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CENTRAL AUDITORY PROCESSING DISORDERS IN MINORITY CHILDREN

YVETTE HUS

A Thesis

in

A Special

Individualized

Program

Presented in Partial Fulfillment of the Requirements

for the Degree of Doctor of Philosophy at

Concordia University

Montreal, Quebec, Canada

August 1997

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This dissertation is dedicated to the memory of the extraordinary humanitarian and educator Janusz Korczak, and to all the children who tragically perished at the hands of tyrants during the holocaust, and since.

ABSTRACT

Central Auditory Processing Disorders in Minority Children

YVETTE HUS PhD

CONCORDIA UNIVERSITY

1997

Central auditory processing disorders (CAPD) constitute a neuroauditory syndrome which affects the lives of adults and children in profound ways. CAPD is often diagnosed in children who experience educational distress despite intact hearing and cognitive ability. The benefit of early diagnosis of CAPD is in the potential for implementation of an intervention program designed to ameliorate and minimize the negative effects of this syndrome.

Diagnostic and therapeutic instruments are almost exclusively constructed for children for whom English is a first language (L1). Consequently, children for whom English is a second language (L2) who are experiencing educational distress are excluded from the benefits of diagnosis and intervention for CAPD since their difficulties are usually blamed on their L2 status.

This study was designed to investigate the usefulness of the CAPD construct in the assessment of L2 children's educational distress, to explore the ability of current diagnostic instruments to distinguish those with CAPD in both L2 and L1 children, and to determine the effect CAPD has on those who are clinically diagnosed.

The study included 116 children, aged 8;0-11;11, with normal cognitive ability and peripheral hearing. Two groups were formed on the basis of identification of their mother's mother tongue, and its use in the home. The two groups differed significantly on oral language tests. The children were investigated for CAPD and in terms of educational distress variables.

Multiple regression analyses showed that CAPD or low central auditory system efficiency (CASE) was significantly correlated with low performance on oral language measures and academic distress in the L2 group. In the L1 group low CASE was significantly correlated with a psychosocial/ behavioural variable and with low oral language test performance. Cluster and discriminant analyses identified educational performance clusters in both language groups. Low CASE was associated with clusters of children manifesting learning problems in the L2 group, but not in the L1 group. A multiple embedded case study profiled children with severe CAPD and demonstrated that while CAPD had a negative impact on the academic lives of individual children in both language groups, the problems of the L2 children were often more severe.

Résumé

Les troubles d'intégration auditive (TIA) constituent un syndrome neuro-auditif qui touche la vie d'un adulte ou d'un enfant de manière profonde. Le diagnostic de TIA est souvent posé chez des enfants qui démontrent des difficultés scolaires en dépit d'une acuité auditive normale et de capacités cognitives normales. L'identification rapide d'un TIA permet l'implantation d'un programme d'intervention visant à remédier et à minimiser les effets négatifs de ce syndrome. Les outils d'évaluation et d'intervention en anglais existent à peu près exclusivement pour les enfants ayant cette langue pour langue maternelle (L1). Par conséquent, les enfants en difficulté scolaire qui ont l'anglais comme langue seconde (L2) sont privés d'une identification et intervention immédiates en ce qui concerne les TIA, puisqu'on attribue le plus souvent leur difficulté au fait d'être confronté à une deuxième langue. La présente étude visait les buts suivants: évaluer l'utilité du concept de TIA lors d'une évaluation de difficulté scolaire chez les enfants ayant l'anglais comme L2, sonder la capacité des instruments d'évaluation courramment utilisés à reconnaître les cas de TIA parmi les enfants ayant l'anglais comme L1 et comme L2, et identifier les effets du TIA chez ceux qui en reçoivent le diagnostic clinique.

L'étude portait sur 116 enfants âgés de 8;0 à 11;11 ayant tous des capacités cognitives normales et une acuité auditive normale. Deux groupes ont été constitués en fonction de la langue maternelle de la mère et de l'usage de cette langue à domicile. Les deux groupes avaient une performance significativement différente aux tests de langage oral. Les enfants ont été évalués pour la présence de TIA et selon des indices de difficulté scolaire. Des analyses à régression multiple ont démontré chez les enfants à L2 une corrélation significative entre le TIA ou une faible efficacité du système auditif central et la faiblesse langagière et la difficulté scolaire. Chez les enfants à L1, la faiblesse du système auditif démontrait une corrélation significative avec une variable behavioro-psychosociale et avec le niveau de langage oral. Des analyses en grappes et des analyses discriminantes ont mis en évidence des grappes par performance scolaire chez les deux groupes de enfants. La faiblesse du système auditif était associée aux grappes démontrant des difficultés d'apprentissage parmi les enfants à L2 mais pas parmi les enfants à L1. Une étude à cas multiples portant sur des enfants avec TIA sévère a mis en relief l'impact négatif du TIA sur la vie académique d'individus membres des deux groupes; cependant, les problèmes vécus par des enfants à L2 étaient souvent plus sévères.

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---

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PROLOGUE

Tony, a ten year old boy attending grade five in an English school was referred to the school speech and language pathologist by his teacher. An informal teacher interview indicated that he was referred primarily at his mother's request. Further questioning showed that Tony's educational achievement was low. "What do you expect?" said his teacher, "he is not very smart; you will see for yourself".

A preliminary interview with Tony confirmed that he was experiencing difficulty in school, and specifically that he did not understand what he read. Tony's mother was interviewed as well. Routine questioning regarding speech, language, and learning development revealed that she had taken him to a hospital speech and language clinic when he was younger because she felt there was a problem. She was told, "He has problems because he is trilingual: we speak Italian, French, and English at home". The advice she was given was to use only English with Tony because that was his school language. However, Tony's mother, who shared this trilingual history, spoke impeccable English and reported no academic distress throughout her own school years.

During twenty years of practice in speech and language pathology in an educational setting in which the majority of

the student population, and indeed the teacher population, is composed of minority language (L2) speakers, the above scenario (with some variations) has been repeated many times. Often, when a language deficit is diagnosed by a speech-language pathologist, the teacher exclaims: "...But he is Italian! What do you expect?" Poor language skills and low academic achievement seem acceptable, almost 'natural', in referring to L2 students. Parents often report that their concerns about their children's communication skills and learning problems were explained away by pediatricians, speech-language pathologists, psychologists, and teachers, as the 'inevitable' result of multilingual exposure, and that they were advised to discontinue using their home language with the affected child, and focus on the school language only.

The present study is born out of a concern that L2 children's failure to thrive academically is mainly seen as resulting from their minority language status, or from limited cognitive ability. While these explanations may account for difficulties experienced by some children, they cannot underlie *all* minority children's problems. As in majority language (L1) children, other causes may be operating, and therefore require investigation. In this study, L2 and L1 children from the same school system were assessed using audiology and speech-language pathology protocols and instruments. These were used to investigate

areas that, in previous research, have been found to underlie academic underachievement in L1 children.

CHAPTER 1

SETTING THE STAGE

1.1 Introduction

Teachers', administrators', and professionals' attempts to explain L2 students' low academic achievement often reflect three major views: (1) bilingualism is responsible for weakness in an individual's cognitive ability, (2) having to use a second language in acquiring knowledge hampers academic achievement, and (3) minority group status results in social and cultural deprivation. Although these views may appear unrelated, they have a common base in that they stem from the dominant language group's mainly negative view of minority language and minority group membership.

The underlying assumption in the first view is that bilingualism probably results in an inherent limited learning capacity. The second view suggests that somehow, education via a second language leaves children confused and predisposes them to academic failure. In many contexts, a minority language has been associated with economic disadvantages. This leads to the third view, and academic expectations for a minority language child that are often lower than for a dominant language student.

Theory and research in the last decade show that the development of basic skills which underlie reading ability begins quite early (Schuele & van Kleeck, 1987). Reading

ability is now accepted as having a language base, rather than mainly a visual-perceptual base. Smith (1978, 1983) believes that non-visual information is the basis for bringing meaning to print. This information consists of the following: knowledge of language, knowledge of subject matter, and knowledge of how to read. This non-visual information allows for prediction, an important ability in the decoding process. Prediction allows for fluent and meaningful reading. It follows, therefore, that the less non-visual information is available, the more reliance on visual information is required and the harder it is to read. Others have shown that reading is an interactive process whereby both basic cognitive mechanisms and higher order cognitive processes interact and influence each other to produce fluent and effective reading in both monolingual and bilingual readers (Segalowitz, 1986, Segalowitz & Hébert, 1990).

Oral language skills form the foundation for transference to written language: "Language is more than a powerful tool for communication...it is an essential tool for reasoning and ...learning" (Lyngass, Nyberg, Hoekenga, & Gruenewald, 1983, p. 242). Therefore deficits in language may lead to difficulties in learning (Magnusson & Naucler, 1987). For example, speech production or speech perception problems may lead to difficulties in word-decoding; word finding difficulties may lead to problems with comprehension

of decoded words; syntactic problems can lead to difficulties in comprehension of written sentences; oral discourse comprehension problems may lead to difficulty in understanding written stories or long passages (Menyuk & Flood, 1987). It is therefore recognized that achievement in reading demands the application of one's language knowledge (Butler, 1987; Cornett & Chabou, 1986; Keith, 1985; Sawyer & Lipa, 1981; Schuele & van Kleeck, 1987).

Language knowledge in the preliterate, according to Schuele and van Kleeck (1987), comprises: oral language comprehension, oral language expression, and metalinguistic ability. They define the latter as 'ability to focus on language as an object of thought', and believe this ability to be the precursor to reading. They specify the following metalinguistic skills in normal language development: 1. word consciousness: the ability to separate the word from its meaning, 2. grammatical awareness: the idea that single units make up language and that the combinations of these units are rule governed, and 3. phonological awareness: the ability to segment spoken words into phonological units and synthesize these into a meaningful word.

Studies of language disordered children show that language deficits profoundly influence the child's educational achievement (Aram & Nation, 1980; Magnusson & Naucler, 1987; Sawyer & Lipa, 1981; Wiig & Semel, 1980; Wolf-Nelson, 1981). Children who exhibit oral language

difficulties as preschoolers later show academic difficulties. Bashir, Kuban, Kleinman, and Scavuzzo (1983), identified the following behaviors in language impaired preschoolers: They exhibited comprehension and production problems of syntax and morphology, limited vocabulary, and word-finding problems; they had difficulty organizing language to tell or retell a story; they exhibited conversational skill problems; and they showed phonological disorders often accompanied by 'verbal apraxia' (difficulty with voluntary sequencing of oral movements).

The learning disabled exhibit specific types of language problems: deficits in word knowledge, deficits in word and sentence formation, deficits in word-finding, and deficits in interpreting complex relationships expressed in language (Wiig & Semel, 1980). Many learning or reading disabled also exhibit deficits in higher level language forms such as narrative discourse and figurative language (Kamhi & Catts, 1986). Also, research has shown that they recall less information from stories than their achieving peers, and that their ability in story comprehension and spontaneous story production is inferior as well (Roth & Spekman, 1986).

The above research suggests that language and academic learning are interdependent. This relationship was recognized in 1981 by the American National Joint Committee on Learning Disabilities in a definition of learning

disabilities. The American Speech-language and Hearing Association (ASHA, 1990) endorsed this definition fully:

> Learning Disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to Central Nervous System dysfunction.
>
> Even though a learning disability may occur concomitantly with other handicapping conditions (for example: sensory impairment, mental retardation, social and emotional disturbance) or environmental influences (for example: cultural differences, insufficient/ inappropriate instruction, psychogenic factors), it is not the direct result of those conditions or influences (p.2).

With regard to language acquisition in particular, researchers have attempted to identify and distinguish the variables operating in the process in order to understand language acquisition problems. The crucial variables identified and proposed as playing an important role in language acquisition difficulties are: problems in processing rapidly changing auditory information, symbolic representation, hypothesis-testing, and inferencing abilities (Kamhi & Catts, 1986; Merritt & Liles, 1987).

Language development includes: *content*, the semantic aspect; *function*, the pragmatic aspect; and *structure*, the morphological-syntactic aspects (Bloom & Lahey, 1978). For normal language development to occur, auditory messages must be adequately received and processed. In order for this to happen, there must be an intact sensory end organ and an

adequately functioning neurological system, that is, a healthy ear and central processing mechanism (Rampp, 1981). When either the ear or the central processor is impaired, language development may be delayed or disordered (Musiek, Gollegly, & Ross, 1985; Rampp, 1981; Sloan, 1986; Willeford & Burleigh, 1985).

The deleterious effects of a permanent hearing loss on the development of speech, language, learning (Ling, 1975, 1976), and socialization (Hus, 1979) are well documented. Research also suggests that fluctuating hearing losses due to otitis media (infections of the middle ear cavity) also affect normal development of auditory processing, language, and academic performance (Gottlieb, Zinkus, & Thompson, 1979, as cited in Zinkus, 1986). However, some children with no evidence of damage to the *ear* appear to have problems in processing what they hear. According to Willeford and Burleigh (1985) large numbers of children exhibit *central auditory processing disorders* (CAPD) and normal peripheral hearing. Approximately seventy percent of school age children with language-learning disabilities have some type of auditory (but not necessarily "hearing") impairment (Hoshko & Hus, 1987). In an apparently normal population, Pimsleur, Sundland, and McIntyre, (1966) found that twenty to thirty percent of children who underachieved in foreign language learning exhibited poor auditory abilities despite normal learning aptitudes as demonstrated

by their achievement in English, math, history, and science.

Typically, children with a CAPD appear to be poor listeners, have short attention span, are underachievers (that is, perform below the level predicted by their cognitive ability), have difficulties in following directions, have poor auditory memories, poor language skills, and exhibit learning problems. Research indicates that a CAPD can lead to difficulties in three basic areas: language development, learning development, and psycho-social development. Interaction between these areas may account for CAPD symptom clusters.

Some CAPD children may manifest an oral language deficit. For example, they exhibit delays in comprehension and production, and in the syntactic, semantic, phonological, and pragmatic aspects of oral communication. Other children manifest a learning problem in reading (encoding, decoding, and comprehension) and in writing (orthography, sentence construction, compositions, and ideation). These two subgroups, however, are not mutually exclusive, and their difference may represent two sides of the same coin rather than a difference in kind.

There are CAPD children who manifest difficulties in all areas, and the severity levels may range from serious to mild. Kamhi and Catts (1986) found that language-learning disabled children show evidence of difficulties in the following: (1) encoding phonological information in long-

term memory, (2) retrieving phonological information from long-term memory, (3) using phonological codes in working memory, (4) segmenting speech into phonemic and syllabic units, (5) processing rapid speech, and (6) understanding speech in noisy environments.

Although the precise interactions and functioning of the auditory pathways that lead to speech perception are still not completely clear, what is clear is that a CAPD is like a two-edged sword: It interferes with language-learning development, and this in turn interferes with auditory processing. This latter consequence may be explained by the same mechanism proposed by Smith (1978) in his theory of acquisition of reading fluency, namely prediction. When language skills are intact, ambiguous auditory signals may be processed by prediction: knowledge of the context, content, and of the linguistic features permit the deciphering and interpreting of the acoustic signal.

A CAPD not only interferes with first language acquisition, but often disrupts second language acquisition (Pimsleur, Sundland, & McIntyre, 1966; Willeford & Burleigh, 1985). Researchers note that many groups of minority language students have been found to experience severe academic difficulties (see e.g., McKeon, 1994). Cummins (1984) points out that significant numbers are referred for psychological and educational testing. Interestingly, CAPD testing is rare for these students, whereas it is quite

common in investigations of L1 students who are experiencing academic problems.

Researchers agree that language delayed children represent a heterogeneous group in both etiology and the pattern of the language impairment exhibited (Bashir, et al., 1983; Miller, 1983). However, minority language children's difficulties in language acquisition and subsequent learning difficulties are often explained by the very fact of their L2 status itself or by factors such as social and cultural deprivation or socio-economic status, native language interference, dialect, and so on. In research, minority language children are often treated as a homogeneous group, and indeed individual variables such as auditory processing skills are neglected.

An assumption underlying this study is that learning difficulties in the L2 child cannot always be accounted for by social variables. Nor is it the case that their problems are always due to the fact that the school language is their second language. Each child is a unique learner with unique talents and needs. The learnability of language is a given, and when access to a language is unhindered the child is expected to acquire it with relative ease (Pinker, 1994). When L1 children exhibit academic distress, an investigation that includes internal learner variables is often initiated. The children can then benefit from a thorough assessment followed by an intervention plan which will assist in

remediation. Minority language children may be excluded from such an option when mainstream professionals automatically attribute their problems to limitations of education via a second language, cognitive weakness due to bilingualism, or societal variables. This practice, in essence, constitutes a form of neglect of the minority child's needs which, in principle, should be assumed to be similar to those of the dominant language child.

1.2 Research Review

The research review in Chapter 2 is divided into three major sections. The first section contains a review of research on academic failure in minority group children. The search for causes for these children's social, cognitive, and academic failure is based on an assumption of homogeneity, and is reflected by the predominance of group studies. Grosjean's (1985) concept of the bilingual as a specific listener-speaker may better serve these children and families, and in turn the larger community. Wong-Fillmore's study (1976) of second language acquisition (SLA) in a group of children demonstrated that strategies and knowledge employed in first language acquisition (FLA) continue to be employed 'the second time around'. However, as Wong-Fillmore notes 'the path in language learning may be similar', but the style, rate, and success in the learning

process underscores the importance of individual variability.

