number on roll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashford High School</td>
<td>Surrey</td>
<td>Secondary</td>
<td>11 – 16</td>
<td>Mixed</td>
<td>600</td>
</tr>
<tr>
<td>Cherry Orchard School</td>
<td>Worcestershire</td>
<td>Primary</td>
<td>5 – 11</td>
<td>Mixed</td>
<td>640</td>
</tr>
<tr>
<td>Chiswick Community School</td>
<td>Hounslow</td>
<td>Secondary</td>
<td>11 – 19</td>
<td>Mixed</td>
<td>1240</td>
</tr>
<tr>
<td>Fawbert and Barnard School</td>
<td>Essex</td>
<td>Primary</td>
<td>4 – 11</td>
<td>Mixed</td>
<td>200</td>
</tr>
<tr>
<td>Feltonfleet School</td>
<td>Surrey</td>
<td>Independent Prep</td>
<td>3 – 13</td>
<td>Mixed</td>
<td>290</td>
</tr>
<tr>
<td>Holy Trinity School</td>
<td>Oldham</td>
<td>Primary</td>
<td>3 – 11</td>
<td>Mixed</td>
<td>200</td>
</tr>
<tr>
<td>Leiston School</td>
<td>Suffolk</td>
<td>Secondary Middle</td>
<td>9 – 13</td>
<td>Mixed</td>
<td>470</td>
</tr>
<tr>
<td>Little Parndon School</td>
<td>Essex</td>
<td>Primary</td>
<td>5 -11</td>
<td>Mixed</td>
<td>254</td>
</tr>
<tr>
<td>Manor Junior School</td>
<td>Barking</td>
<td>Junior</td>
<td>7 – 11</td>
<td>Mixed</td>
<td>467</td>
</tr>
<tr>
<td>Marlborough School</td>
<td>Hounslow</td>
<td>Primary</td>
<td>3 – 11</td>
<td>Mixed</td>
<td>630</td>
</tr>
<tr>
<td>Marshland High School</td>
<td>Norfolk</td>
<td>Secondary</td>
<td>11 – 16</td>
<td>Mixed</td>
<td>850</td>
</tr>
<tr>
<td>Merchant Taylors School</td>
<td>Hillingdon</td>
<td>Independent Secondary</td>
<td>11 – 18</td>
<td>Boys</td>
<td>776</td>
</tr>
<tr>
<td>Sacred Heart School</td>
<td>Redcar &amp; Cleveland</td>
<td>Secondary</td>
<td>11 – 16</td>
<td>Mixed</td>
<td>726</td>
</tr>
<tr>
<td>St Patricks School</td>
<td>Southampton</td>
<td>Primary</td>
<td>4 – 11</td>
<td>Mixed</td>
<td>310</td>
</tr>
<tr>
<td>The Aveland School</td>
<td>Lincolnshire</td>
<td>Secondary</td>
<td>11 – 16</td>
<td>Mixed</td>
<td>247</td>
</tr>
<tr>
<td>The Heathlands School</td>
<td>Hounslow</td>
<td>Secondary</td>
<td>11 – 18</td>
<td>Mixed</td>
<td>2335</td>
</tr>
</tbody>
</table>

**CHAPTER 3. APPENDIX C – FULL DETAILS OF THE SCHOOLS WHO PARTICIPATED IN THE SOCIODYNAMIC STUDY**
APPENDIX D (1). Information for individual children who stutter, together with composition of peer groups

**CHILD ID:** S.R.  **GENDER:** MALE  **AGE:** 12 YRS 1 MTH  **CLASS MEAN AGE:** 12 YRS 11 MTHS

**SCHOOL TYPE:** INDEPENDENT SECONDARY  **NO. ON ROLL:** 776  **NO. IN CLASS:** 20 (ALL BOYS)

The table below shows the number of peer nominations received by S.R. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th></th>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>2</td>
<td>2.40 (1.57)</td>
<td>5.00 (1.76)</td>
<td>1.55</td>
<td>2.05 (3.80)</td>
<td>1.35 (2.21)</td>
<td>1.30 (3.20)</td>
<td>1.75 (3.34)</td>
<td>1.50 (3.15)</td>
<td>3.00 (1.71)</td>
<td>5.00 (3.28)</td>
</tr>
</tbody>
</table>