In the second section, the complexity of the auditory nervous system and the process of speech perception are reviewed. The lack of an adequate theoretical model that can account for how a word is recognized from an acoustic wave form and the role of psycholinguistic knowledge in the recognition process is felt to have contributed to the delay in agreement on a definition of CAPD, and consequently on establishing a cause for CAPD. However, an operational definition may well serve in the identification and assessment of children. It is suggested that Feuerstein's (1979) model for information processing may be applied in further explaining individual variability in the CAPD population. Because CAPD is believed to underlie communication problems and academic distress in a relatively large population of L1 children, CAPD assessment is now almost routinely performed (Cherry, 1992; Willeford & Burleigh, 1985). Since L2 children are often excluded from this process, they cannot benefit from early identification and intervention.

In the third section, the review covers the audiological investigations for CAPD and the minority child. Although tests are meant to assess the efficiency of the auditory system by subjecting the system to stress, most tests use linguistic stimuli (digits, words, and sentences)

in this process. Consequently, results are subject to influence from linguistic factors. Because audiology tests used in the USA and Canada are mainly standardized on English L1 children, CAPD assessment of minority children is often discouraged on the grounds that the norms may be inappropriate.

The importance of CAPD assessment is in planning a remediation program for the child so that synchrony with the social environment can be restored, and school achievement improved. Feuerstein's (1980) 'mediated learning' approach, meant to remediate information processing deficits, is suggested as appropriate for CAPD children. CAPD is accepted as intrinsic to auditory system deficits and underlying any language system, therefore, it is just as likely to occur in an L2 as in an L1 child. This concept constitutes the rationale for the present study. The last section of the review expands on this rationale, and poses the research questions.

1.3 Research Design

In Chapter 3 the design of the present study is outlined. The procedures for recruiting, screening, and selecting participants are described. The instruments for data collection are presented, including speech-language protocols and audiology instruments as well as

questionnaires and school records. Statistical procedures are briefly previewed.

1.4 Results, Case studies, & Discussion

The findings from each of the assessment procedures are reported in terms of the research questions. Both descriptive and inferential statistics are presented in tables and figures. The findings confirm some group differences between L1 and L2 children and indicate some very dramatic individual differences which are further treated in Chapter 5.

Case studies

In Chapter 5 a multiple case study examines two L1 and two L2 groups of children. Performance on the audiology instruments was used for the selection of the groups. Those on the extreme ends of the audiology performance continuum were compared. Performance profiles as well as personal histories were remarkably different between the groups within each language sample as well as between language samples.

Discussion

The findings of this study are discussed in Chapter 6. L2 children form a majority in many classrooms on this continent and in industrialized countries across the ocean.

The findings in this study illustrate that for many second generation L2 children SLA is an ongoing process despite middle SES. The importance of comparing L2 children to language peers rather than L1 children is demonstrated. The point that educational distress is not a unitary phenomenon that can be explained by L2 status nor by a limited cognitive capacity is emphasized. The ability of test instruments normed on L1 groups to uncover problems in L2 children is discussed as well.

1.5 Conclusions & Epilogue

The major conclusions are summarized in Chapter 7. The relationship between central auditory system efficiency (CASE) and educational performance in both L2 and L1 children is highlighted. The point that classroom listening conditions penalize L2 children with weak CASE is emphasized. L2 children continue to be misunderstood by their educational settings and professionals in general. The epilogue emphasizes the point that the use of mother tongue in the home is *not* the cause for speech, language, and learning distress, and that the elimination of mother tongue from the child's life is *not* a desirable intervention strategy.

CHAPTER 2

THEMES AND ISSUES

2.1 Minority Language Children and School Achievement

A review of the literature on academic achievement in L2 children reveals an attitude that is best described by Frender and Lambert (1972):

> Children from lower social classes, or from minority group backgrounds typically achieve less well in school than their middle class peers...Because opportunities to share in many of the benefits and enrichments of modern society are increasingly dependent upon achievement in school, the futures of these children are comparatively unpromising (p.237).

This grim prediction was based on the above authors' extensive research review. For a variety of reasons social class and minority group status are often related to academic failure and subsequent economic underachievement, a reality which has not substantially changed in the nearly 25 years since the Frender and Lambert review (Bourne, 1989; Cummins, 1994; Martin-Jones, 1989; McKeon, 1994). However, a review of the literature on childhood bilingualism reveals the existence of attitudinal biases in some research methodology and consequently in research findings and recommendations arising from these, even when under the guise of benevolent concern for the children whose future is uncertain.

Minority language children is a term that can refer to (1) native born children from minority groups whose parents'

native language is not the mother tongue of the majority group (Handscombe, 1989; Mclaughlin, 1985), or (2) immigrant children who learn the dominant language as a second language (Cummins, 1984). Although at first glance these definitions seem clear cut, they represent the complexity inherent in the task of defining the relationship between the dominant language and so-called minority groups.

In short, the term minority language children does not in itself describe a unitary phenomenon or population. Similarly, the term 'minority group' children, as cited by Frender and Lambert, seems to refer to a unitary condition which practically guarantees poor academic achievement. And yet, many adults from diverse minority groups are living testament that immigration during childhood does not in itself lead to an 'unpromising future'.

What, then, is the population that is alluded to in the Frender & Lambert quotation? Does bilingualism in North America set the stage for failure? What are the conditions that result in academic success versus academic failure for this population, and are these conditions different from those that operate in an L1 population? These are only some of the questions that require clarification when one examines the perplexing relationship between school achievement and bilingualism.

Although more than 30 million Americans come from homes where English is a second language (Mclaughlin, 1984), the

view that most Americans (and indeed the world) hold is that the U.S. is a monolithic linguistic entity (Homel & Palij, 1987). As Good-Erickson (1985) points out: "...the large number of individuals who speak languages other than English...is... enough to show that the United States is more a 'salad bowl' than a 'melting pot'." (p.2). However, the educational institutions and their explicit and implicit goals largely ignore this reality in their treatment of children from non-standard English and minority language homes. Westby and Rouse (1985) suggest that educators practice "...an unconscious form of cultural imperialism which they impose indiscriminately on others..." (p.15).

The picture in Canada parallels the one found in the United States. Even though Canada describes itself as a cultural and linguistic 'mosaic', many second generation minority group children and children of Canada's native people do not have a functional knowledge of their mother tongue. Members of 'ethnic groups' (non-Native, non-French, and non-English, as defined by McAndrew, 1987), according to the 1986 Census (Statistics Canada document 94-110), constitute approximately 42% of the total population of more than 25 million, with almost seven million listing multiple origins.

Cummins points out that educational institutions have traditionally assumed that minority language children need as much exposure to English as possible in order to

'overcome' their bilingual 'handicap'(1984, p.5). As Haugen stated in 1970: "The term 'bilingual' has come to be a euphemism for a linguistically handicapped person..." and a 'bilingual child' often refers to "...a child who has not learned enough English in the home to profit adequately from English teaching in the school" (in Alatis, 1970, p.40). This attitude has not changed greatly in two decades (see Cummins, 1988; Saville-Troike, 1992).

The search for causes for academic underachievement.

Minority group and minority language children are over-represented in special education classes, in both the United States and Canada (Gamlin, 1989; Good-Erickson, 1985; Cummins, 1984; Genesee, 1994; Cloud, 1994). Various government and educational institutions, as well as professionals from various concerned disciplines, have investigated the possible causes of this disproportionate representation.

The resulting research, both in North America and abroad, represents basically a search for either learner (internal) factors, or societal (external) factors responsible for academic underachievement. Therefore, language proficiency and cognitive variables are presented as possible candidates for the cause on the one hand, and sociolinguistic and socio-economic variables are emphasized as the culprits on the other hand.

A major study connecting bilingual children with academic underachievement is that by Skutnabb-Kangas and Toukomaa (as cited in Skutnabb-Kangas, 1981). This research investigated Finnish immigrant children's performance on Finnish and Swedish tests requiring cognitive operations. The children were rated by their parents and teachers as fluent in Swedish. The results indicated that their linguistic skills did not encompass cognitive/academic language proficiency aspects despite their seeming fluency in both Finnish and Swedish. (p.11).

These researchers used the term 'semilingualism' (coined by Hansegard, 1962, cited in Skutnabb-Kangaas, 1981) to describe the children's lack of adequate knowledge of either language. They believed that semilingualism affects cognitive functioning such as the ability to understand the meaning of abstract concepts, semantic development, and the general ability to cope with highly decontextualized language. The researchers promoted an educational program via the children's mother-tongue before the second language is introduced because they have found that such programs help students develop academic skills and even linguistic skills in the majority language. However, the study highlights the difficulties inherent in the assessment of minority children, using mainly tools and knowledge gained from research on majority language subjects. Skutnabb-Kangas (1981) noted that the term "...semilingualism has

become a dirty word in the Scandinavian debate" (p.248), but she maintained that although the term has outlived its usefulness, the phenomenon behind it lives on, as a direct result of deficiencies in the educational system rather than in the minority children.

Ekstrand (as cited in McLaughlin, 1985, p.34) denounced the use of the term semilingual on the grounds that it serves to malign and cause further discrimination against immigrant children. His fear was not unfounded. In 1982, a Montreal newspaper reporter, using Skutnabb-Kangas and Toukomaa's research conclusions and the infamous term 'semilingualism' wrote: "Kids whose parents speak a minority language at home do not achieve the same standards as other kids at school...they can be called semilinguals...they won't speak or write or understand Italian, for example, like a native of Italy, and they won't have a command of French like a Francophone, or English like an Anglophone" (Zosky, 1982, p.8-10). This statement manages to connect solidly the idea that the use of a minority language puts a low ceiling on the development of linguistic abilities, and by implication, academic abilities. For those already convinced, a blanket statement such as this can serve as 'proof' that these children are only 'semicapable' compared to majority children.

The Skutnabb-Kangas and Toukomaa research was found to have both methodological and theoretical flaws (McLaughlin,

1985). Nonetheless, inadvertently, it facilitated the viewing of intelligence and language proficiency as one and the same, and thereby confirmed for those who already held a negative view of bilingualism or minority status, that these lead to some sort of internal deficiency which in turn causes permanent disadvantage.

Tsushima and Hogan (1974) studied the verbal abilities and school achievement of bilingual children on American army bases in Japan. A child whose mother was born and raised in Japan and whose father was reared in the United States was defined as bilingual. These children's performance was compared to that of monolingual (English) peers. The researchers found that there was no significant difference between these groups up to grade three, but beyond this level the monolinguals outperformed the bilinguals in school achievement and verbal abilities tests.

They concluded that bilingualism is associated with impairment in certain types of verbal functioning and academic learning. They took care to note that the mothers of these children were also bilingual but failed to specify the extent of their or their children's bilingualism. This factor may be crucial in the children's SLA process since the mothers may not have had the linguistic or socio-cultural background to assist them in this educational context (Wong-Fillmore, 1992). Also, Tsushima and Hogan did not point out that although these children were half

Japanese, all their education was delivered by non-Japanese, American English teachers, on an American military base, in a school modeled on a typical 'all American' curriculum, constructed by mainstream American pedagogues.

Had the researchers addressed this point, they might have concluded that the bilingual children's life-experiences, cultural, and linguistic knowledge were ignored in the educational and assessment process. As a result, any pedagogical, cognitive, and verbal abilities tests were inevitably biased, and therefore could not reflect the children's true abilities (Feuerstein, 1979). Yet this study as well connects bilingualism with inevitable academic underachievement.

In a review of research of bilingualism and intelligence, Darcy (1963) reports the following conclusion:

> Though English is used as the medium of instruction in the New York city schools, the Puerto Rican communities retain Spanish as their principal language and, as a result, many Puerto Rican children have an inadequate knowledge of both languages (p.262).

Clearly bilingualism has been viewed as producing a condition of insufficiency. Maintaining a mother tongue was felt to cause problems in learning a second language and in learning in general. The poor performance of L2 children in school achievement and intelligence measures was directly attributed to bilingualism. Katchan (1986), in a review of research on the relationship of childhood bilingualism and cognitive development, explains that the preoccupation of

proving bilingualism a 'friend or foe' stems from the belief that bilinguals are functioning under a handicap since they must divide their limited capacity between two languages.

In the summer of 1995, a court judge in Texas, in a child-custody case, ordered a Hispanic mother to stop speaking Spanish to her five-year-old, and stated that depriving the child of English constitutes a form of abuse (Verhovek, 1995). Evidently, negative attitudes to mother tongue maintenance, and the view of bilingualism as a 'foe', are quite prevalent more than thirty years after Darcy's research review.

However, as Darcy pointed out, when monolingual and bilingual groups are matched on socio-economic-status, the significant differences between the groups disappear when non-verbal scores are compared. As well, when reading facility is achieved in the second language, differences on verbal intelligence tests between the two groups also diminish.

As a result of studies which pointed out a relationship between bilingualism and poor performance on intelligence tests, many minority group and minority language children came to be viewed by mainstream society as inherently less 'intelligent' than their monolingual majority group counterparts. As Gamlin (1989), says, "Static notions of intelligence are largely responsible for a plethora of racist attitudes" (p.14). He points out that the use of

standard intelligence tests reflects a belief that they measure 'true ability' or academic potential which is resistant to change, and that "this has had disastrous consequences for minority groups, in particular" (p.14).

Bernstein (1995), in his sardonic response to Herrnstein and Murray's (1994) The Bell Curve, a book connecting IQ levels with race, points out that "All tests measure something...IQ tests measure something. The problem is what to call it." His essay underlines the point that research that connects the 'it' as measured by a quotient or 'size' with a permanent innate academic ability is as valid as connecting 'it' with hat size (For an extensive critique of intelligence testing, see Gould, 1996).

In light of the many studies that insist on such connections, it is hardly surprising that educators hasten to refer minority children for psychological assessment or that psychologists often recommend special education placement (De Avila, 1987; Cummins, 1984,). De Avila (1987) questioned the theories and methodologies that underlie studies which equate bilingualism with low IQ, and consequent low academic achievement. Plainly, there has been no agreed upon definition of bilingualism. The term was often confounded with minority group membership, and as a result the subjects were often grouped on basis of ethnicity. He points out that in a review conducted with Duncan (1980) of approximately 100 studies on the effects of

bilingualism and cognitive style on Spanish language background children, few studies controlled for language proficiency in either Spanish or English, or for non-verbal IQ. The reported differences, he believes, cannot be considered valid.

De Avila notes that a longitudinal study he conducted with Duncan and Ulibarri (1982) of 1200 children from six ethnolinguistic backgrounds, showed that linguistic proficiency accounted for more than 70% of the total variance in predicting school achievement for the bilinguals. However, cognitive style and IQ development were the salient variables among monolingual English students' school performance.

The 1968 Bilingual Education Act in the United States was meant to compensate for linguistic deficiencies. Educators held that if English were taught as a second language (ESL), academic performance would improve. As a result education in the early years was delivered via children's mother tongue, mainly Spanish, and an ESL program. De Avila noted that studies of the ESL programs found that teachers tended to foster rote memory and use simple logic when interacting with minority group children. The simplified logic was evident in the modified speech style they tended to use with their students. He concluded that minority children's educational curriculum consisted mainly of paired associate or rote learning and recall of

factual information. Consequently, concept formation and complex information processing were not nurtured.

De Avila (1987) reports that in a study with bilingual elementary students, with varied linguistic proficiency in both English and Spanish, a bilingual supplemental academic program emphasizing science and math activities which required cognitive operations and problem solving was implemented. The performance of the treatment group was compared to non-treatment peers from the same schools. The results demonstrated that access to education that fosters complex concept formation results in higher academic, linguistic, and cognitive achievement.

De Avila concluded that education in a traditional classroom which emphasizes linguistic proficiency but neglects intellectual development is not sufficient for academic achievement. His research showed that changes in educational content and goals can produce positive changes in minority language children. De Avila's studies succeeded in demonstrating that educators' and professionals' biases have profound effects not only on school performance, but more significantly, in shaping the minority child's intellect.

Although the Tsushima and Hogan, and Skutnabb-Kangas and Toukomaa studies demonstrate negative effects of bilingualism in children, and De Avila focused on disproving these, many Canadian studies have concluded that there are

positive consequences of bilingualism. Peal and Lambert (1962) showed that bilingual, French-dominant 10 year old students outperformed their monolingual French peers on IQ tests and academic achievement. This study has been criticized on the basis that the subjects, although matched on socio-economic-status, were not matched on nonverbal IQ (Tsushima & Hogan, 1974).

Lambert and Tucker (1972) were asked to evaluate an English-language children's early French immersion educational program initiated by a group of parents from the community of St.Lambert, Quebec. English language children were taught via French throughout their elementary years. Reports of positive results from this program have had a profound impact on the direction of education in Canada for English language students. Many versions of immersion programs have been implemented across Canada and with mainly positive results (Barik & Swain, 1976; Genesee, 1976; Harley, Hart, & Lapkin, 1986; Samuels, Reynolds, & Lambert, 1969). It was found that even language impaired children benefited from a French immersion educational placement, and those who were transferred early out of the immersion program, retained their second language skills when tested a year later (Bruck, 1982, 1985).