**CHILD ID:** M.J.  **GENDER:** MALE  **AGE:** 13 YRS 6 MTHS  **CLASS MEAN AGE:** 13 YRS 6 MTHS

**SCHOOL TYPE:** SECONDARY  **NO. ON ROLL:** 600  **NO. IN CLASS:** 23 (14 BOYS, 9 GIRLS)

The table below shows the number of peer nominations received by M.J. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th></th>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>MJ</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>0</td>
<td>2.43 (1.83)</td>
<td>6.00 (3.47)</td>
<td>0.91</td>
<td>1.30 (2.14)</td>
<td>0.91 (1.28)</td>
<td>1.17 (2.29)</td>
<td>1.00 (2.15)</td>
<td>0.78 (1.31)</td>
<td>2.00 (2.14)</td>
<td>10.00 (3.32)</td>
</tr>
</tbody>
</table>
## APPENDIX D (2)

**CHILD ID:** D.F.  
**GENDER:** MALE  
**AGE:** 11 YRS 1 MTH  
**CLASS MEAN AGE:** 10 YRS 8 MTHS

**SCHOOL TYPE:** PRIMARY  
**NO. ON ROLL:** 254  
**NO. IN CLASS:** 25 (12 BOYS, 11 GIRLS)

The table below shows the number of peer nominations received by D.F. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
<td>DF Mean</td>
</tr>
<tr>
<td>2</td>
<td>2.40 (1.57)</td>
<td>5</td>
<td>2.35 (1.76)</td>
<td>0</td>
<td>1.55 (4.01)</td>
<td>10</td>
<td>2.05 (3.80)</td>
<td>0</td>
<td>1.35 (2.21)</td>
</tr>
<tr>
<td>14</td>
<td>1.30 (3.20)</td>
<td>0</td>
<td>1.75 (3.34)</td>
<td>0</td>
<td>1.50 (3.15)</td>
<td>3</td>
<td>1.30 (1.71)</td>
<td>5</td>
<td>1.15 (3.28)</td>
</tr>
</tbody>
</table>

**CHILD ID:** S.L.  
**GENDER:** MALE  
**AGE:** 8 YRS 6 MTHS  
**CLASS MEAN AGE:** 8 YRS 6 MTHS

**SCHOOL TYPE:** PRIMARY  
**NO. ON ROLL:** 630  
**NO. IN CLASS:** 27 (11 BOYS, 16 GIRLS)

The table below shows the number of peer nominations received by S.L. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
<td>SL Mean</td>
</tr>
<tr>
<td>0</td>
<td>2.81 (2.51)</td>
<td>1</td>
<td>2.33 (1.75)</td>
<td>0</td>
<td>1.30 (1.41)</td>
<td>0</td>
<td>2.19 (2.51)</td>
<td>0</td>
<td>2.59 (1.93)</td>
</tr>
<tr>
<td>2</td>
<td>1.26 (1.70)</td>
<td>0</td>
<td>1.59 (1.42)</td>
<td>1</td>
<td>1.85 (1.35)</td>
<td>1</td>
<td>1.07 (1.87)</td>
<td>2</td>
<td>1.11 (0.89)</td>
</tr>
</tbody>
</table>
APPENDIX D (3)

CHILD ID: K.K.  GENDER: MALE  AGE: 11 YRS 11 MTH  CLASS MEAN AGE: 11 YRS 8 MTHS
SCHOOL TYPE: SECONDARY  NO. ON ROLL: 2335  NO. IN CLASS: 23 (12 BOYS, 11 GIRLS)

The table below shows the number of peer nominations received by K.K. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>KK</td>
<td>Mean</td>
<td>KK</td>
<td>Mean</td>
<td>KK</td>
<td>Mean</td>
<td>KK</td>
<td>Mean</td>
<td>KK</td>
<td>Mean</td>
</tr>
<tr>
<td>4</td>
<td>2.96 (1.69)</td>
<td>11</td>
<td>2.91 (2.43)</td>
<td>0</td>
<td>1.13 (2.42)</td>
<td>1.22 (1.79)</td>
<td>2.30 (2.32)</td>
<td>6</td>
<td>1.65 (2.21)</td>
</tr>
</tbody>
</table>