These studies raise the question of why these children benefit from education via a second language whereas the children reported previously were said to suffer from

education via a second language. McLaughlin (1985) suggests that Lambert's (1977, 1981) distinction between 'subtractive' and 'additive' bilingualism can account for these differences. According to Lambert (1977) subtractive bilingualism refers to a condition "...whereby an ethnolinguistic minority group loses its home language in acquiring a prestigious national or international language, and 'additive' bilingualism, whereby members of a high prestige linguistic community acquire the second language without jeopardizing the home language." (p.101-102). Obviously, the minority language children's situation can often be described as "subtractive bilingualism" whereas that of the majority language children in immersion programs can best be described as "additive bilingualism".

McLaughlin (1985) differentiates between "submersion" and "immersion" conditions. Immersion programs are constructed for linguistic majorities of middle class status families characterized by high motivation and involvement. Submersion situations largely involve linguistic minorities from low status families with mainly low motivation and low parental involvement. The low parental participation, notes McLaughlin, resulted from the educational institutions' neglect in ensuring that parents play a role in the development and implementation of bilingual programs in their communities (p. 139).

According to Feuerstein (1979), low parental involvement, regardless of socio-economic-status, often results in insufficient quantity and quality of mediated learning experiences for the child, and as a result, a kind of deprivation is produced that hampers the child's interaction with the environment and prevents or disturbs "...the development of hierarchically higher forms of cognition" (p.72). The above underline the need to take into account ecological factors when evaluating children's abilities (Thurman, 1985).

Wong-Fillmore's hypothesis (1991) that early L1 loss in minority group children contributes to the erosion and possible severance of the vital communication line between parents and children may very well explain the difference in quantity and quality of parental involvement between the majority middle SES and minority low SES groups. Many minority group parents, and specifically refugees and immigrants, cannot effectively communicate with and transmit their culture and value system to their children because they literally lack a common language. The children's L1 skills are inadequate for effective communication while the parents' L2 skills are often severely limited. As a result, notes Wong-Fillmore, the parental role is thwarted, the parents can no longer be the main socialization agents for the children. Alienation and even destruction of the family may occur.

In the 1970's many studies focused on ecological or environmental variables for minority children's academic underachievement. Poverty was found to be the major cause for failure (Entwisle, 1970). Educational settings, teachers' and researchers' attitudes, and societal expectations are all variables which were found to influence the minority child's academic process, including performance on tests (Cazden, 1970; Osborn, 1970; John & Horner, 1970). Studies on superficial attributes such as speech style of children from poverty sticken families, for example, revealed educators' negative biases regarding minority children's aptitudes and personalities (Edwards, 1979; Seligman, Tucker, & Lambert, 1970).

However, in Frender and Lambert's (1972) study of grade 4 minority language (mainly Italian) boys in Montreal, their hypothesis that teachers were negatively biased toward children with a 'foreign' speech style was not supported. The teachers were 'positively' biased, rating these children higher than their actual achievement on standardized tests. Frender and Lambert were at a loss to explain their finding. The researchers' application of the American or British experience to a Montreal educational setting did not produce the expected research results. In contrast to other studies, where the teachers represented mainly majority group and majority language membership, many of the CECM (La Commission des Écoles Catholiques de Montréal, formerly

known as the Montreal Catholic School Commission) English sector teachers, themselves CECM graduates, share group membership with their students. In this case, teachers who shared an educational experience, a culture, and a religious affiliation with their charges were not negatively influenced by such variables.

Frender and Lambert (1972) noted low academic achievement in the Italian children, and they explained it by using low oral linguistic proficiency as the underlying variable. They used a passage reading task to acquire a voice sample, and they noted that the students exhibited difficulties in reading. They attributed the boys' academic underachievement to oral language proficiency.

In hindsight, the students' reading difficulties should perhaps have received more attention. Another possible explanation for Frender and Lambert's findings is that these L2 children, a classroom majority in this study, may have exhibited oral language proficiency levels that were shaped by the nonstandard input from their L2 peers' variety of English. Consequently, as in the situation described by Wong-Fillmore (1992), the children may have developed an "ethnic" version of English that, when measured against norms developed in other environments, appears as low oral language skills. For example, a language screening study (Hoshko & Hus, 1984) of L2 Canadian elementary school children using a language test normed mainly on American

English speaking children, showed a one-to-three year lag on most subtests, and while the lag decreased slightly with age, no age group ever met the established test norms.

The studies reviewed thus far focused on exposing either external or internal factors underlying the underachievement often reported in L2 children's academic histories. However, all children, whether unilingual or multilingual, whether originating in a minority or a majority group, are products of the interactions between their internal make-up and external ecologies and histories. Each child, therefore, is a unique and whole individual, and as such, is best viewed from an integrative or a holistic approach.

The bilingual as an individual learner with specific competencies.

Studies reviewed demonstrate that the assumption of homogeneity, and the search for a unitary cause, whether 'internal' or 'external', for low academic achievement, in minority group and minority language children, leave many observations unexplained. They also show that application of assessment instruments, largely standardized on majority group children, that purport to measure learning potential (IQ for example), are often used to show an inherent lack of that potential in the minority language child.

Second language acquisition (SLA), whether by adult or child, shows similarities to first language acquisition (FLA)(Ervin-Tripp, 1974; Lightbown, 1977; McLaughlin, 1984; Stevens, 1984; White,1989). Strategies used, and knowledge acquired the first time around are put to use 'the second time around' (Wong-Fillmore, 1976). However, the use of the same underlying neurological mechanisms (Kinsbourne, 1981, p.227), and the same cognitive operations (Slobin, 1973; Stevens, 1984) do not in themselves guarantee a uniform acquisition process for all learners of a specific language. The unique 'history of the learners' efficacies and inefficacies' (White, 1960), and the product of their experience with linguistic events in specific contexts (Jenkins, 1974), will result in individual variability in the acquisition process.

The research reviewed thus far largely ignores individual differences amongst minority children. These have been demonstrated to be quite significant by researchers such as Wong-Fillmore (1976) whose study highlights the importance of individual differences in children's SLA. She examined the development of ESL in five Spanish speaking children whose ages ranged from 5.6 to 7.3 years. The children in Wong-Fillmore's study attended a bilingual school in which the population consisted of both Spanish and English speaking children, and in which both languages were used in equal parts to deliver the academic

program. Each Spanish speaking child was paired with an English speaking class-peer, and their SLA in a naturalistic setting was examined over one year. Wong-Fillmore noted in her study that the child who achieved most in the one year study was Nora. She exhibited very high motivation in learning the L2 and in communicating with the target language speakers. Juan, who exhibited the least motivation to communicate with the target language speakers was the slowest in his SLA. A boy named Alej, exhibited great difficulty initially but eventually 'made good progress in language learning'.

Wong-Fillmore's description of Alej and his specific course in the SLA process accentuates the importance of individual variables in studying child language acquisition. She notes that Alej "...had a cold from September to June ..." (p.140) and that his ability to imitate speech was poor even when it was slow and clear. His ability to hear may have been compromised. In FLA, otitis media, for example, is associated with frequent and long lasting colds and with delay in development of speech perception and language (Kavanagh, 1986). Wong-Fillmore's (1976) final description of Alej seems to confirm that his hearing and listening status might have been impaired at the time of the study:

> Alej was much poorer in these [language] areas: He had difficulty remembering how expressions in the new language sounded, and an enormous difficulty reproducing them. He often garbled what he was

saying so badly that it was nearly impossible to understand him (p.713).

Wong-Fillmore's case studies show that although children may follow the same path in the process of learning a second language, their rate and style in this process differ greatly. Group studies, in contrast, tend to mask these important learner differences. Variables such as home communication style versus classroom communication style (Wells, 1981; Iglesias, 1985), an elaborated versus a restricted speech code (Bernstein,1970), social-class and child rearing practices (Heath, 1983), and cultural attitudes toward the significance of written literacy (Miller, 1990), all contribute to the creation of a unique learner, with unique needs, and competencies (Grosjean, 1985; Cook, 1992).

2.2 Individual Difference Variables In Language Acquisition: Central Auditory Nervous System Function

Fillmore's (1976) study underscores the need to examine children's language development on an individual basis. Group statistics tend to erase individual differences, and perhaps difficulties, which may hinder the acquisition process. The boy Alej, for example, exhibited problems reminiscent of those found in some FLA children with middle ear disease or otitis media with effusion (OME) who are also diagnosed as having a developmental central auditory processing dysfunction (CAPD), a difficulty which may

profoundly influence both oral and written language development.

Sloan (1986) defines auditory processing as "... everything that occurs from the moment a sound enters the external ear canal to the moment that that particular acoustic event is experienced by a listener" (p.1). This definition seems cautious and limited as it implies an acoustic event which ends at the moment of sound recognition or even sound detection. Lasky and Katz (1983), on the other hand, provide a definition that includes the entire gamut of the transformation of the acoustic signal from a nonsensical sound to a meaningful one: "...central auditory processing [is] the manipulation and utilization of sound signals by the central nervous system ... what we do with what we hear. CAP involves a range of activities from the awareness of the presence of a sound to analysis of linguistic information" (p.4).

The major differences between these two definitions are the following: The first implies a passive event and involves only part of the CANS, whereas the second is unmistakably a dynamic process and includes the entire tract. These differences reflect an underlying issue in defining the upper limits of central auditory processing. As Doehring (1989) notes, the lower limit of peripheral auditory processing is well understood as are peripheral hearing disorders, but central processing is more difficult

to understand because determining the precise "...point where auditory processing ends and higher levels of processing begin is a major problem" (p.2). He explains that the upper limit issue involves auditory perception, and because there is no generally-accepted theory of auditory perception,

> ...it is difficult to distinguish between discrimination and perception at the lower limits and between perception and comprehension at the upper limits. There is no agreement as to whether perception is a separate process, or whether it is inextricably combined with cognitive and linguistic processes (p.3).

The lack of a theory of CAP and its disorders (Doehring, 1989), has resulted in two conflicting approaches: CAP is a data-driven rather than a meaning-driven phenomenon, that is, an auditory rather than a linguistic event. As well as a conflict in approaches, the absence of an explicit theory also led to a conflict in the view of the role of CAP in normal and disordered language acquisition (Friel-Patti, 1994).

Duchan and Katz (1983) summarize the views of the two approaches to CAP. The language processing view (O'Connell, 1982) emphasizes that language information already exists in the mind of the listener and the acoustic signal offers very little additional information. Language processing is achieved by using higher linguistic and cognitive knowledge, that is an analysis-by-synthesis process (Lubert, 1981; Luce & Pisoni, 1987, p.20). The

listener uses language knowledge to 'guess' the speaker's message.

The auditory processing view admits that language knowledge helps us to understand without the need to examine each sound and word individually. However, information from the acoustic signal must be processed through several steps before becoming available for analyses by higher level knowledge. Some words a child knows very well may still be mistaken when the acoustic context and conditions are varied, and others known equally well are not mistaken. The effects of even a mild hearing impairment on language acquisition (Davis, Elfenbein, Schum, & Bentler, 1986), and the consequences of processing language in a noisy environment, make one realize the importance of the acoustic signal.

Duchan and Katz (1983) point out that a synthesized approach to CAP is more viable than a complete separation of approaches. The bottom-up (auditory) and the top-down (linguistic, prior-knowledge) processing activities are interactive and mutually influenced as they represent one of the dichotomous dimensions of auditory processing (Lemme & Hedberg, 1988). Bernstein and Stark (1985) support this view when they state that in order to understand a breakdown in language acquisition the complex interactions between perceptual and linguistic processes must be taken into account.

In most situations there is a continual flow between the two operations (Duchan & Katz, 1983). When events are unpredictable we attend more to the signal, and when they are predictable we attend more to the linguistic message. Therefore, depending on predictability, the signal/language ratio will vary. Keith (1985, p.146) provides a reading example which is analogous to this auditory process. When the words on a page are highly familiar, the reader relies on a cognitive or a top-down approach, but as they become less and less familiar (as in names of complex drugs or chemicals) the reader switches to a more analytical or bottom-up approach.

As Lemme and Hedberg (1988) point out, human information processing systems have been treated historically as isolated cognitive activities: attention, perception, memory, and comprehension. They consider this to be erroneous as there is evidence that these activities are integrated in auditory linguistic processing. The human nervous system, they note, is not a passive receiver and analyzer of auditory information, but rather a system that "...is capable of controlling its own input and processing" (p.304).

The auditory nervous system pathway.

The result of auditory processing is auditory perception. Katz and Wilde (1985), for example, treat

processing and perception as synonyms. Although this event may be experienced as immediate, it does take place in real time. The complex auditory nervous system pathway, comprising a peripheral and a central system, is the prime communication facilitator. The following delineate the main components of the auditory pathway (see Willeford & Burleigh, 1985; Musiek, 1985).

The cochlea, located in the inner ear is the primary sensory organ for the reception of auditory signals. The initial analyses of frequency (Hz) and intensity (dB) are made here. The Organ of Corti, located in the cochlea, contains about 23,000 sensory receptor cells that underlie all auditory activity. The hair cells send impulses to the central auditory nervous system (CANS) via afferent or sensory neurons, and also receive impulses traveling from the CANS via efferent or motor neurons. Auditory messages travel to and fro via the eighth cranial nerve: the acoustic nerve, a bundle of nerve fibers (about 5 mms in length). The bundle consists of fibers from the vestibular system (responsible for balance), and from the seventh cranial nerve: the facial nerve.

The CANS begins at the point where the acoustic or auditory nerve connects at the cochlear nucleus. It is located on each side of the brainstem in the area of the medulla. This is where the initial stage of central processing occurs, and where temporal features of sounds are

coded, therefore the 'timing' mechanism may be said to be located at this initial level. Fibers from the nucleus connect with the superior olivary complex, an important relay station of the ascending tract, and responsible for binaural listening functions.

Fibers from here arise bilaterally to form the lateral lemniscus: the primary auditory pathway in the brain stem, the transmission lines for ascending and descending fibers through the brainstem. Fibers from here continue to: 1. the midbrain, to the inferior colliculus: a relay centre for transmitting information to the thalamic area, and 2. the medial geniculate body: the highest level of subcortical function before transmission to the cortex.

Another important mechanism in the brainstem is the reticular activating system; activated by auditory signals, it arouses the cortex so that the information can be interpreted, and it discriminates and selects signals for higher transmission. It also functions as a coordinator of visual, somatosensory and auditory stimuli. An inefficient reticular system can cause many difficulties in attention, discrimination, and integration of auditory processing.

Fibers from the medial geniculate body are projected to the temporal lobes of the cortex. Each hemisphere receives projections from both ears, resulting in binaural representation of auditory stimuli in each temporal lobe. Each hemisphere contains a primary auditory area, and second

and third association areas surrounding the primary area. The final link that completes the auditory chain is the corpus callosum: a massive bundle of fibers that connects the two hemispheres, and is responsible for cooperation and communication between them.

Based on the neuroanatomic structures of the auditory system, CAP efficiency can be broadly defined as the relative ability to attend to specific auditory signals in the presence of background signals, discriminate between them, inhibit undesirable signals, reorder or modify them, recognize them, and assign meaning to them.

Obviously, unimpaired reception of sounds is necessary for the function of the auditory system but not sufficient for meaningful communication. The central auditory processing system must be functional and intact for correct interpretation and the resulting meaning to occur (Rampp, 1981).

Speech perception: a multilevel process.

Basic to human communication is the speech signal "...a complex, continuously varying, acoustic stream in which isolated segments and words appear hidden" (Luce & Pisoni, 1987). Speech perception is the process whereby the speech signal undergoes metamorphosis with the product being an identifiable, meaningful message (Gierut and Pisoni, 1988).

This transformation involves several stages of analyses (Sloan, 1986; Luce & Pisoni, 1987):

a. Peripheral auditory analysis: Important speech sound discrimination occurs at the peripheral level. The information gathered from this analysis is stored briefly in what is called echoic memory at the sensory organ level, until the next level of analysis is reached.

b. Auditory analysis: Here, information from the echoic memory is used to extract more information about the sound structure, fundamental frequency, overall loudness, duration of the signal, sound pressure or amplitude onset and offset, and feature analysis. The acoustic feature detector gives clues about phonetic classification. The features scanned in consonants are those of manner, place, and voicing, and in vowels the features are frontness-backness, and height. The auditory analysis, therefore, results in speech sound discrimination.

c. Phonetic analysis: This can be considered as the first stage of linguistic processing. Here, a synthesis of acoustic and phonetic feature information takes place. Although some believe that specialized feature detectors exist at this level, the evidence suggests otherwise, according to Luce and Pisoni (1987). Phonetic analysis, although highly automatic, is a 'learned' or acquired perceptual skill, rather than an innate ability.

d. Phonemic analysis: At this level the phonetic segments are changed into phonemes. These are the basic units of the sound system of a language. At this stage, analysis of the signal, in essence, involves suppressing information about the uniqueness or variation of a sound, and attending to the 'sameness' of it, that is, recognizing, discriminating, and assigning the phoneme to a recognizable category.

It is here that the listener must apply phonological knowledge of his or her language in order to perform accurate analysis; and in turn, at the previous levels of analyses, accurate information must have been extracted so that the phonetic analysis could be mapped onto the phonemic.

e. Linguistic analysis: The transformed speech signals undergo additional recoding and extraction of lexemes. Here extractions are matched to lexemes stored in long term memory and word meanings are extracted from semantic memory. The word's functional semantic and syntactic roles are also analyzed so that interpretation is possible. Not only the words but also the prosodic features of an utterance are analyzed. This allows storage in short-term memory until the linguistic analysis is completed and the message understood.