CHILD ID: B.F.  GENDER: MALE  AGE: 12 YRS 1 MTH  CLASS MEAN AGE: 12 YRS 8 MTHS
SCHOOL TYPE: MIDDLE  NO. ON ROLL: 470  NO. IN CLASS: 25 (15 BOYS, 10 GIRLS)

The table below shows the number of peer nominations received by B.F. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF</td>
<td>Mean</td>
<td>BF</td>
<td>Mean</td>
<td>BF</td>
<td>Mean</td>
<td>BF</td>
<td>Mean</td>
<td>BF</td>
<td>Mean</td>
</tr>
<tr>
<td>3</td>
<td>2.88 (2.17)</td>
<td>0</td>
<td>2.44 (3.42)</td>
<td>0</td>
<td>1.68 (4.06)</td>
<td>2.80 (4.37)</td>
<td>2.40 (2.33)</td>
<td>5</td>
<td>1.92 (2.61)</td>
</tr>
</tbody>
</table>

183
APPENDIX D (4)

CHILD ID: I.Z.   GENDER: MALE   AGE: 13 YRS 0 MTHS   CLASS MEAN AGE: 12 YRS 9 MTHS
SCHOOL TYPE: SECONDARY   NO. ON ROLL: 1240   NO. IN CLASS: 26 (13 BOYS, 13 GIRLS)

The table below shows the number of peer nominations received by I.Z. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>IZ</td>
<td>Mean</td>
<td>IZ</td>
<td>Mean</td>
<td>IZ</td>
<td>Mean</td>
<td>IZ</td>
<td>Mean</td>
<td>IZ</td>
<td>Mean</td>
</tr>
<tr>
<td>1</td>
<td>2.53</td>
<td>3</td>
<td>2.23</td>
<td>0</td>
<td>1.65</td>
<td>6</td>
<td>3.19</td>
<td>0</td>
<td>2.58</td>
</tr>
<tr>
<td></td>
<td>(2.14)</td>
<td></td>
<td>(2.71)</td>
<td>(1.61)</td>
<td>(2.73)</td>
<td></td>
<td>(3.06)</td>
<td></td>
<td>(3.06)</td>
</tr>
</tbody>
</table>

CHILD ID: A.B.   GENDER: MALE   AGE: 12 YRS 9 MTHS   CLASS MEAN AGE: 12 YRS 8 MTHS
SCHOOL TYPE: SECONDARY   NO. ON ROLL: 850   NO. IN CLASS: 25 (13 BOYS, 13 GIRLS)

The table below shows the number of peer nominations received by A.B. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>Mean</td>
<td>AB</td>
<td>Mean</td>
<td>AB</td>
<td>Mean</td>
<td>AB</td>
<td>Mean</td>
<td>AB</td>
<td>Mean</td>
</tr>
<tr>
<td>1</td>
<td>2.08</td>
<td>4</td>
<td>1.84</td>
<td>0</td>
<td>0.80</td>
<td>2</td>
<td>1.84</td>
<td>0</td>
<td>2.08</td>
</tr>
<tr>
<td></td>
<td>(1.16)</td>
<td></td>
<td>(1.46)</td>
<td>(0.80)</td>
<td>(1.93)</td>
<td></td>
<td>(1.65)</td>
<td></td>
<td>(3.27)</td>
</tr>
</tbody>
</table>

184
The table below shows the number of peer nominations received by J.L. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>JL</td>
<td>Mean</td>
<td>JL</td>
<td>Mean</td>
<td>JL</td>
<td>Mean</td>
<td>JL</td>
<td>Mean</td>
<td>JL</td>
<td>Mean</td>
</tr>
<tr>
<td>3</td>
<td>2.84</td>
<td>2.58</td>
<td>(1.54)</td>
<td>2.00</td>
<td>3.23</td>
<td>0</td>
<td>3.31</td>
<td>3.08</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
</tr>
<tr>
<td>1</td>
<td>2.42</td>
<td>1</td>
<td>0.83</td>
<td>1.17</td>
<td>0.92</td>
<td>3</td>
<td>0.92</td>
<td>1</td>
<td>0.58</td>
</tr>
</tbody>
</table>

The table below shows the number of peer nominations received by H.A. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
<td>HA</td>
<td>Mean</td>
</tr>
<tr>
<td>1</td>
<td>2.42</td>
<td>4</td>
<td>2.67</td>
<td>1.08</td>
<td>1.17</td>
<td>0</td>
<td>0.92</td>
<td>0</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D (6)

CHILD ID: S.H          GENDER: MALE       AGE: 9 YRS 5 MTHS   CLASS MEAN AGE: 10 YRS 2 MTHS
SCHOOL TYPE: PRIMARY    NO. ON ROLL: 200   NO. IN CLASS: 30 (17 BOYS, 13 GIRLS)

The table below shows the number of peer nominations received by S.H. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH Mean</td>
<td>SH Mean</td>
<td>SH  Mean</td>
<td>SH Mean</td>
<td>SH Mean</td>
<td>SH Mean</td>
<td>SH Mean</td>
<td>SH Mean</td>
<td>SH Mean</td>
<td>SH Mean</td>
</tr>
<tr>
<td>0</td>
<td>2.70 (1.82)</td>
<td>5</td>
<td>2.03 (2.51)</td>
<td>0</td>
<td>1.13 (1.94)</td>
<td>1</td>
<td>2.23 (2.56)</td>
<td>0</td>
<td>2.43 (2.34)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.43 (2.34)</td>
<td>2</td>
<td>1.83 (2.56)</td>
<td>1</td>
<td>1.93 (2.88)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1.70</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.53</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.70</td>
<td>6.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.70</td>
<td>1.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.53</td>
<td>1.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.70</td>
<td></td>
</tr>
</tbody>
</table>

CHILD ID: C.B.          GENDER: MALE       AGE: 14 YRS 3 MTHS   CLASS MEAN AGE: 13 YRS 9 MTHS
SCHOOL TYPE: SECONDARY   NO. ON ROLL: 726   NO. IN CLASS: 26 (14 BOYS, 12 GIRLS)

The table below shows the number of peer nominations received by C.B. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB Mean</td>
<td>CB Mean</td>
<td>CB  Mean</td>
<td>CB Mean</td>
<td>CB Mean</td>
<td>CB Mean</td>
<td>CB Mean</td>
<td>CB Mean</td>
<td>CB Mean</td>
<td>CB Mean</td>
</tr>
<tr>
<td>2</td>
<td>1.27 (1.28)</td>
<td>0</td>
<td>1.12 (1.82)</td>
<td>1</td>
<td>1</td>
<td>0.92</td>
<td>1.19</td>
<td>0</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.23 (1.77)</td>
<td>2.77</td>
<td></td>
<td>3</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.15 (2.34)</td>
<td>0.92</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.83)</td>
<td></td>
<td></td>
<td>1.19</td>
<td>(1.02)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.20)</td>
<td></td>
<td></td>
<td>0.38</td>
<td>(1.02)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.02)</td>
<td></td>
<td></td>
<td>0.42</td>
<td>(1.00)</td>
</tr>
</tbody>
</table>
The table below shows the number of peer nominations received by A.P. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
<td>AP Mean</td>
</tr>
<tr>
<td>3</td>
<td>2.71 (1.46)</td>
<td>0</td>
<td>1.13 (2.28)</td>
<td>1.94 (2.05)</td>
<td>2.25 (2.22)</td>
<td>4</td>
<td>1.72 (3.13)</td>
<td>1.88 (1.77)</td>
<td>1.53 (4.13)</td>
</tr>
</tbody>
</table>

The table below shows the number of peer nominations received by J.B. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
<td>JB Mean</td>
</tr>
<tr>
<td>1</td>
<td>1.66 (1.99)</td>
<td>0</td>
<td>1.59 (2.08)</td>
<td>0.72 (1.31)</td>
<td>0.93 (1.41)</td>
<td>0</td>
<td>1.03 (1.35)</td>
<td>1.03 (3.02)</td>
<td>1.03 (1.67)</td>
</tr>
</tbody>
</table>
CHILD ID: D.B.  
**GENDER:** MALE  
**AGE:** 11 YRS 5 MTHS  
**CLASS MEAN AGE:** 10 YRS 8 MTHS  
**SCHOOL TYPE:** JUNIOR  
**NO. ON ROLL:** 467  
**NO. IN CLASS:** 29 (14 BOYS, 15 GIRLS)