There is a great interdependence between all levels of analyses: the better the function of the system at lower

levels, the more linguistic information is acquired; the more linguistic knowledge is acquired, the better the analyses at the lower levels. However, the exact ratio and the nature of this symbiotic relationship is largely speculative (Elliot, 1985). This interdependence makes it difficult to separate cause from effect when a system-breakdown occurs (Willeford & Burleigh, 1985, p.13, Lahey, 1988, p.95), and is the basis for the ongoing controversy in the area of auditory processing or perception of speech: bottom-up or perceptual versus top-down or linguistic approach (Duchan & Katz, 1983; Keith, 1985; Friel-Patti, 1994)

The issue of agreement on a CAPD definition and cause.

Gerber and Mencher (1985), in their introduction to the proceedings of the 6th Elks' symposium on the hearing impaired child, stated that: "It was with considerable trepidation, in fact, that we decided to attempt a publication on this [CAPD] subject...we had perused the literature...without finding anyone who would say what central processing is or what a central processing disorder is" (p.7). The main problem, in their view, is one of definition.

Keith (1985) agreed that a problem with definition exists, and he attributed it not only to a lack of agreement about terminology, but to a basic disagreement about a

theory of CAP. Doehring (1986, class notes on the CAP topic to McGill audiology students) stated that: "...since there are no theories of normal central auditory processing, there are no explicit theories of central auditory disorders."

The lack of adequate theories and a clear definition of CAPD becomes more significant when CAPD is studied in the pediatric population. Issues of assessment as well as etiology surface. Bornstein and Musiek (1981) point out that the lack of adequate theoretical bases influences the assessment process: Many tasks used with, and standardized on, adult populations are used with children; a minimal amount of methodological investigation or research is accepted as sufficient before a test battery is used, and when results are obtained there is a great question as to "...how performance on these tasks relates to language and learning abilities" (p.26).

O'Connell (1982) objected vehemently to a review of literature on CAPD in language-impaired children (Lubert, 1981) because it hinged on results from studies of acquired CAPD in adults. She pointed out that these populations differ significantly in etiology, and in symptomatology. The issue of etiology or lack of verification of a specific 'site-of-lesion' in children with developmental CAPD, resulted in one of the central objections of the 'top-down' theorists to the use of the term CAPD in the pediatric population (Doehring, 1986, classnotes). They insisted that

the problem was linguistic rather than perceptual. However, Musiek (1985, 1989) points out that not all disorders "occupy space". Problems can arise from small neurologic deficits as well as from biochemical abnormalities. He refers to studies that show that neuron response to acoustic stimuli is changed by neurotransmitters and biochemical influences.

Downs (1988), for example, found that many children with histories of middle ear disorders (OME) show developmental language delays, but are often termed CAPD. Their problems, she notes, stem from early language deprivation and not from a 'congenital brain dysfunction'. As Musiek (1985, 1989) notes, however, auditory deprivation such as caused by early middle ear disease, can cause neuron atrophy in the central system, and early sound deprivation has 'measurable interference effects' at the cortical, speech processing level (Eggermont, 1989).

Katz and Wilde (1985) state that there is ample evidence to suggest that early auditory deprivation can have serious consequences for the behavioral, chemical, and structural development of the CANS. It has been shown that children with an early history of OME perform more poorly on auditory perceptual tests, experience less academic success than non-OME peers, require more special services than their controls, and that it is possible to predict these problems from OME history (Brandes and Ehinger, 1981, Menyuk, 1986,

1991). Zinkus (in Kavanagh, 1986) notes that although a cause-effect relationship between chronic OME and CAPD is difficult to establish, "There is growing evidence (American Academy of Pediatrics 1984) demonstrating the correlation between middle ear disease...[and] delays in development of speech, language, and cognitive skills" (p.115). One of the problems with OME research, no doubt, is the difficulty of getting accurate OME data years after the fact.

Perusal of the literature on the subject of early OME and its relationship to development of speech, language, and learning, reveals diverse hypotheses and study results (Eimas & Clarkson, 1986; Landis, 1990; Paden, Novak, & Beiter, 1987, 1989; Roberts, Burchinal, Koch, Footo, & Henderson, 1988; Wallace, Gravel, McCarton, & Ruben, 1988). This, as Levitton and Bellinger (1986) point out, is probably a direct result of the great variability in design and quality of studies in this area. They found, for example, that only two out of five studies that they investigated were adequate, and that those two showed 'a convincing' association between early persistent OME and later language function deficiency.

In a discussion of the relationship between the neuroendocrine system and auditory perception, Barr (1976) found that an insufficiency of hormonal products affected auditory detection acuity, localization, speech discrimination ability, loudness judgments, and impairments

in integrating speech stimuli into meaningful patterns. A system with such a problem would appear to be 'brain different' rather than 'brain damaged', notes Barr. Katz and Wilde (1985) state that because the actual cause for a child's CAPD is difficult to determine, developmental CAPD should be viewed as a 'deficit' rather than a 'damage' in the CANS.

Downs (1988) argues that CAPD is not the basis for language learning problems. She pointed out that auditory deprivation is the major cause of language problems in children with recurrent OME. Further, she argues that environmental factors can lead to language problems. She asks: "what happens when there is environmental deprivation in language due to reduced or low-quality language stimulation in the home? This too is auditory deprivation, whether it is reduced quantity of auditory input or whether the input is of poor quality" (p.194).

Although the consequences may seem similar for the two groups, one may object to the analogy because children with an intact auditory system are able to learn more than one linguistic code. Therefore, even when they come from homes with so called 'poor quality language' they can still acquire the 'standard' form, much like a second language, when exposed to it in school, providing that they have adequate access and opportunity (De Avila, 1987). For further argument against the reduced language stimulation

hypothesis, one may look at what happens to hearing children born to deaf parents. Not only do they develop 'adequate language skills' but many of them as adults are found to be high achievers (Hoffmeister, 1985).

A major problem in the construction of adequate theories probably lies in the complexity of the CANS (Willeford & Billger-Burleigh, 1978, 1985; Keith, 1988) and the issues involved in speech perception research and theory. As Phillips (1989) puts it, "Our data on auditory neuroscience as it pertains to central dysfunction, and our knowledge of the nature of auditory perceptual consequences of central pathology are frustratingly incomplete" (p.30).

Gierut and Pisoni (1988) hold that the following phenomena led to false assumptions regarding the speech perception process:

1. A distinct set of acoustic features corresponds to each phoneme, and when a phoneme is used, the same acoustic cues are identifiable in the signal regardless of context. This is termed 'the invariance condition'. 2. A specific sound corresponds to each phoneme in a spoken word, and units of sounds are discrete and are ordered in a particular sequence. This refers to the 'condition of linearity'.
3. The speech signals can be dismantled and reassembled into acoustically distinct, independent units corresponding to specific phonemes. This constitutes the 'segmentation condition'.

These conditions led to the major assumption of one-to-one invariant mapping between acoustic and phonemic properties of sounds. However, this was not confirmed by research: there are more acoustic cues than phonemic elements in speech sounds, acoustic properties of sounds change and vary depending on context, and overlapping information is present about pre-, present-, and post-phonemes. The question remains: how does the listener recognize speech sounds despite lack of correspondence between the acoustic signal and the phonemic message?

A second issue identified by Gierut and Pisoni (1988) is that of 'intra- and inter-talker normalization'. That is, the rate, pitch, stress, and loudness of a speech sound are not constant in a conversation. This is due to individual as well as socialization tendencies. Therefore, there exists great variation in production of the same set of sounds (e.g., as in different accents), and yet, listeners can still recognize these sounds. How do they suppress irrelevant aspects of speech sounds and attend to the relevant ones? A third issue deals with the internal representation of speech: where and how is speech stored for cognitive processing both in perception and production?

The three issues address the problem of how a word is recognized from a sound wave form. This represents 'the primary recognition problem', which includes the question of what role experiential, conceptual, linguistic knowledge, or

memory play in speech perception. Speech perception research includes both bottom-up and top-down processing questions, and to date, no theoretical model has been constructed that can adequately answer all the above questions.

Another source contributing to the difficulty in agreement on a definition comes from the fact that many disciplines have a vested interest in this area and each uses its own approach, terminology, theory, assessment, and management (Katz & Wilde, 1985; Gierut & Pisoni, 1988; ASHA, 1990; Friel-Patti, 1994). However, problems of definition also exist in areas such as dyslexia, cognition, language, and are rather common in the behavioural sciences (Keith, 1985; Katz & Wilde, 1985). Eisenson (1985) summarizes this issue in the following:

> Perhaps we cannot provide a firm definition of what we are talking about any more than we are likely to find a firm definition of cognition. This minor weakness has not prevented the propagation of courses, books, and advanced degrees in cognitive psychology (p.13).

Toward an operational definition of CAPD.

Gerber and Mencher (1985) provide a physiological approach in their definition: "central auditory processing and central auditory disorders begin anatomically at the level of the cochlear nuclei" (p.9). This definition clearly separates peripheral from central anatomical structures. Having identified the anatomical boundaries,

they continue their definition with a clinical audiological approach: "central dysfunction can be identified when there is evidence of an auditory disorder in the absence of any peripheral dysfunction which would explain that disorder" (p.10). This defines CAPD as failure on audiological assessments, and thus may provide an adequate definition for audiologists but falls short as far as other disciplines are concerned. However, when they touch on symptomatology, the picture of what constitutes a CAPD becomes more focused: "The most prominent revealing symptom is difficulty in the perception of speech and the auditory comprehension of language" (p.10).

Sloan (1986) defines auditory processing difficulties in the following terms: "...a difficulty in processing the acoustic speech signal that interferes with accurate and efficient perception of speech" (p.35). She elaborates on this definition by pointing out that the clinical identification of auditory processing difficulties in many children does not include a definite 'site of lesion' or neural pathology. Nonetheless, she points out, "These children demonstrate problems in speech discrimination and speech perception in the absence of peripheral hearing loss" (p.35).

This distinction is important since it draws a definite line between disorders due to hearing impairment and those that cause 'normally hearing' children to behave as if they

were hearing impaired (Willeford & Burleigh, 1985, p.49). Sloan limits the disorder to 'speech perception'. However, Tallal (1980, 1985) demonstrated in a series of experiments that specifically language impaired (SLI) children's perception of rapidly presented non-verbal auditory stimuli was equally deficient, thus pointing to an underlying auditory rather than a linguistic deficit.

Sloan's definition includes an identification of speech perception as an important area of dysfunction, but it tends to omit not only a description but also a reference to the consequences of a speech perception dysfunction, that is, defective word reception. Keith's definition (1985), on the other hand, emphasizes the consequences: "...a child with an auditory processing problem is one with an inefficient auditory system resulting in a receptive language disorder" (p.146). This language problem, in turn, causes the child to process auditory information more slowly and less efficiently. Keith thereby establishes a cause-effect relationship between CAPD and language, and then emphasizes the mutual dependence between the prelinguistic and linguistic processing events.

Eisenson (1985, 1986) believes that the definition of CAPD and of Developmental Aphasia are synonymous: "The underlying impairment in developmental aphasia is for the processing of acoustic events which are rapidly changing and which require phonemic and temporal order resolution"

(p.15). He defines CAPD as a language disorder: "It is a disorder in which the primary impairment is the processing (decoding and in turn encoding) of oral language when the symbol-signals are presented at a normal rate and not in excessive quantity" (p.14). Eisenson, therefore does not endorse the mainly artificial dichotomy between prelinguistic and linguistic processing.

His definition not only includes the entire range of speech processing levels, but defines language as an auditory phenomenon. When one considers the difficulties hearing impaired children have in acquiring oral language, or the elderly adult's struggle to comprehend speech following hearing loss, or even normal hearing adults' problems in following a conversation in an acoustically unfavorable environment, the above emphasis on the auditory system does not seem excessive.

Furthermore, the speed of auditory processing and the transitory nature of the signal are such that in reality, it is difficult to separate the acoustic event from the linguistic one. Speech sounds are meaningful events from very early on in human development. Therefore, how does one determine where one ends and the other begins? Miller (1956), in his discussion of information processing, presented the analogy of a person learning Morse code. First, one hears dits (dots) and dahs (dashes) as discrete and meaningless auditory units, and later these are

perceived in groups, that is, they take on meaning and are heard as words or information units. Does the perceptual grouping and consequent change in 'meaningfulness' of these discrete events imply that they are no longer processed as dits and dahs? When the acoustic event is transformed into a linguistic event, does it cease to be an auditory experience? By the same token, does listening to a stream of speech in a totally unfamiliar or 'meaningless' language constitute a purely auditory experience or a meaningless linguistic event? An assumption of a dichotomous auditory processing system allows for such fruitless questions.

Eisenson's definition was born out of his observation of the similarity between children with a diagnosed CAPD and adults suffering from an acquired Wernicke's aphasia, often referred to as auditory aphasia. In this disorder, speech comprehension problems are thought to be due to a disability in processing speech at the phonemic level. The primary deficit, he concludes, is "...in speech sound discrimination for temporally ordered events when the signals are presented at the rate and quantity normally spoken by speakers of that language" (p.14).

Eisenson's definition is congruent with that of Lasky and Katz (1983). They state that "...the child with problems in CAP often has difficulty when s/he must attend, comprehend, manipulate, interpret, and remember auditorily presented linguistic signals, generally in cognitive tasks"

(p.25). They emphasize that the processes of perception, comprehension, learning, and memory are not only very similar but also interactive, and as a result are very difficult to separate. This, no doubt, contributes to the difficulty in agreeing on *the* definition of CAPD.

Keith (1986) elaborates on this topic by stating that the term Auditory Processing Disorders (synonymous with several terms including CAPD, auditory perceptual problems, and nonsensory hearing impairment) refers to individuals who have communication or learning problems. He defines these as follows: "...the inability or impaired ability to attend to, discriminate, recognize, or comprehend information presented auditorily even though the person has normal intelligence and hearing sensitivity. These difficulties are more pronounced when listening to low redundancy (distorted) speech, when there are competing sounds, or in poor acoustic environments" (p.3). He adds that in the course of normal development the child's auditory processing abilities develop in a parallel or reciprocal relationship with language abilities. Keith accepts that language disorders in children may have an etiology other than auditory perceptual by admitting that: "Children with auditory processing disorders are a subset of the larger group of children with language and learning disorders" (p.4).

The CAPD child: specific deficits and consequences.

Tallal (1985) described the neuropsychological stages of CAP as follows: After an auditory signal is detected, the system must determine if the signal constitutes one continuous event or is made up of two events. The ability to determine this is possible because of 'temporal resolution': the time necessary to decide when one stimulus has ceased (offset) and the other begun (onset). The next stage involves the determination by the system of whether the two events are the same or different. Information about frequency, amplitude, and time, is used to perform this discrimination task.

An important stage following the determination that the two stimuli are different is the ability to perceive the temporal order or the sequence of the occurrence of the stimuli. The storage of these sequenced stimuli in short term memory occurs next, as additional stimuli undergo the same stages of processing and subsequent storage. The sequenced storage of the stimuli allows their recall and combination. The basic components of auditory perception, the product of CAP, therefore, are: detection, temporal resolution, discrimination, sequencing, and serial memory (Tallal, p.17). According to Tallal, the temporal aspect in CAP may be central in the perception of speech, and is the variable most implicated in auditory perceptual disorders of many language impaired children.

Barr (1976), in his discussion of possible etiologies of auditory perceptual disorders, noted that in studies of neuroendocrine control of auditory perception, the most noted defect was in the perception of temporal relationships (p.7). Bornstein and Musiek (1981) state that, "The temporal nature of auditory-neural processing is important for auditory perception" (p.26), and they note that speech perception studies support the view that temporal processing deficits probably affect not only the perception of vowels and consonants but the 'entire speech stream' because temporal or duration cues also provide linguistic cues (p.28).

In her review of the literature on specific language disordered children, Lubert (1981) found that most studies suggest that these children exhibit a 'rate-specific' auditory perceptual deficit. She notes that this may explain the clinical observation that language-impaired children are deficient in processing rapid speech but improve when dealing with slower speech. She believes that speech perception problems may interfere with language acquisition.

Fuller (1982), objected to Lubert's hypothesis deficits on the basis that if it were true, then the incidence of articulation problems in this population should be very high, and yet many do not exhibit articulation problems. Thus, Fuller used articulation ability as

evidence for an intact speech perception mechanism. However, Stark, Tallal, and Mellits (1985), found that receptive and expressive language disorders show different underlying etiologies. In a study comparing SLI children to a linguistically intact group they found that a different set of variables operated in receptive and expressive abilities for the SLI group but not for the normal children. Speech motor variables as well as verbal visual processing were highly correlated with expressive language but *not at all* with receptive language. In addition, they found that receptive language was highly correlated with both verbal and nonverbal auditory processing variables. Based on this, it is not certain that speech perception difficulties can be excluded on the grounds that a child has the ability to produce sounds.

The importance of the temporal variable in CAP has been implicated in the behaviour of the CANS at the level of the neuron, lending support to the above studies. Willeford & Burleigh (1985) cite Stillman's (1980) work on the response of cochlear nucleus neurons to auditory signals. Stillman emphasized that the timing aspect will determine whether neurons will respond to signals. He suggested that the precise timing of signals that excite or inhibit neural activity along the entire auditory tract is vital if a differential response to environmental sounds is to occur (Willeford & Burleigh, 1985, p.33).

Philips (1989), in his discussion of auditory neurophysiology, confirms the importance of temporal coding, along the entire tract, including the auditory cortex, especially for complex stimuli. Sloan (1989), reiterates that the timing factor is critical to speech intelligibility, and is one of the important aspects of auditory processing. Although there is no consensus as to etiology or definition, almost all agree that the most pervasive complaint about children who exhibit CAPD is that they can not process the 'normal speech stream' (Johnston, 1988).

Barr (1976) in discussing CAPD etiology, claims that children with auditory perceptual problems exhibit auditory discrimination problems due to 'minimal brain dysfunction' (p.34). Musiek, et al., (1985) agree that in a majority of children, CAPD has a 'benign' neurological base. Tallal (1988) concurs when she states that: "...a specific neurological mechanism may disrupt phoneme perception and production resulting first in delayed language acquisition in young children and subsequently in delayed reading acquisition in older children" (p.15).

Research shows that CAP deficits include problems in the following: analysis, figuring out the parts of the signal; synthesis, combining parts of speech to form a whole; sequencing, arranging sounds and words in proper order; figure-ground, the isolation and discrimination of

primary sounds from background noise; phonemic discrimination, differentiation of words that sound alike; and auditory integration of words with multi meanings, selection of the word meaning most appropriate to a context, and auditory memory difficulties (Barr 1976, Rampp, 1981).

Barr (1976) hypothesized that the problem did not occur at the sound level but rather at the level of the syllable. Tallal (1980) found that children who exhibited no problem in discriminating rapid presentation of phonemes in isolation, had problems when they were embedded in a syllable.

Barr stated that auditory perceptual problems underlie problems in language acquisition and in learning. He notes that 46-70% of learning disabled children show auditory perceptual problems. Rampp (1981), citing Toman (1969) estimates that because approximately 70% of instruction in the classroom is verbal, these difficulties will profoundly influence language, reading and spelling.

Recent advances in reading research have shown that auditory perceptual rather than visual perceptual problems often underlie reading difficulties (Galaburda, Menard, & Rosen, 1994; Kamhi, 1989). Phonological processing (the transformation of the acoustic signal to phonemes), and metaphonological knowledge were found to underlie success in the reading process (Catts, 1989; Kahmi & Catts, 1986;

Liberman & Shankweiler, 1985; Liberman, Shankweiler, Camp, Blachman, & Werfelman, 1980; Sawyer, 1981).

Katz and Wilde (1985), found that in addition to figure-ground discrimination and temporal sequencing problems, the CAPD child often demonstrates poor auditory attention, poor auditory memory, and delayed receptive language ability. They note that CAPD children's integration skills are defective. Rampp (1981) too noted that the CAPD child's highly variable auditory responsiveness is due to a deficient integration ability: "He does not relate his hearing meaningfully to the environment" (p.40). Luick, Agronowitz, Kirk, and Busby (1982), also found that children with severe oral language disorders exhibited a central organization deficit or an integration problem.

Fisher (1980, in Keith, 1986), Rampp (1981), and Willeford and Burleigh (1985), presented a behavioral profile of CAPD children. The most salient auditory behaviour they noted was the inconsistent awareness of and responses to sounds. CAPD children often misunderstand what is said, and say "huh" and "what" frequently. They appear to have a short attention span and are easily distracted both at home and in the classroom. They have trouble following directions, and are classified by teachers as 'poor listeners'.

The above researchers' profiles show that academically, these children often exhibit reading and spelling problems, and have difficulty expressing themselves verbally in a coherent manner. Typically, there is a significant discrepancy between their expected and their actual performance when IQ is considered. Their academic performance is often a source of disappointment and frustration for both themselves and their families. Their families' reactions to their difficulties may lead to conflicts and a subsequent behaviour problem.

In my own SLP practice I have found that CAPD children are often misunderstood by home and school alike. Because of their distractibility they are often labeled as Attention Deficit Disordered (ADD), and yet when parents complete a Conners' Parent Questionnaire (Conners, 1990) for identification of children with ADD, the results typically do not support this diagnosis. As well, there often exists a great discrepancy between the CAPD child's behaviour at home and school.

Ivey (1986) also notes that many of the children referred for CAPD testing, have "no apparent trouble learning at home" (p.5). When one considers that a classroom generally constitutes an unfavorable acoustic environment (Hétu, Truchon-Gagnon, & Bilodeau, 1990) in which great demands are made on the auditory channel, this observation is not surprising.

Semantic and syntactic knowledge aid greatly in discriminating and identifying word boundaries in connected speech. A newcomer to a language, for example, has difficulty recognizing where a word begins and where it ends in running speech. CAPD children, despite demonstrated adequate oral language skills, often exhibit difficulty in determining word boundaries when listening to running speech, thus acting like 'newcomers' to their own language. They may, for example, attach the last phoneme of a word to the initial position of the next word and thus totally alter the meaning of the sentence and render it nonsensical. For example: "give me some others" may become "give me some mothers". Their poor speech perception can cause a question such as: "What causes ice to melt?" to become " What causes eyes to melt?". The faulty sentence perception results in not only a breakdown in the communicative act but also a confused and often frustrated child.

In my clinical practice I have also observed that these children often exhibit significant gaps in their general knowledge. They have a difficulty getting information 'through the air', and as a result are often bewildered when reference is made to 'common knowledge'. Their misunderstandings, in these cases, are due to lack of familiarity with specific topics rather than language knowledge.

The most characteristic symptoms seem to be their lack of adaptability in 'less than optimal' listening environments in contrast to children without CAPD. Barnett, Nichols, and Gould (1982), for example, found that non-CAPD children who were exposed to unpredictable and varied noise levels, as found in 'open-space' classes, performed better on auditory tasks requiring attention even in the presence of background noise, when compared to their 'traditional classroom' peers. They learned 'how to listen' in such environments.

A typical symptom of CAPD children is their varied responses even to highly familiar language and contexts. This symptom indicates that the CAPD children's strategies in the extraction, integration, and use of auditory information, that is, their cognitive skills, may be defective. They often exhibit diffuse as opposed to focused perceptions.

Feuerstein's (1979) description and theory of children with perceptual problems and persistent academic failure may provide a basis for understanding many of the seemingly unrelated behaviors observed in CAPD children. He proposes that observed difficulties in children exhibiting perceptual disorders occur in three phases of information processing. In the input phase, the individual gathers insufficient quality and quantity of data with which to attempt to solve a given problem. In the elaborational phase, the individual

is unable to use the data available to him. This may result in bizarre responses, poor responses or complete blocking of responses. Elaboration of cues constitute what is generally meant by *thinking*. Good elaborational skills can exist despite poor data gathering skills. In the output phase, deficiencies result in inadequate communication of final solutions. It can occur because of or be independent of deficiencies in the other phases. The problems consist of difficulties in predicting relationships, trial and error responses, impaired selection of verbal tools for communicating adequately, impaired need for precision and accuracy in communicating responses, and impulsive, acting-out behaviour.

Not all the above deficits necessarily exist in one individual, notes Feuerstein. However the existence of clusters of the above may greatly impair their ability to function. Also, Feuerstein believes that these deficiencies can adversely affect the child's affective-motivational development and therefore make the child fearful of structured situations that require focus and organization.

Feuerstein's model of information processing deficits can be useful in dealing with CAPD children in several ways: it may be used to explain the behavioral variability amongst children with similar CAPD profiles: they have difficulties at different phases of information processing. The model can also explain why some children with considerable

demonstrated CAP difficulties are able to cope with their academic environments in more than adequate ways: they are able to compensate for inefficient auditory systems because of their efficient information processing strategies at all phases of the process.

In addition, Feuerstein's model may assist greatly in the evaluation as well as intervention process by facilitating the following: determining at which phase the child experiences most difficulty, predicting which areas and tasks at school will be most problematic, anticipating social-emotional consequences, and based on the above, structuring appropriate interventions.

2.3 The Audiological Investigation of CAPD and The L2 Child

The need to evaluate children suspected of CAPD with controlled acoustic stimuli has been noted by many (Musiek, 1985; Musiek et al., 1985; Katz & Wilde, 1985; Willeford & Burleigh, 1985). Assessment instruments that are presented outside of an audiology booth fail to control the environmental variables, acoustic features of the test signals, speed and consistency of the signal, and often require visual responses. They measure psycholinguistic rather than psychoneurological abilities (Willeford & Burleigh, and Musiek et al., 1985).

Audiological tests, in contrast, stress the CANS by presenting well controlled, low language dependent auditory

signals (Lasky & Katz, 1983). Musiek, Gollegly, and Ross (1985), were able to report five central auditory test profiles of learning disabled children. These tests suggested a differential etiology amongst the children. In two cases, the tests were sensitive to active neurological disorders (eg. absence seizures or petit mal); another case was determined to represent interhemispheric processing problems; the last two showed a neuro-developmental etiology. Had psycholinguistic tests been used instead of audiological, these children might have obtained a superficial uniform profile.

Some important principles that guide diagnostic test construction were delineated by Willeford & Billger-Burleigh (1978, based on Jerger, 1960), and Keith (1988). The first, is 'the principle of redundancy', that is, there is a lot more information in the speech signal than is required for intelligibility. High redundancy signals facilitate understanding of speech and are insensitive to lesions of the CANS. Therefore, diagnostic testing must have redundancy reduced speech. This can be done by filtering, time-compressing, and lowering the signal/noise ratio of the speech stimuli. Another principle is the 'subtlety' concept, that is, the higher up the CANS the location of the lesion or defect the greater the test sensitivity that is required. A third concept Keith discusses is the 'bottleneck principle'. According to this principle,

'neural congestion' occurs at the eighth nerve and brain stem, therefore subtle CANS defects before and beyond the bottleneck will not affect speech discrimination ability.

Audiological tests can be divided into two major categories: those involving physiologic measures such as brain-stem response and auditory reflexes, and those requiring a behavioural response. Most of the controversy, mentioned earlier, regarding CAPD and its assessment revolves around the latter. Behavioral tests generally are of the following paradigm: monotic, one stimulus is presented to one ear at a time; diotic, one stimulus is presented to both ears; or dichotic, two different stimuli are applied at the same time to both ears. Binaural fusion refers to tests that apply portions of unintelligible speech at the same time to opposite ears. Each paradigm was designed to assess a specific process of the CANS.

Tedeschi (1984) identified five basic areas that are considered vital in CAP evaluation: 1. Selective listening refers to the ability to concentrate and maintain attention on a task, and is also used to assess auditory memory. 2. Binaural separation is the ability to attend and integrate information presented to one ear while ignoring signals presented to the other at the same time. 3. Binaural integration refers to the ability to combine different information presented to each ear at the same time. 4. Temporal sequencing is the ability to recognize

the correct sequence or order of signals, and 5. Inter-hemispheric interaction assesses the communication between the two hemispheres and the integrity of the corpus callosum. In order to ensure that all processes are evaluated it is strongly recommended that a battery of tests be applied (Katz & Wilde, 1985; Musiek, 1985; Musiek et al. 1985; Gerber & Mencher, 1985; Ivey & Willeford, 1988).

Despite the seemingly straightforward safeguards and principles followed in the construction and use of audiological tests, the assessment and management of CAPD in the pediatric population is highly complex. Matkin (1990), warns of the following pitfalls: an assumption of cause-effect relationship, attempting to interpret CAP test results without knowledge of the child's overall developmental level, an assumption that available tests have equivalent sensitivity and psychometric soundness, and limiting interpretation of results to diagnosis without consideration of an intervention plan. He adds, however, that CAP testing and language testing do not assess the same skills, and despite the difficulties, it is vital to uncover the problem so that remedial services are given.

CAP testing is generally considered difficult because of influence from variables such as age and intelligence. The presence of conductive and/or sensory-neural peripheral hearing loss, use of drugs, and linguistic background may also lead to erroneous interpretation of test results and

CANS function status (Katz & Wilde, 1985; Keith, 1988). The linguistic background factor is especially noted because many audiological tests used in the USA and Canada at present were standardized on English L1 children. Although some were translated into Spanish and French, the English L1 standards are used in determining problems.

In his Screening Test for Auditory Processing Disorders (SCAN) in children Keith (1986) states: "...examiners should use caution when interpreting the scores of children from homes where English is not spoken or where the child uses English as a second language". The caution about 'English as a second language' (ESL) can be found in many speech, language, and audiology tests. Nonetheless, the L2 child's performance on these tests is often used to form diagnoses of 'disabilities'. These are formed despite the possibility that the L2 child's difficulties may reflect symptoms characteristic of learners in the midst of sorting out the L2 code, and in the process of learning to use the code appropriately in an academic environment. Appropriate tests are therefore difficult to find.

The linguistic background factor, however, has mainly led to the exclusion of L2 children from CAPD investigation. This is evidenced by the lack of tests that are normed on such populations, despite the undeniable existence, in English language schools, of millions of children for whom English is not a native language. CAPD testing is not

normally pursued when L2 children experience academic distress. They are mainly sent for intelligence testing (Cummins, 1980, 1984, 1989), often, followed by special education placement (Cummins, 1984; Good-Erickson, 1985).

The preferability of using audiological tests in assessment of CAPD hinges on the claim that these tests "...minimize the dependence on linguistic talents and exercise the necessary test protocols that will permit assessment of the balance and strength of the CANS" (Willeford & Burleigh, 1985, p.97). If this is the case then how much English need a child know before it is determined that she is 'proficient' enough to benefit from a CAPD assessment? Katz and Wilde (1985) note that more than 75% of children with learning disabilities were found to have demonstrated 'auditory channel' deficits, and that these were first noted and suspected by their parents and teachers.

Given this significant number, it is at least plausible that bilingual children who are having difficulties in the language acquisition process and academic achievement may be affected by a CAPD rather than by their languages. Researchers emphasize that the goal of audiologic assessment is to identify defective processes so that appropriate therapeutic plans can be initiated (Tedeschi, 1984; Matkin, 1990; Friel-Patti & Finitzo, 1994). Obviously, to date, English monolingual children in North America have a great

advantage over minority language children, given that the audiologic test batteries were almost exclusively designed for them.

Katz and Wilde (1985) state that the purpose of evaluation is the identification of areas of auditory deficits that can explain the child's problems in the classroom. As they note, "The finding of a dysfunction which can reasonably be associated with the auditory difficulties the child is having can be therapeutic by itself" (p.667). This is so because it provides parents and teachers with a reasonable explanation for the child's seemingly bizarre behaviors (often labeled as 'misbehaviors'). Using the identification-recommendation approach, educators and clinicians attempt to intervene directly by altering the child's listening environment. This approach is based on the premise that there is a direct relationship between CAPD and the ability to perform academically. The recommendations that accompany this approach are designed "...to modify the acoustic and visual environments by reducing background noise, increasing the loudness and clarity of the primary messages and maximizing the non-auditory cues" (p.667). The recommendation of control of the acoustic environment, coupled with the recommendation for altering teaching style, constitutes the basic approach to management of the CAPD child in a

classroom (Clark, 1980; Edwards, 1990; Keith, 1986; Matkin, 1990; Musiek, 1985; Willeford & Burleigh, 1985).

However, as Hétu, Truchon-Gagnon, and Bilodeau (1990), note in the study of noise in schools, there are no guidelines in the construction of school settings that effectively deal with noise control. As a result, they found that "...the acoustic environment in school settings is far from ideal". This indicates that it may be unrealistic to expect a change in the child's acoustic environment solely on the basis of a recommendation. In addition, as Matkin (1990), Armour (1990), and Edwards (1990) note, many teachers resist changing their teaching style. Given the above, it may be more realistic to 'modify' the child rather than his human and acoustic environment. For example Sloan's (1986) and Tallal's et al. approach (1996) to intervention with CAPD, and specific language impaired children respectively, is comprised of auditory training for improvement of speech sound discrimination skills. Sloan's program is based on an oral delivery of CV syllables containing speech sound contrasts. The Tallal, et al. program is an interactive computer based auditory training with a built in temporal variable. That is, syllables are presented in slowed speech mode and as the child's ability to discriminate speech sounds improves, syllables are progressively shortened temporally, until the child is able to discriminate sounds in normal speech rate

presentations. Bacon (1992) on the other hand, recommends a combination of classroom management and improvement of auditory skills as an appropriate management program for children with CAPD.

Feuerstein, (1980) found through extensive work with children that the cognitive-perceptual deficiencies which they exhibit are reversible. According to Feuerstein (1980), there are two principal learning modalities, 1. Learning through direct exposure. This occurs through immediate and direct contact with environmental stimulation. Spontaneous manipulation and chance encounters are sufficient for a modification to occur. 2. Learning through mediated experience. Feuerstein (1980) argues that the latter is the key to altering the above deficiencies.

He defines the mediated learning experience as "... the interactional processes between the developing human organism and an experienced, intentional adult who, by interposing himself between the child and external sources of stimulation, 'mediates' the world to the child by framing, selecting, focusing, and feeding back environmental experiences in such a way as to produce in him appropriate learning sets and habits" (p.71). In this process learning does not depend on chance confrontation with objects, ideas, etc., but on the adult's intervention in making the child focus on and/or manipulate them.

He points out that in the mediated learning process, intentionality on the part of the mediator rather than the language and content of the activity is important. Mediated experience, for those that *don't* learn well by direct exposure is highly beneficial and is a prerequisite to effective independent, and autonomous use of environmental stimuli by the child.

Dollaghan (1990) states that the role of the clinician in the intervention process is as a preprocessor. This too is based on a 'mediated experience' approach. The CAPD child needs mediation or assistance because he or she does not have an isolated problem, but a multi-faceted one which has repercussions in multiple areas and aspects. The role of the preprocessor, she believes, is to circumvent processing breakdown: facilitate encoding and storing relevant information by manipulating the auditory signal, manipulating the linguistic signal, and manipulating the link between the signal and the situation.