The table below shows the number of peer nominations received by D.B for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DB</strong></td>
<td><strong>Mean</strong></td>
<td><strong>DB</strong></td>
<td><strong>Mean</strong></td>
<td><strong>DB</strong></td>
<td><strong>Mean</strong></td>
<td><strong>DB</strong></td>
<td><strong>Mean</strong></td>
<td><strong>DB</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>1</td>
<td>2.79 (2.05)</td>
<td>4</td>
<td>2.69 (2.86)</td>
<td>5</td>
<td>0.66 (1.45)</td>
<td>0</td>
<td>0.97 (1.92)</td>
<td>1</td>
<td>0.97 (1.12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>1.24 (2.38)</td>
<td>2</td>
<td>2.79 (4.82)</td>
<td>0</td>
<td>0.80 (1.40)</td>
<td>0</td>
<td>1.03 (3.61)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>0.97 (1.92)</td>
<td>0</td>
<td>0.97 (1.12)</td>
<td>0</td>
<td>1.28 (3.77)</td>
<td>0</td>
<td>0.97 (2.13)</td>
</tr>
</tbody>
</table>

CHILD ID: R.R.  
**GENDER:** MALE  
**AGE:** 11 YRS 1 MTH  
**CLASS MEAN AGE:** 10 YRS 11 MTHS  
**SCHOOL TYPE:** PRIMARY  
**NO. ON ROLL:** 310  
**NO. IN CLASS:** 30 (16 BOYS, 14 GIRLS)

The table below shows the number of peer nominations received by R.R. for social and behavioural categories (shaded columns) in comparison to the class mean for those nominations (unshaded column).

<table>
<thead>
<tr>
<th>Liked most</th>
<th>Liked least</th>
<th>Shy</th>
<th>Assertive</th>
<th>Cooperative</th>
<th>Disruptive</th>
<th>Leader</th>
<th>Seeks help</th>
<th>Bully</th>
<th>Bully victim</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RR</strong></td>
<td><strong>Mean</strong></td>
<td><strong>RR</strong></td>
<td><strong>Mean</strong></td>
<td><strong>RR</strong></td>
<td><strong>Mean</strong></td>
<td><strong>RR</strong></td>
<td><strong>Mean</strong></td>
<td><strong>RR</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>1</td>
<td>2.57 (1.92)</td>
<td>3</td>
<td>2.60 (4.82)</td>
<td>0</td>
<td>0.80 (1.40)</td>
<td>0</td>
<td>1.03 (3.61)</td>
<td>0</td>
<td>0.87 (1.63)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>0.83 (1.15)</td>
<td>1</td>
<td>1.07 (1.70)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To Parents / Guardians of students in Year 9.

Dear Parents,

Researchers at University College, London have asked me if they can do a little work at The Aveland School. I would like to give them our support as far as possible. The research involves 2 people visiting us on a couple of occasions later this week. They will join my History lessons and during the visits they will talk to the group as a whole and also have short conversations with the students individually. The research is to do with the relationships of young people with each other.

All conversations are treated confidentially and no one will be under any pressure. The visitors are trained researchers from the University. Additional I, myself, will be present all the time.

If you have any questions then please contact me at school and I will be pleased to discuss them with you.

Thank you for your cooperation in this matter.

Yours sincerely,

K L Balich
Headteacher.
CHAPTER 3 - APPENDIX F
Description of Behavioural Categories (Adapted from Coie, Dodge and Coppotelli, 1982)

**Shy** – very quiet with other children and adults, often likes to play or work by themselves, it is very hard to get to know a child like this.

**Assertive** – will always get their ideas across. Likes to be in charge and tries to get people to do things their way.

**Co-operative** – a child like this is good to have in your group (class) because he or she is pleasant and helpful, joins in, shares and gives everyone a turn.

**Disruptive** – this child upsets people in the group (class), interrupts when people are talking, does not share with others.

**Leader** – is chosen by other people to be in charge, is helpful and responsible with other children.

**Uncertain** – lacks confidence in their own ability, asks for help even before they have tried very hard.

**Bully** – someone who picks on other children, teases them or says or does nasty things to them for no reason.

**Bully victim** – someone who is picked on, teased or has nasty things said or done to them for no reason.
SOCIAL BEHAVIOUR AT SCHOOL
(EXAMPLE AGED 5 TO 10 YEARS)

Please read carefully through the following list of important interpersonal skills. Then observe the individual closely in a variety of situations until you feel you can answer these questions adequately and reliably. Please circle the appropriate answer depending on whether you view each item as a problem for that person.