The use of Feuerstein's and Dollaghan's intervention approach combined with Feuerstein's (1979) approach to the investigation of the integrity of each phase of information processing, may provide a model for intervention with CAPD children that allows for individualization of the remediation program. This may better prepare them in their attempts to master their environment, and to make 'sense' out of 'nonsense'.

Keith (1985, 1986) states that it is vital to view developmental auditory processing disorders as "...part of a continuum of problems... that are more or less important to children's academic and social achievement and to their general emotional adjustment" (p.4). The model that he suggests not only considers that CAPD can result from different etiologies (neurologic disorder, cerebral morphological abnormalities, and neuromaturational lag, Musiek, 1994, p.257), but that school achievement is affected by a myriad of variables, all of which should be considered in evaluation and treatment design. His model emphasizes that CAPD requires an interdisciplinary approach so that all the child's needs are met. Indeed, the complexity of CAPD and its ability to impact on the child in many possible ways warrants the highest level of care, i.e., an interdisciplinary management approach for both diagnostics and therapy.

As Keith (1985) notes, there are many questions in the area of CAPD that require answers. These questions encompass issues in research, test design, assessment, and remediation. Matkin (1990) too notes the need for more research, but above all, he emphasizes, an acceptable definition must be formulated. A definition may, after all, end the 'war-of-the-words' amongst the different disciplines that have a vested interest in the child with communication problems: CAPD is a memory problem versus CAPD is a

language problem versus CAPD is an attention deficit, and so on. The issue is not whether CAPD exists, but rather its appropriate definition and the construction of an explanatory theory.

In summary, a CAPD may act as an occult (as used in medicine: e.g. occult cleft palate & occult spina bifida refer to defects that are hidden from direct view but are inferred from behavioural observations) variable in linguistic and academic underachievement in the English monolingual child. And yet, an extensive literature review in this area revealed a serious neglect of the minority language child whose language and academic development may similarly be affected by the presence of a CAPD.

The glaring lack of research of CAPD in minority language children results simultaneously in their exclusion from the benefits of identification of this disorder and subsequent appropriate interventions, and in the perpetuation of the myth of the handicapping condition of bilinguality.

2.4 Research Goals & Rationale

The importance and indeed the usefulness of determining the presence of CAPD in academically at risk children for whom English is a first language has been well established. The present study is designed to explore the usefulness of

the CAPD construct in the investigation of minority language children's academic distress.

The use or application of assumptions and paradigms from investigations of monolinguals within a bilingual context is not novel (for example, Vasos, 1983, p.33). However, the specific use of the CAPD construct and the CAP evaluation paradigm in the investigation of the bilingual population has not been reported to date. Such an investigation may aid in determining not only the usefulness of the construct but also the applicability of the CAP evaluation tools for this group.

The variables most often used to explain the L2 child's academic performance are socio-economic and minority or second-language status. However, the human central auditory processing instrument transcends language. It is reducible to the structures and mechanisms of processing that are used to access any language system or systems. Oral language acquisition or communication is an auditory event, and since difficulties in this modality impact on the L1 child, it is logical to conclude that these difficulties can also affect the L2 child.

Variables noted in the investigation of CAPD children.

Smoski, Brunt, and Tannahill (1992) note that in children who exhibit unexplained academic problems, it is their listening behaviours that alert parents and teachers

to a possible disorder with a consequent referral for a CAP evaluation (p.145). The researchers used a questionnaire type scale to collect information from teachers about the listening behaviour of children with a diagnosed CAPD. Since listening behaviour was found to be an indicator for CAPD in L1 children, it is important to establish whether it is also an indicator for L2 children.

Further, Smoski et al. (1992) found that in L1 children exhibiting a CAPD, academic performance was not a good indicator for this problem since only 50% were reported as functioning below grade level. Moreover, teachers referred children for CAPD assessment even though they were not exhibiting markedly different academic achievement from others in the classroom. Their school performance ranged from failure to better than average. Reading was the only area, the researchers found, that was implicated in at least half of the CAPD children, and these were the same ones who failed at least three out of the four CAP tests. This finding may point to a relationship between CAPD and reading ability. Because the educational case histories completed by the teachers were quite general in nature, no information was provided as to what aspect of reading was most affected. More information on the nature of the reading problem may contribute to the pool of indicators that signal the presence of a CAPD.

Interestingly, it was not academic problems but rather concern over the children's listening behaviour that prompted these teachers to refer them for assessment. Achievement, then, does not seem to be affected all the time. Nonetheless it does not rule out the possibility that the CAPD child may be achieving academically at a great cost of extended effort, that is, the achievement may be disproportionate to the amount of effort invested by the child.

In the CAPD L1 child's situation, for example, the presence of an ideal environment for language development, that is, the presence of parents who are native speakers of the school language-of-instruction, and who provide comprehensible input in an ideal listening environment, may 'prevent' or head-off immediate academic achievement problems. However, it may not prevent them from arising later on when the situations are not ideal and the 'academic pressure' is on.

As the academic demands are increased, the child's tolerance threshold may be reached, and finally the child will demonstrate academic distress. This may not be reached until late elementary or high school, for example. The fact that some CAPD children do not exhibit academic problems may be due to the fact that the challenge is not sufficient at the time of evaluation.

The question for each CAPD child is how much pressure he or she can tolerate in the educational setting before a problem becomes salient or evident, or how much the child can compensate for the CAPD. Information from the educational case history about academic standing may provide a clearer view of the child's academic life. The degree of effort may be expressed in some emotional-behavioural terms, and these may be indicated in scales designed to measure or provide insight into the child's emotional-behavioural development.

Cantwell and Baker (1991, p.xii) found, for example, that speech and language development influences all other developments including emotional and behavioural, and that children with speech/language and learning disorders are at risk for the development of psychiatric problems. They note that these children showed high rates of attention deficit disorder with hyperactivity (ADHD), a psychiatric disorder.

This disorder is defined by DSM-III (American Psychiatric Association, 1991), a manual designed to provide operational definitions of adult and childhood psychiatric symptoms, their classification, and specific diagnostic criteria for each category. It is important to establish whether children with a CAPD diagnosis would also exhibit this psychiatric disorder.

In addition, L2 children have the disadvantage of not having the instructional linguistic instrument available to

them in the same way that it is for L1 children: from birth, in all contexts, and in equivalent quantity. Therefore, it can be said that for the L2 child the acquisition process of the language of instruction does not occur as 'ideally' as for the L1 child. Consequently, the impact of a CAPD may be greater on the actual acquisition of the L2 instrument, that is, the learning of the L2 may be affected, and as a result its impact on the child's academic life may be evident much sooner than for the L1 child. The question that arises from this is whether CAPD is related to L2 acquisition and whether it may be a predictor for academic achievement in the L2 population.

The Smoski et al. (1992) study alerts us to the possibility that there are children who exhibit the presence of CAPD and no appreciable impact on academic performance, and there are those whose academic achievements are drastically affected. The investigation of what variables are different between these children and what variables are shared is another issue that needs to be addressed.

If academic performance is not the obvious variable that teachers use to pick out the CAPD children in the L1 group, the question of pinpointing what combination of factors the teachers use to pick out these children in the L2 population needs to be answered. The teacher's concern with the child's listening-attention behaviour may be an identification of a precursor to academic distress.

In the L2 population, the impact of different languages may be expressed in terms of the patterns of performance, and the patterns may be different from those in the L1 population. An examination of case histories is also of interest as it may contain early indicators or predictors of academic or linguistic performance. For example, grade retention history may show a long-standing problem. Also, the possible contributing role of Otitis Media to occurrence of CAPD has been mentioned. It is therefore interesting to establish whether OME is salient in the L2 child's audiological history.

Lastly, because the audiological instruments which are currently used to determine CAPD were standardized on L1 populations, it is not known whether the test norms are meaningful when applied to the L2 population. Also, some instruments, e.g., the Staggered Spondaic Word Test (SSW) (Katz, 1991) are used to distinguish subtypes of CAPDs. The importance of identification of CAPD subtypes, notes Katz, lies in its utility as a guideline for remediation. The ability of the instrument to classify L2 children must therefore also be determined.

The question of how a CAPD is recognized in an L2 child is crucial. The ultimate objective is to discover the answer to this question because it pertains to or approaches the problem from the point of view of clinical utility.

Research questions.

The determination of what makes up a CAPD in the L2 population requires that the variables noted in the previous sections be addressed. The following is the theoretical question that this study is designed to answer: Is CAPD a useful construct in the investigation of L2 children's academic distress?

There are three sets of major research questions. The first deals with the performance of L2 and L1 children on audiological tests:

1. How does L2 children's performance on Central Auditory Processing Tests (CAP) compare with test norms (obtained from L1 populations), and how does an L1 sample drawn from the same educational system as the L2 group perform on these tests?

2. Do the L1 and L2 samples show different severity levels and subtypes of CAPD?

The second set of questions deals with educational distress variables (EDVs). These are comprised of the L2 and the L1 children's performance in the areas of oral language, basic reading skills, reading comprehension, listening, psychosocial variables, and class performance:

3. How do L2 children and L1 peers (drawn from the same school system) perform on the EDVs: oral communication, basic reading, reading comprehension, listening,

psychosocial-behavioural measures, and class performance tests and instruments standardized on L1 populations?

4. How do the two language groups compare to each other on the EDVs?

The third set of questions examines the relationship between CAP performance and performance on EDVs.:

5. Is CAP performance related to performance on EDVs (oral language, basic reading skills, reading comprehension, listening, psychosocial behavioural, and class performance) in the L1 and L2 language groups: a. Can CAP severity be predicted from performance on EDVs? b. Can CAP subtype be predicted from performance on EDVs?

6. Does performance on the EDVs permit the clustering of children with similar profiles?

7. How are language group membership and EDV performance cluster related to CAP severity?

8. Are EDV performance clusters associated with specific CAP subtypes in the L2 and the L1 language groups?

9. What are the performance profiles of L2 and L1 children with low CAP performance, and what are the profiles of those with high CAP performance?

CHAPTER 3

METHOD

3.1 Overview

Two samples of elementary school children, an L2 and an L1 group, from the same school system were assessed by an audiologist, a speech-language pathologist (SLP), their classroom teachers, and their parents. The assessment included measures of the major variables believed to be associated with or influenced by the presence of a CAPD. Both standardized tests and rating scales provided the basic data on which statistical analyses were performed. The variables are summarized in Table 3.1.

Table 3.1

Study Variables

Screening	Educational Distress
1. Nonverbal Cognitive Ability	1. Oral language
2. Peripheral Hearing	2. Basic Reading
	3. Reading Comprehension
Grouping	4. Listening
1. L1= Mother's L1 English	5. Psychosocial-Behavioural Variables (home & School)
2. L2= Mother's L1 Italian	6. Class Performance
Audiology	
1. CAPD Severity	
2. CAPD Subtype	

Statistical analyses reported in the Results section used the grouping depicted in Table 3.1, and the basic data provided by measures of the Educational Distress Variables (EDVs) and the audiology tests.

3.2 Participants

School selection.

The participants in this study were 116 elementary school children, aged 8;0 to 11;11, in grades 3-6 inclusive, from the English sector of the CECM. The main vehicle for education and literacy in these school is English. However, French is taught from Kindergarten on a daily basis either as a second language or as part of a bilingual program where a quarter of a day in Kindergarten and one half of a day, from grade one, is conducted in French only. In the first three years, oral language comprehension and expression is emphasized in French, and literacy is not taught officially until grade three.

Since literature review for this study indicated that SES is associated with difficulties in many aspects of a child's development, children were drawn from six CECM schools that were not designated as belonging to the 'inner city' category, and were therefore *NOT* part of the 'Project Renewal' program (schools that receive additional funding from the Montreal Island Council because of their populations' low SES and inner city status).

Student selection.

The students were selected for the study from the school population according to the following procedures. Language variable: The selection of the children in this study was based on whether English was the child's mother tongue (L1) or second language (L2). This identification resulted in two language samples: an L1 and an L2 sample. In order to control for undesirable variability, and because children of Italian background constitute a majority in the English sector, only children whose mother tongue belonged to any variety of Italian were included in the L2 sample (for an in-depth description of the Montreal Italian community and its socio-politico-educational history see Taddeo & Taras, 1987).

Mother tongue was operationally defined as (1) the language the child's mother reports as her mother tongue and (2) the use of her mother tongue at home and with extended family (including mixing of mother tongue and any other language); Italian therefore was the mother tongue for the L2 sample, and English for the L1 sample. This operational definition was based on the assumption that young children spend a considerable portion of the time communicating with their mothers.

Information regarding the children's mother tongue was taken from a consent form, completed by the parent (see Appendix A & B). In cases where the information was not

clear, school records and telephone interviews were used to make the necessary determination.

The L1 sample included children who are 'bilingual'. That is, they may use another language, for example, French, in some social contexts. Nonetheless, by the operational definition, their mother tongue is English, as is the language of instruction.

Cognitive Ability: All prospective participants in the study were tested for general cognitive ability. This screening procedure was used to rule out the possibility of an underlying cognitive weakness (expressed by an IQ that is below the norms) that may be the major contributing factor to poor performance on other measures.

In order to avoid possible effects due to poor auditory system efficiency and language proficiency, a non-verbal test was selected. The Test Of Nonverbal Intelligence (TONI; Brown, Sherbenou, & Johnsen, 1982) is described in Appendix C. This test has a mean of 100 and a standard deviation of 15. Children who showed a score greater than 85 on the test were selected as candidates for participation in the study.

Language groups.

Children who were selected for participation and successfully fulfilled the requirements of the cognitive screening were then evaluated in audiology, in speech-

language pathology, and by teachers and parents. Complete data were obtained for a total of 116 children. The L2 language sample included 71 participants: 35 boys and 36 girls. In the L1 language group there were 45 participants: 21 boys and 24 girls. Table 3.2 shows their age distributions.

Table 3.2.

Age distribution in the L2 and L1 samples

	L2 (N=71)		L1 (N=45)	
Age	Number	Percent	Number	Percent
8;0 - 8;11	18	25	9	20
9;0 - 9;11	21	30	17	38
10;0 - 10;11	27	38	15	33
11;0 - 11;11	5	7	4	9

Note: L2=Italian mother tongue, L1=English mother tongue, N=total group size.

3.3 Audiology

Apparatus.

1. The Welch-Allyn 23300 audioscope was used for the cursory nondiagnostic otoscopic examination. This is to verify that the ear canal is free of debris and that the ear drum is visible and intact.

2. The Tracoustics single-walled Acoustical Enclosure RS-143-B (serial #7631) was the booth in which the children were tested. The audiometric suites consist of the control

and examination rooms forming a 2-room suite. Noise reduction from outside to inside either room corresponds to ANSI (1991, S3.1) measured standard attenuation regulations; control room to examination room noise reduction approximates standard double wall attenuation regulations.

3. The Amplaid 720 Immittance bridge was used to assess middle ear impedance and acoustic reflex function. Acoustical Immittance is a method for investigating the status of the middle ear system. A lack of compliance of the ear drum can indicate the presence of fluid in the middle ear cavity. Tympanometry is designed to reveal abnormalities of the structures and function of the middle ear.

4. The Madsen, Micro-5, diagnostic audiometer calibrated in accordance with ANSI (1989, S3.6) before the collection of data was used to present test items to the children via TDH 39 earphones with MX-AR/41 cushions. The speech reception threshold and word discrimination tests were administered live voice using this system. The central auditory processing test battery (SSW, SCAN auditory figure-ground subtest, & DDT) tape-recorded test stimuli were presented through the audiometer and a Technics RS-TR515 dual channel stereo cassette player. The CAP tests' stimuli were presented at 50dB SL (50 dB above the individual child's

puretone average across the frequencies of 500 - 2000 Hz for each ear).

Tests.

Air Conduction: Air conduction is a process by which sound is conducted to the inner ear via earphones. The audiometer produces pure tones of specified frequencies which are presented at various intensities. Hearing thresholds (the softest level at which sound is detected 50% of the time) are then plotted on an audiogram, and hearing acuity is determined for each ear separately.

Speech Reception Threshold: Spondaic words (bisyllables with equal emphasis on both syllables) were presented at 50dB HTL in each ear and then the intensity level for presentation was decreased in increments of 10dB until the level at which the child could respond correctly 50% of the time was determined. This constituted the speech reception threshold.

PBK-50 Word Lists for Word Discrimination Test (WDS): The PBK word lists (Davis, Silverman, Reynolds, Eldert, & Benson, 1952; Egan, 1948; Goetzinger, 1972) were used to assess speech discrimination. It consists of phonetically balanced monosyllabic words, that is, phonemes occur in this test in the same percentages as in normal spoken or written

language. The child must repeat the words which she or he hears. The test is given at 40dB SL under earphones in quiet (figure is salient, background is quiet) and in ipsilateral noise (white noise at a signal-to-noise ratio of +10dB). The number of correctly repeated words is calculated and expressed in a percentage. The Katz (1994, 1996) norms were used to define normal versus abnormal performance in both quiet and noise listening protocols.

Screening Test for Auditory Processing Disorders: The auditory figure-ground subtest of the SCAN (Keith, 1986), a speech-in-noise task, assesses word discrimination competence in a noisy environment. Monosyllabic words and background noise were presented simultaneously to the same ear at 50dB SL. The background noise consists of spontaneous speech babble such as may be found at an informal or party style gathering, and no single speaker or message is identifiable in the noise. The speech-to-noise ratio in this subtest is +8 dB which indicates that speech (figure) is 8 dB more intense or louder than the noise (ground). In testing, the child is required to repeat each word accurately. The number of correct responses is then calculated for each ear and then combined to produce a total subtest score. This yields a raw score which is then converted to a standard score and a percentile rank. The

SCAN has age-rated normative data from three through twelve years, zero months.

Performance on this task helps differentiate between children with an attention-deficit-disorder (ADD) and those with a CAPD. According to Keith (1986), ADD children invariably have no difficulty with this task, while children with poor language and learning performance show an inability to listen to the signal in this condition. Katz (1991), on the other hand, also notes that children who show fading memory problems also tend to have poor figure-ground scores. Katz suggests that this phenomenon may be due to the fact that both functions are located in the same neuro-anatomical region.

Dichotic Digit Test (DDT, Musiek, 1983a, 1983b, 1991). The DDT is composed of naturally spoken monosyllabic digits from 1-10 with matched onset times that are within 70 msec. Number seven was therefore excluded. Because it deals strictly with digits, it is considered a minimally language dependent test. The test consists of two options: listening to 20 single digits delivered to both ears simultaneously, or listening to 20 dichotic pairs (double digits) delivered to each ear.

The digits were administered at 50dB SL. Another option is the use of the pure tone average or 1000 Hz threshold. In testing, the subjects were required to repeat

all the digits they heard, and were encouraged to guess when uncertain. They were told that the order in which they report the digits is unimportant. They were given as much time as needed to respond to each trial. A percentage correct score wass calculated for each ear and for each test protocol. This allowed for inter-test and inter-ear comparisons. The DDT test provides both adult and child norms (from age 8 years) for comparison of each individual score.

Staggered Spondaic Word Test (SSW, Katz, 1987): This dichotic listening test requires accurate repetitions of 40 spondaic words (words consisting of two long syllables, e.g. raindrop). Spondees were chosen because they were found to be practically perfectly intelligible, even when close to the child's or adult's speech thresholds and when word discrimination scores were reduced. The presentation level was 50dB SL, and the SSW child norms were applied for comparison of each individual score. See Appendix D for a complete description of this test, including the classification of CAPD subtypes.

3.4 Educational Distress Variables

Tests.

Oral Language: This was measured by two tests: Test Of Oral Language Development (TOLD-I 2, Hammill, & Newcomer, 1988),

and The Listening Test (Barrett, Huisingh, Zachman, Blagden, & Orman, 1992). The first was chosen because it provides discrete measures of language components, and the other because it assesses integrative oral language skills which resemble those required in a classroom. These tests are described in Appendixes E and F.1 respectively.

Reading Ability: This variable was assessed by the Woodcock Reading Mastery Tests, revised (WRMT-R, Woodcock, 1990). The subtests used in this study, their administration, and scoring tools are described in Appendix G.

Scales.

Listening Ability: This was measured by the Children's Auditory Processing Performance Scale or CHAPPS (Smoski, Brunt, & Tannahill, 1992). This questionnaire type scale is shown in Appendix H.

Class Performance: The SIFTER: a Screening Instrument For Targeting Educational Risk was used to measure this variable. This instrument, developed by Anderson (1989) is described in Appendix I.

Psychosocial-Behavioural Variable: (home and school) This was assessed by the Conners' teacher rating scales (CTRS-39), and the Conners' parent rating scales (CPRS-48)

developed by Conners (1989). The scales and their scoring are described fully in Appendix J.

3.5 Procedure

Selection of children.

Selection of the children for the study began with the distribution of letters seeking parental consent (Appendix A contains a sample of the letter). The response to the first letter appeared to have encouraged the participation of children who were experiencing academic difficulty. A telephone interview with the parents confirmed this observation. In order to ensure that the total sample of children had a wide range of academic achievement, a second selection of children was made. The second selection was based on the children's successful performance on a screening task. In this task (Pesiri, 1986) the children were asked to select, from a choice of three words, the one that 'goes with' a set of two given words. I found that this semantic-cognitive written task , which I named "The thinking test" and used for group administration, asissted in identifying the lowest academic performance group in grades 3-6 inclusive (administration time average is 20 minutes). Prior to task administration, the class teacher was asked to name the children he or she felt were experiencing academic difficulties. The lowest scoring

children on the task almost always corresponded to those on the teacher's list.

My confidence that the task could identify students with the poorest academic performance was based on several hundred scores gathered in my work as a school SLP over a three year period prior to this study. Further evidence that this task was useful as a screening instrument came when the principal of a school, (not one of the six schools selected for this study) after several hours of observation in a third grade class in which the task had been administered the previous week, compiled a list of children he felt were exhibiting difficulties that warranted further examination. His list matched the lowest scoring group identified a week earlier (the task actually identified one more child). The teacher's list also matched the task and the principal's list.

After the 'thinking test' was administered in grades 3-6 in the designated schools for purposes of selecting participants for this study, I selected the children with the highest scores. In addition, I required that the teacher agree that the students exhibited no academic difficulties. Parental consent letters were then sent to the parents of these children. Appendix B contains a sample of this letter which emphasizes that the child successfully completed the screening task.

Both parental consent letters noted that the researcher reserved the right to select the children from amongst those who wished to participate. This stipulation was included because it was essential to remove from the sample any students whose poor academic performance could be attributed to below normal cognitive ability.

Each participating child was tested individually by the speech-language pathologist (myself) at the child's school, and by the audiologist at the audiology clinic. When a child had been selected, I contacted the parent by telephone, and provided the name and telephone number of the audiology clinic and contact person, so that an individual assessment appointment could be arranged. Transportation to the clinic on appointment day was offered for those parents who required it. However, none of the parents asked for transportation.

Audiology data collection.

Each child was accompanied by a parent (in most cases it was the mother, but in some cases both parents were present at the time of testing. In one case a step-father, a legal guardian, accompanied the child). A standard audiology case history, described in Appendix K, was completed by the parent prior to the child's evaluation in audiology, or at the audiology clinic while the child was

being evaluated. The completed case history form was collected from the parent at this time.

Prior to the evaluation the child was given an explanation of the equipment and procedures that would be used, and was told that the evaluation required approximately one hour. Next, an otoscopic exam was performed to verify that the ear canals were not obstructed, and acoustical impedance was administered to assess middle ear function.

The child was then seated in a sound proof room. Standard audiometric techniques were employed for pure tone, speech reception threshold, and word discrimination tests to determine the status of the peripheral hearing mechanism (Katz, 1985). Each of the CAP tests was administered according to its standard test administration techniques. Both the peripheral and the central assessment was achieved using the apparatus and tests described earlier.

All central auditory measures were obtained in a 30 minute session immediately following the hearing testing. In order to avoid fatigue, habituation, and practice effects, the order of presentation of test materials was counterbalanced. All test scoring was performed by the audiologist. Results were not given to me until I had completed all remaining testing.

Speech-language pathology data collection.

Prior to testing in each school, I met with the teachers who had the selected participants in their classrooms and briefly described the study and the procedures that would be followed. Each teacher was given an approximate date on which her class would be visited.

I tested each child individually in a quiet room at the child's school. Testing lasted from approximately 90 to 120 minutes. Prior to testing, each child was given the option of a short break from testing, for stretching, water, or bathroom needs, at the end of each test. In order to reduce anxiety, a pleasant tone of voice that denotes an atmosphere of ease was adopted in all communications with the child. The three standardized tests (the two language tests and the reading test) were administered in a random order to avoid possible order effects in test performance. All instructions to the child were given according to each test's administration protocol. A file containing a check list for all test forms and questionnaires was opened for each child. As each test was completed, the item was checked off.

At the end of testing, each child was given a package for the teacher which consisted of a form of the SIFTER (Appendix I), the CTRS (the teacher's Conners' scales in Appendix J), and the CHAPPS (Appendix H). A note was attached to the package informing the teacher that if he or

she needed time to complete these forms, I would be available to stay with the entire class for 20 minutes per package (some teachers were asked to complete forms for as many as five children from their class) so that the forms could be completed within the teacher's class time.

The child was also given a package for the parents which consisted of the audiology case history, and the CPRS (the Conners' parent scales in Appendix J). A note informing the parents that I would be calling to ask about the audiology testing appointment date, and asking them to inform me when audiological testing was completed, was attached to the package. This was to ensure that the audiology appointments were actually made and kept. Notes were made in the child's file that the packages had been handed out.

All scoring of the standardized tests was completed by me manually as well as with computer assisted programs designed for the TOLD (Hauger, 1988) and the WRMT (Hresko, & Schlieve, 1986). As well, I collected and scored all forms containing the questionnaires and rating scales for each child, completed by the parents and teacher. At the end of testing, I obtained for each child all the academic records from Kindergarten to the year and semester in which testing took place. All test forms, parent and teacher questionnaires, and copies of school records were added to the child's file, and the items were checked off to show

that these tasks were completed. As well, when the parents informed me that the audiological testing was completed, a check was made in this file. This system of storing test results and information helped me greatly in ensuring that I had complete data for each participant. These procedures were followed in each school before I moved on to another one.

Directly after testing was completed in each school, the participating teachers, the school principal, and the school secretary were invited to a lunch offered by me, and were given a T-Shirt which I designed with the logo 'All Children Can Learn' written on it.

I summarized all SLP test and questionnaire scores, for each child; the child's name, school, grade, age, gender, and language group membership (L1 or L2) was noted at the top of the sheet. When audiological testing was completed, a summary sheet with all test scores was completed for each child and both the SLP and the audiology summaries were placed in each child's file.

When all testing was completed, a reliability check was performed on all the files by a speech-language-pathologist associated with another university (McGill) to ensure that all files were indeed complete, test forms properly scored, and that the selected files actually contained all the required information and the resulting data.

Procedure for data analysis.

Quantitative as well as qualitative analyses were used in the data analyses. The quantitative analyses consisted of descriptive as well as inferential statistics. The relationship between CAP test results and academic distress variables was examined by multiple regression analyses.

In order to determine whether CAPD tasks are able to distinguish between L2 children with noted academic difficulties and those without such problems, and because a major purpose of this study was the profiling of L2 children with CAPD, cluster analysis (Lorr, 1983; Skehan, 1986, 1989) followed by discriminant analysis was applied in this study. Klecka (1980) explains that discriminant analysis refers to several statistical activities that can be viewed as belonging to either those of 'interpretation' or those of 'classification'. The latter is concerned with the classification of 'cases' into the groups that they most resemble according to some group characteristics (Klecka, 1980; Stevens, 1986). Interpretation, notes Klecka, is concerned with determining how well a 'set of characteristics' or variables is able to discriminate between groups, and identifying which of the variables are the most powerful discriminators (p.9). Both interpretation and classification applications of discriminant analysis were used in this study.

The qualitative analyses comprised multiple embedded case studies of children from both language groups, with and without CAPD. Chapter five is devoted to the case studies.

CHAPTER 4

RESULTS

4.1 Audiology

The results obtained from the audiological investigations address the general question of how L2 and L1 children perform on CAP tests, and what tests of the CAP battery contribute most to identification of CAP system efficiency in each language group. More specifically these are to answer the following:

1. How does L2 children's performance on Central Auditory Processing (CAP) tests compare with test norms (obtained from L1 populations), and how does an L1 sample drawn from the same educational system as the L2 group perform on these tests?
2. Do the L1 and L2 samples show different severity levels and subtypes of CAPD?

CAP test performance for L1 and L2 children.

Descriptive information, such as means, standard deviations, and ranges of scores obtained by standard procedures is reported for each test. Parametric statistical tests that compare the L2 and the L1 language samples were performed only on the Staggered Spondaic Words (SSW) test since it alone is designed to provide information on level of CAP system efficiency or CAPD severity, and subtypes. The Bonferroni procedure (Neter, Wasserman, &

Kutner, 1990; Stevens, 1986), was used to guard against Type I error (rejecting the null hypothesis when it is true) and to avoid capitalizing on chance differences between groups when a number of variables are compared experiment-wise. According to this procedure, an experiment-wise alpha level of .05 can be achieved by adopting a probability (p) of .01 (.05 divided by 5 between groups comparisons =.01) for each of five between language group comparisons.

Nonparametric statistical tests were performed on the Word Discrimination Test (WDS), the Dichotic Digits Test (DDT), and the auditory figure-ground subtest of the SCAN because non-normal score distributions were evident (ceiling effects were found) in these. The Kruskal-Wallis Oneway ANOVA or H test was chosen because it is analogous to the parametric F of the Oneway ANOVA except that it is based on a between groups sum of squares that is computed on ranks of scores (Welkowitz, Ewen, & Cohen, 1991). In this procedure the two groups were combined and the cases ranked. The ranks were summed for each group and the H statistic calculated from these sums (Norušis, 1990, p.221)

Word discrimination tests (WDS).

These yielded percent correct scores for the Right and Left ears in both quiet and noise conditions for the L2 and the L1 groups.

The descriptive results are summarized in Table 4.1. They include means, standard deviations, and degradation (drop of performance) from the quiet to the noise condition for each ear and language sample.

Table 4.1.

WDS language group means, SDs, and performance difference scores expressed in percent

	QUIET			NOISE			
	Mean	SD	Range	Mean	SD	Range	Differ
L2 (N=71)							
Right Ear	96.00	4.73	72-100	76.39	15.45	20-96	19.61
Left Ear	94.48	6.60	76-100	76.96	13.17	36-96	17.52
L1 (N=45)							
Right Ear	95.91	4.39	72-100	76.89	10.65	56-100	19.02
Left Ear	96.09	5.01	68-100	79.73	10.32	52-96	16.36

Note. L2=Italian mother tongue, L1=English mother tongue, Differ=Difference between quiet and noise conditions (performance degradation), Quiet=signal word without noise background, Noise=signal word with white noise background @ 50dB & +10 s/n ratio.

The L2 group range was narrow, and the means, in the quiet condition for both the Right and Left ears, were well above the 90% criterion for normal performance as defined by Katz (1994). The L2 means in the noise condition did not show a degradation of as much as 20%, and thus also met the required criterion. However, the range was very wide. Similar results were noted for the L1 group, that is, the range was narrow in the quiet condition and wider in the

noise condition, but not as wide as in the L2 group. However, the mean scores and the degradation between conditions for each of the ears were within normal standards.

The differences between the L2 and L1 in the noise condition were examined using the Kruskal-Wallis Oneway ANOVA. There were no significant differences between the language groups on either the right ear (Chi-Square =.004, p>.05) or the left ear (Chi-Square=.453, p>.05) on the WDS test.

SCAN figure-ground subtest.

This subtest yielded results expressed in standard scores with a mean of 10 and a standard deviation of 3. The results for each language group are summarized in Table 4.2. It contains the language group mean, standard deviation, and a comparison score to show the difference from test mean expressed in a standard deviation score.

The deviation mean score was calculated by deducting the language group mean from the SCAN mean (10) and dividing the remainder by the language group standard error of the mean. This score is useful in that it allows an instant view of how far the language group means deviate from the test norms in either direction, that is, above or below the mean.

Table 4.2.

L2 and the L1 group means on the SCAN Figure-Ground subtest

Group	Range	Mean	SD	SE	10-Mean/Group SEm
L2(N=71)	3 - 12	5.72	2.57	.31	13.81
L1(N=45)	3 - 13	6.44	2.74	.41	8.68

Note. L2=Italian mother tongue, L1=English mother tongue
SEm=standard error of the mean.

The resulting L2 group score showed 14 standard errors below the norming group, and the L1 group score showed 9 standard errors below the SCAN norming group. Although both language groups' scores deviated greatly from the SCAN norms, the L2 group score seemed notably more deviant than the L1 group. However, the Kruskal-Wallis Oneway ANOVA showed no significant differences between the groups on the SCAN test (Chi-Square= 2.354, $p>.05$). Such low scores in a non-clinical population suggest that the SCAN norms are not appropriate for these groups. An acceptable level for test sensitivity (the accuracy in identifying individuals with disorders) and specificity (the accuracy in identifying individuals without disorders) remains to be established in this population. The auditory figure-ground subtest of the SCAN showed excellent sensitivity but poor specificity and had little diagnostic power in separating out these clinically nondisordered groups.

Dichotic Digits test (DDT).

The single and double digits subtests for both the right and the left ear were administered. The test yielded percent correct scores. Table 4.3 contains the descriptive scores for single and double digits for the right and left ears, for both groups.

Table 4.3.

The DDT single and double digits Right and Left Ear means, ranges, and standard deviations

Lang Group	N	RIGHT EAR Mean	SD	Range	LEFT EAR Mean	SD	Range
Single Digits							
L2	71	98.68	2.91	85-100	94.13	9.68	40-100
L1	45	99.56	1.79	90-100	95.67	5.18	80-100
Double Digits							
L2	71	89.78	10.58	45-100	71.94	21.07	13-100
L1	45	90.02	8.06	68-100	76.90	13.53	48-100

Note. L2=Italian mother tongue group, L1=English mother tongue group.

The single digits test results for the Right Ear for both the L1 and the L2 group, expressed in percentage correct responses, were close to 100%, and narrow in range. Although the Left ear condition yielded high means as well, it showed a somewhat wide range of performance for the L1 group, and a notably wider range for the L2 group.