1. Is the child bullied frequently? No Yes
2. Is the child teased frequently? No Yes
3. Is the child easily influenced by other children to misbehave? No Yes
4. Does the child have difficulty resisting group pressure? No Yes
5. Does the child avoid contact with peers? No Yes
6. Does the child have difficulty keeping out of fights? No Yes
7. Does the child have difficulty accepting criticism appropriately? No Yes
8. Does the child become embarrassed easily? No Yes
9. Does the child have difficulty standing up for him/herself with other children? No Yes
10. Does the child find it hard to or fail to talk to other children? No Yes
11. Are the child’s verbal responses very brief and/or infrequent? No Yes
12. Does the child find it hard to or fail to initiate conversations with peers? No Yes
13. Does the child find it hard to or fail to initiate conversations with adults? No Yes
14. Does the child find it hard to or fail to approach adults with requests? No Yes
15. Does the child become angry when teased? No Yes
16. Does the child become angry when bullied? No Yes
17. Does the child find it difficult or fail to express his/her feelings? No Yes
18. Does the child find it hard to or fail to apologize when he/she does something wrong? No Yes
19. Does the child find it hard to or fail to ask others for help? No Yes
20. Does the child find it hard to or fail to ask others if he/she can join in a game? No Yes
### APPENDIX G

|   |   | If Yes, In what way?
|---|---|----------------------
| 21. Does the child avoid making eye contact or look away during conversation with others? | No | Yes |
| 22. Does the child find it hard to or fail to ask questions in class? | No | Yes |
| 23. Does the child interrupt inappropriately? | No | Yes |
| 24. Does the child talk excessively or at inappropriate times? | No | Yes |
| 25. Does the child stare excessively during conversation? | No | Yes |
| 26. Does the child fidget and fiddle excessively? | No | Yes |
| 27. Does the child slouch badly or use poor posture? | No | Yes |
| 28. Is the child verbally aggressive during conversation with peers? | No | Yes |
| 29. Is the child verbally aggressive during conversation with adults? | No | Yes |
| 30. Does the child fail to say thank you upon receiving things? | No | Yes |
| 31. Does the child fail to give cues of listening when you talk to him e.g. no head movements or verbal feedback? | No | Yes |
| 32. Does the child tease other children inappropriately? | No | Yes |
| 33. Is the child’s facial expression generally inappropriate to the situation e.g. laughs, smiles, frowns etc., when inappropriate? | No | Yes |
| 34. Does the child find it hard to introduce him/herself to others? | No | Yes |
| 35. Does the child fail to or find it hard to tell an adult when something is wrong? | No | Yes |
| 36. Does the child find it hard to talk to strangers? | No | Yes |
| 37. Is the child unpopular? | No | Yes |
| 38. Does the child fail to make friends with peers? | No | Yes |
| 39. Does the child find it hard to or fail to take orders and obey instructions from adults? | No | Yes |
| 40. Is the child often cheeky to adults? | No | Yes |
| 41. Does the child talk too loudly? | No | Yes |
| 42. Does the child talk too quietly? | No | Yes |
APPENDIX H. Chapter 4 Individual scores on all Dow and Moruzzi battery tasks.

<table>
<thead>
<tr>
<th>ID</th>
<th>Group</th>
<th>Age (yrs)</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>btbs</td>
</tr>
<tr>
<td>11</td>
<td>CWS</td>
<td>15</td>
<td>3.025</td>
</tr>
<tr>
<td>14</td>
<td>CWS</td>
<td>17</td>
<td>1.979</td>
</tr>
<tr>
<td>17</td>
<td>CWS</td>
<td>15</td>
<td>.249</td>
</tr>
<tr>
<td>22</td>
<td>CWS</td>
<td>18</td>
<td>1.456</td>
</tr>
<tr>
<td>25</td>
<td>CWS</td>
<td>17</td>
<td>.339</td>
</tr>
<tr>
<td>28</td>
<td>CWS</td>
<td>18</td>
<td>1.094</td>
</tr>
<tr>
<td>30</td>
<td>CWS</td>
<td>17</td>
<td>1.037</td>
</tr>
<tr>
<td>31</td>
<td>CWS</td>
<td>15</td>
<td>2.101</td>
</tr>
<tr>
<td>32</td>
<td>CWS</td>
<td>13</td>
<td>1.876</td>
</tr>
<tr>
<td>44</td>
<td>CWS</td>
<td>14</td>
<td>2.640</td>
</tr>
<tr>
<td>50</td>
<td>CWS</td>
<td>13</td>
<td>8.885</td>
</tr>
<tr>
<td>51</td>
<td>CWS</td>
<td>13</td>
<td>1.486</td>
</tr>
<tr>
<td>52</td>
<td>CWS</td>
<td>16</td>
<td>2.021</td>
</tr>
<tr>
<td>61</td>
<td>CWS</td>
<td>15</td>
<td>.265</td>
</tr>
<tr>
<td>65</td>
<td>CWS</td>
<td>16</td>
<td>6.399</td>
</tr>
<tr>
<td>70</td>
<td>CWS</td>
<td>13</td>
<td>5.482</td>
</tr>
<tr>
<td>71</td>
<td>CWS</td>
<td>14</td>
<td>27.097</td>
</tr>
<tr>
<td>73</td>
<td>CWS</td>
<td>13</td>
<td>1.332</td>
</tr>
<tr>
<td>75</td>
<td>CWS</td>
<td>13</td>
<td>3.449</td>
</tr>
<tr>
<td>78</td>
<td>CWS</td>
<td>16</td>
<td>.558</td>
</tr>
<tr>
<td>84</td>
<td>CWS</td>
<td>13</td>
<td>3.519</td>
</tr>
<tr>
<td>88</td>
<td>CWS</td>
<td>9</td>
<td>.</td>
</tr>
<tr>
<td>97</td>
<td>CWS</td>
<td>15</td>
<td>.634</td>
</tr>
<tr>
<td>98</td>
<td>CWS</td>
<td>10</td>
<td>1.990</td>
</tr>
<tr>
<td>99</td>
<td>CWS</td>
<td>14</td>
<td>.889</td>
</tr>
<tr>
<td>100</td>
<td>CWS</td>
<td>13</td>
<td>2.826</td>
</tr>
<tr>
<td>ID</td>
<td>Group</td>
<td>Age (yrs)</td>
<td>bbs</td>
</tr>
<tr>
<td>-----</td>
<td>-------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>101</td>
<td>CWS</td>
<td>13</td>
<td>1.245</td>
</tr>
<tr>
<td>103</td>
<td>CWS</td>
<td>14</td>
<td>.678</td>
</tr>
<tr>
<td>104</td>
<td>CWS</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>CWS</td>
<td>10</td>
<td>7.374</td>
</tr>
<tr>
<td>113</td>
<td>CWS</td>
<td>14</td>
<td>1.660</td>
</tr>
<tr>
<td>114</td>
<td>CWS</td>
<td>12</td>
<td>1.933</td>
</tr>
<tr>
<td>115</td>
<td>CWS</td>
<td>11</td>
<td>6.565</td>
</tr>
<tr>
<td>116</td>
<td>CWS</td>
<td>12</td>
<td>2.868</td>
</tr>
<tr>
<td>119</td>
<td>CWS</td>
<td>12</td>
<td>10.974</td>
</tr>
<tr>
<td>123</td>
<td>CWS</td>
<td>11</td>
<td>2.589</td>
</tr>
<tr>
<td>125</td>
<td>CWS</td>
<td>13</td>
<td>11.654</td>
</tr>
<tr>
<td>127</td>
<td>CWS</td>
<td>10</td>
<td>6.882</td>
</tr>
<tr>
<td>161</td>
<td>Control</td>
<td>9</td>
<td>1.545</td>
</tr>
<tr>
<td>179</td>
<td>Control</td>
<td>11</td>
<td>.349</td>
</tr>
<tr>
<td>509</td>
<td>Control</td>
<td>11</td>
<td>6.155</td>
</tr>
<tr>
<td>512</td>
<td>Control</td>
<td>17</td>
<td>.257</td>
</tr>
<tr>
<td>513</td>
<td>Control</td>
<td>17</td>
<td>.609</td>
</tr>
<tr>
<td>662</td>
<td>Control</td>
<td>18</td>
<td>2.044</td>
</tr>
<tr>
<td>663</td>
<td>Control</td>
<td>11</td>
<td>5.530</td>
</tr>
<tr>
<td>667</td>
<td>Control</td>
<td>10</td>
<td>1.275</td>
</tr>
<tr>
<td>687</td>
<td>Control</td>
<td>17</td>
<td>3.326</td>
</tr>
<tr>
<td>688</td>
<td>Control</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>689</td>
<td>Control</td>
<td>18</td>
<td>.</td>
</tr>
<tr>
<td>690</td>
<td>Control</td>
<td>18</td>
<td>1.167</td>
</tr>
<tr>
<td>691</td>
<td>Control</td>
<td>19</td>
<td>1.375</td>
</tr>
<tr>
<td>692</td>
<td>Control</td>
<td>18</td>
<td>.528</td>
</tr>
<tr>
<td>693</td>
<td>Control</td>
<td>19</td>
<td>.958</td>
</tr>
<tr>
<td>694</td>
<td>Control</td>
<td>19</td>
<td>.636</td>
</tr>
<tr>
<td>ID</td>
<td>Group</td>
<td>Age (yrs)</td>
<td>btbos</td>
</tr>
<tr>
<td>-----</td>
<td>-------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>695</td>
<td>Control</td>
<td>12</td>
<td>.714</td>
</tr>
<tr>
<td>712</td>
<td>Control</td>
<td>14</td>
<td>2.850</td>
</tr>
<tr>
<td>713</td>
<td>Control</td>
<td>14</td>
<td>.303</td>
</tr>
<tr>
<td>729</td>
<td>Control</td>
<td>12</td>
<td>.642</td>
</tr>
<tr>
<td>730</td>
<td>Control</td>
<td>13</td>
<td>.771</td>
</tr>
<tr>
<td>731</td>
<td>Control</td>
<td>14</td>
<td>.887</td>
</tr>
<tr>
<td>732</td>
<td>Control</td>
<td>14</td>
<td>2.187</td>
</tr>
<tr>
<td>733</td>
<td>Control</td>
<td>14</td>
<td>.481</td>
</tr>
<tr>
<td>734</td>
<td>Control</td>
<td>15</td>
<td>.936</td>
</tr>
<tr>
<td>735</td>
<td>Control</td>
<td>15</td>
<td>1.503</td>
</tr>
<tr>
<td>736</td>
<td>Control</td>
<td>15</td>
<td>1.262</td>
</tr>
<tr>
<td>737</td>
<td>Control</td>
<td>11</td>
<td>1.011</td>
</tr>
<tr>
<td>745</td>
<td>Control</td>
<td>13</td>
<td>.736</td>
</tr>
<tr>
<td>746</td>
<td>Control</td>
<td>10</td>
<td>4.531</td>
</tr>
<tr>
<td>747</td>
<td>Control</td>
<td>14</td>
<td>.881</td>
</tr>
<tr>
<td>748</td>
<td>Control</td>
<td>13</td>
<td>1.533</td>
</tr>
<tr>
<td>749</td>
<td>Control</td>
<td>9</td>
<td>.653</td>
</tr>
<tr>
<td>750</td>
<td>Control</td>
<td>17</td>
<td>1.224</td>
</tr>
</tbody>
</table>
References


Bishop, D,V,M. (1989) The Test for Reception of Grammar. Published by the author: Manchester


Travis, L.E. (1957). *Handbook of speech pathology.* East Norwalk,CT: Appleton Century Croft


212
van Lieshout, P. H. H. M. (2001). Recent developments in studies of speech motor
control in stuttering. In B. Massen, W. Hulstijn, R. Kent, H.F.M. Peters, P.H.H.M. van
Nijmegen, Netherlands: Uitgeverij Vantilt

Children and Adults, Inc.


test-retest reliability investigation. *Journal of Fluency Disorders*, 17, 177-190.

communication attitude and fluency failure of stuttering and nonstuttering children.
*Journal of Fluency Disorders*, 21, 109-118.

relationship between communication attitude and emotion of children who stutter.

Warnock Report, Department of Education and Science (1978) *Special

Watson, J. B. (1987) Profiles of stutterers’ and nonstutterers’ affective, cognitive

Webster, W. G. (1993). *Hurried hands and tangled tongues. Implications of
current research for the management of stuttering*. In E. Boberg (Ed.), Neuropsychology
of Stuttering, (pp73-127). Edmonton, Alberta, Canada: The University of Alberta Press.