The double digits subtest showed a wide range of performance for both language groups; the L2 group's range

extended well below that of the L1 group for both the right and left ears.

A difference of means was noted for both language groups from the single digits to double digits performance, as well as from the right to the left ear. Table 4.4 contains the mean differences for both language groups.

Table 4.4.

DDT performance difference of means from single to double digits, and right to left Ear

	Right Ear			Left Ear		
	Single	- Double	Difference	Single	- Double	Difference
L2	98.68	- 89.78 =	8.90	94.13	- 71.94 =	22.19
L1	99.56	- 90.02 =	9.54	95.67	- 76.90 =	18.77
	Single Digits			Double Digits		
	Right	- Left	Difference	Right	- Left	Difference
L2	98.68	- 94.13 =	4.55	89.78	- 71.94 =	17.84
L1	99.56	- 95.67 =	3.89	90.02	- 76.90 =	13.12

Note: L2=Italian mother tongue, L1=English mother tongue.

A notable drop of performance from single digits to double digits subtest occurred in the right ear for both language groups, however a substantially larger drop occurred in the left ear. Also, the difference of performance between the right and the left ear was much larger in the double digits subtest than in the single digits. This shows that the single digits right ear performance was better for both groups than any other

listening condition. The left ear double digits listening performance appeared to be the most difficult for both language groups, but apparently more difficult for the L2 than the L1 group.

The differences between the L2 and L1 language groups on the DDT double digits in both the right and the left ears were tested using the Kruskal-Wallis Oneway ANOVA. No significant differences between L2 and L1 were found in either the right ear (Chi-Square=.2637, $p>.05$) or the left ear (Chi-Square= .492, $p>.05$).

Staggered spondaic word test (SSW).

This test yielded scores expressed in actual number of errors (NOE) for both ears in both competing and non-competing conditions. Table 4.5 summarizes language groups' mean NOEs and standard deviations for each ear and listening condition (in the order of test presentation): right noncompeting (RNC), right competing (RC), left competing (LC), and left noncompeting (LNC). As well, it contains the total error rate for each ear to investigate listening path trends in the two groups.

Table 4.5.

SSW Group mean NOEs and standard deviations for RNC,RC, LC, and LNC for the SSW test, and total mean per language group

	N	RNC		RC		LC		LNC	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
L2	71	5.99	4.52	11.35	6.16	18.63	9.07	7.07	5.37
L1	45	4.51	2.97	9.44	4.90	13.49	7.33	4.56	3.32

		REM	SD	LEM	SD
L2	71	17.34	9.71	25.70	15.25
L1	45	13.96	7.12	18.04	9.82

Note: L2=Italian Mother tongue, L1=English Mother tongue, N=group size SD=standard deviation, RNC=right noncompeting, RC=right competing, LC=left competing, LNC=left noncompeting, REM=right ear mean, LEM=left ear mean.

The SSW results showed an expected higher error rate for the competing conditions for both ears in both language groups. The overall means showed the left ear error rate as higher in both language groups.

A repeated measures fully factorial design MANOVA was performed to investigate the SSW right ear versus left ear listening differences in each language group. Table 4.6 displays the cell means and the grand means for ear and language variables.

Table 4.6.

SSW Repeated Ear (Right, Left) within Language group (L2, L1) MANOVA Cell Means & Grand Means

	Right Ear		Left Ear		
	Mean	SD	Mean	SD	Language G-Mean
L1 N=45	13.96	7.05	18.04	9.82	32.00
L2 N=71	17.34	9.71	25.70	13.23	43.04
Ear G-Mean	16.03		22.73		

Note: G-Mean=Grand Mean

These means were used to obtain the results displayed in Table 4.7.

Table 4.7.

SSW Repeated Ear (Right, Left) within Language group (L2, L1) MANOVA

	DF	SS	MS	F	Sig.of F
Within+ Residual	114	21118.44	185.25		
Language Group	1	1679.18	1679.18	9.06	.003
Within+Residual	114	4156.06	36.46		
Ear	1	2136.37	2136.37	58.60	.000
Language x Ear	1	251.96	251.96	6.91	.010

Note: L2=Italian mother tongue, L1=English mother tongue.

The results showed two significant main effects: the language groups differed significantly ($p<.005$) on the SSW NOE, and there was also a significant difference ($p<.001$) between the right and the left ear. A significant ($p<.01$) interaction between language and ear was evident.

Post hoc tests were performed on single effects of ear within each language group. Table 4.8 shows the between language group effects, and the within subject ear effects.

Table 4.8.

SSW Post Hoc tests: Between subjects language group effects & Within subjects ear effects

	D.F.	SS	MS	F	Sig F
Within+Residual	114	21118.44	185.25		
MWithin L1	1	23040.00	23040.00	124.37	.000
MWithin L2	1	65768.56	65768.56	355.03	.000
Within+Residual	114	4156.06	36.46		
MWithin L1 x Ear	1	376.18	376.18	10.32	.002
MWithin L2 x Ear	1	2484.76	2484.76	68.16	.000

The post hoc univariate tests confirmed a significant interaction effect between language group and ear: in each language group the NOE means for the left ear were significantly higher than for the right ear, and the NOE mean for the left ear in the L2 group was significantly higher than the NOE left ear mean in the L1 group.

Next, the total number of errors (NOEs) for both ears under four listening conditions for each subject was calculated and the resulting scores compared with the SSW NOE age norms. The SSW NOE norm was subtracted from the obtained NOE total, and the remainder was divided by the SSW NOE standard deviation. The resulting score, a deviation mean, shows at a glance the fit between the obtained score

and the test norms. The mean and SD of the standard scores as well as the range was calculated for each language group, and these are shown in table 4.9.

Table 4.9.

SSW NOE deviation means, standard deviations, and range of deviation scores for the L2 and the L1 groups

	N	DMean	SD	Range
L2	71	6.389	4.623	-1 - 22.67
L1	45	4.306	3.546	0 - 12.00

Note: L2=Italian mother tongue, L1=English mother tongue, DMean=Deviation Mean, SD=Standard deviation.

The results for both language groups showed rather high means, but the L2 mean was higher and the range of scores considerably wider than the L1 mean and range.

Because the group means were notably high, it was felt that the language group scores were different from the SSW test norms. Accordingly, the distribution of the scores was examined in order to investigate the differences between the group results and the test norms. Table 4.10 summarizes the number of cases in each language group that are within -1 and +1 deviations, the number between +1 and +2, and the number that is greater than 2 deviations above 0. It should be recalled that high scores indicate a greater number of errors.

Table 4.10.

NOE deviation means frequency distribution for the L2 and the L1 language groups

	NOE Z Score Range			
	-1 to +1	+1 to +2	>2	%Cases>2
L2 (N=71) Cases	6	7	58	81.69
L1 (N=45) Cases	11	3	31	68.89

Note: NOE=Number Of Errors, Z Score=Deviation mean.

The L2 group exhibited an enormous percentage of NOE deviation means that were >2 SDs (mean=0= 'no problem' status; mean≥2SD=clinically significant for individual scores). The L1 group as well showed a high percentage of deviation means that were >2 SDs, but not as high a percentage as the L2 sample.

Table 4.11 summarizes a Oneway between group ANOVA that compares the L2 and the L1 NOE deviation means.

Table 4.11.

SSW NOE standard means oneway between language group ANOVA

	D.F.	SumS	MS	F-Ratio	F-Prob
Between Group	1	119.4086	119.4086	6.6434	.0112
Within Group	114	2049.0243	17.9739		

The results did not reach significance with the Bonferroni adjustment ($p<.01$ to indicate $p<.05$ alpha). Without the Bonferroni procedures, a significant ($p<.0112$)

difference occurred between language groups on the NOE deviation means.

CAPD subtypes.

Next, the SSW response biases were used to determine the presence of a CAPD subtype: Decode (D), Tolerance-Fading-Memory (TFM), Organization (O), Integration (I), Generalized (G), and Mixed (M) (See Appendix D for an explanation of the subtypes). Because the Mixed subtype was made up of combinations of Decode, TFM, and Organization, the frequency of each of these within the Mixed subgroup was added to the individual subtype groups. The Mixed subgroup showed the following combinations: D+O; D+TFM+O; TFM+O; TFM+D. Table 4.12 shows the numbers and percentages of those exhibiting no problem (NP), and those showing subtypes, in each language group.

Table 4.12.

L2 and L1 group frequencies and percentages of SSW 'No Problem' and CAPD subtypes

NP	D	TFM	O	I	G	M
L2 (N=71)						
11(15%)	33(47%)	19(27%)	10(14%)	2(3%)	11(16%)	13(18%)
L1 (N=45)						
13(29%)	14(31%)	15(33%)	10(22%)	1(2%)	4(9%)	13(29%)

NOTE: L2=Italian mother tongue, L1=English mother tongue, N=group size, NP=No Problem, D=Decode, TFM=Tolerance-Fading-Memory, O=Organization, I=Integration, G=Generalized, M=Mixed.

The percentage of those exhibiting No Problem in the L1 group was twice that in the L2 group. The CAPD subtype percentages indicated that in the L2 group the most frequent subtype was Decode followed by TFM, whereas in the L1 group TFM was the most frequent subtype followed by Decode. The Generalized subtype (indicated by the presence of a high error rate but no response bias) frequency in the L2 group was almost double that in the L1 group. The Mixed (consists of response biases that show the presence of more than one subtype in the same individual) and the Organization subtypes were more frequent in the L1 than in the L2 group. The Integration subtype was rare in both language groups.

Although the descriptive results seemed to show differences between the language groups' subtype

distribution, a chi-square test did not confirm an association between subtype and language group membership (Chi-square= 10.146, 6 degrees of freedom; $p>.05$).

Question 1 & 2 summary: L2 and L1 groups did not differ significantly from test norms on the WDS and the DDT, nor from each other. Both groups differed from the SCAN test norms but did not differ significantly from each other. While both language groups differed considerably from the SSW test norms, the L2 performed significantly worse than the L1 group. The SSW subtypes were not associated with language group membership.

4.2 Educational Distress Variables

In this section the L2 and the L1 children's test results on the educational distress variables (EDVs) are reported. The reported results are to answer the following questions:

3. How do L2 children and L1 peers (drawn from the same school system) perform on the EDVs: oral communication, basic reading, reading comprehension listening, psychosocial-behavioural measures, and class performance tests and instruments standardized on L1 populations?
4. How do the two language groups compare to each other on the EDVs?

Oral language, basic reading, reading comprehension, listening, psychosocial, and class performance for L1 and L2 children.

Several tests and subtests were administered to examine the children's performance on each of the EDVs. Descriptive information such as means, standard deviations, and ranges is provided for each test. Because of the necessity to restrict the number of comparisons experiment-wise to guard against Type I error, parametric tests were used for between group comparisons on standardized tests only. These were chosen because they provide actual children's responses and therefore provide a clearer view of academic distress than parents' or teachers' observations about the children's performance that questionnaire type scales provide. As for the audiological variables, a probability of .01 is adopted for each comparison so that an experiment-wise Alpha of .05 is maintained (following the Bonferroni statistical procedure to guard against inflated Type I error).

Oral language.

Test of oral language development (TOLD-2 I).

This test provides standard scores with a mean of 100 and a standard deviation of 15 in four language areas: listening, speaking, semantics, and syntax, as well as a total test score. Table 4.13 summarizes descriptive results

for the language groups' listening, speaking, semantics, syntax and overall TOLD performance.

Table 4.13.

TOLD-2 Intermediate means, SDs, and ranges for L2 and L1 language groups

L2 N=71	Mean	SD	Range
Listening	89.70	8.55	74 - 115
Semantics	86.65	9.36	70 - 113
Syntax	84.00	11.63	59 - 109
Speaking	81.00	11.31	61 - 109
Overall	85.33	9.33	69 - 110
L1 N=45			
Listening	95.84	9.30	76 - 117
Semantics	95.44	10.20	79 - 119
Syntax	88.53	10.89	66 - 109
Speaking	88.13	10.49	68 - 113
Overall	92.00	9.14	75 - 113

Note: L2=Italian mother tongue, L1=English mother tongue, N=Group size, SD=Standard Deviation.

The descriptive results showed consistently lower mean scores for the L2 group. Both groups showed the same pattern of performance: in both groups Listening and Semantics showed better performance than Speaking and Syntax, with Speaking being the lowest score. The L2 and L1 groups' subtest scores were examined to see how they compare with test norms. Table 4.14 contains the comparison calculations derived in the following way: the language group mean score was deducted from the TOLD mean (100) and

the remainder was divided by the language group standard error of the mean (SEm). The resulting score shows how far the language group means deviate from the test norms.

Table 4.14.

TOLD Syntax, Speaking, Semantics, and Listening standard error mean difference for L2 and L1

Subtest	L2 SEm	L2 100-M/SEm	L1 SEm	L1 100-M/SEm	L2 - L1 Difference
Syntax	1.38	11.59	1.62	7.07	4.52
Speaking	1.34	14.16	1.56	7.59	6.57
Semantics	1.11	12.02	1.52	3.00	9.02
Listening	1.02	10.15	1.39	3.00	7.15

Note: L2=Italian mother tongue, L1=English mother tongue, SEm=standard error of the mean, M=mean, Gr=group.

The means in all subtests for both groups were below test standards. However, the L2 group means were considerably lower than the L1 group means in all subtests. In the L2 group, although the mean for Semantics was seemingly better than the Syntax subtest mean, the SEms in both showed that they were both well below test standards. In the L1 group the Listening and Semantics subtest SEms were much closer to TOLD standards than the other subtests.

The results showed that the lowest scores occurred in the L2 group. The frequency of distribution of scores was therefore examined, and is depicted in Table 4.15.

Table 4.15.

TOLD distribution of scores (percentage) within 1, 2, and 3 standard deviations below and above TOLD test mean

	3SD<M ≤55	2SD<M 56-70	1SD<M 71-85	1SD<-1SD>M 86-114	1SD>M 115-129	2SD>M 130-144	3SD>M 145-160
L2							
Syn	0	9	47	44	0	0	0
Spe	0	17	51	32	0	0	0
Sem	0	6	44	50	0	0	0
Lis	0	0	41	58	1	0	0
All	0	4	52	44	0	0	0

	3SD<M ≤55	2SD<M 56-70	1SD<M 71-85	1SD<-1SD>M 86-114	1SD>M 115-129	2SD>M 130-144	3SD>M 145-160
L1							
Syn	0	4	33	63	0	0	0
Spe	0	2	42	56	0	0	0
Sem	0	0	22	71	7	0	0
Lis	0	0	13	83	4	0	0
All	0	0	29	71	0	0	0

Note: L2=Italian mother tongue, L1=English mother tongue, TOLD mean=100, SD=15, Syn=Syntax, Spe=Speaking, Sem=Semantic, Lis=Listening, All=Overall.

No cases occurred in the lowest range (<3 SD) in either group. The L2 group showed more cases than the L1 group in the 1 and 2SD<m range in all subtests but Listening, where the L2 group showed no cases in the 2SD<m range.

The Listening Test (TLT). This test, like the TOLD, yielded standard scores based on a standard of 100 and an SD of 15. The results encompass five areas and an overall test score. Table 4.16 contains the descriptive results for each of the areas tested.

Table 4.16.

TLT means, standard deviations, and ranges for the L2 and the L1 language groups

L2 N=71	Mean	SD	Range
Story Comp.	91.92	15.77	55 - 120
Concepts	89.80	15.68	55 - 119
Reasoning	88.87	15.57	55 - 117
Details	87.76	18.10	55 - 119
Main Idea	87.56	16.30	55 - 121
Total TLT	89.18	12.86	57 - 113
L1 N=45			
Story Comp.	97.27	12.41	55 - 117
Concepts	95.04	14.95	59 - 119
Reasoning	89.71	12.66	56 - 120
Details	97.11	14.42	67 - 128
Main Idea	97.31	11.67	67 - 115
Total TLT	95.30	9.27	71 - 114

Note: L2=Italian mother tongue, L1=English mother tongue, Story Comp=story comprehension, SD=standard deviation.

These results showed that in all areas tested the L2 means were lower than the L1 means which appeared more similar to the TLT test means. The ranges in both groups were notably wide.

The L2 and L1 groups' subtest scores were examined to see how they compare with test norms. Table 4.17 contains the comparison calculations.

Table 4.17.

TLT subtests' standard error of the mean difference for L2 and L1

Subtest	L2 SEm	L2 100-M/SEm	L1 SEm	L1 100-M/SEm	L2 - L1 Difference
Story.	1.87	4.32	1.85	1.48	2.84
Concepts	1.86	5.48	2.23	2.22	3.26
Reasoning	1.85	6.02	1.89	5.45	0.57
Details	2.15	5.70	2.15	1.34	4.36
Main Idea	1.93	6.43	1.74	1.55	4.88

Note: L2=Italian mother tongue, L1=English mother tongue, SEm=standard error of the mean, M=mean.

In all subtests, the SEms for both groups showed that the means were below TLT standards (m=100). However, the L2 group SEms showed notably lower means than those of the L1 group in all subtests except for Reasoning where the means were very close as shown by the small SEm difference. This indicated that for the L1 group, this subtest was the most difficult.

Frequency of score distribution was examined for both language groups to note the scores that lay between 1 and 3 SDs below and above test means in each subtest and for the total. Table 4.18 shows these results.

Table 4.18.
TLT percentage distribution of scores from 1 to 3 SDs below test mean

	3SD<M ≤55	2SD<M 56-70	1SD<M 71-85	1SD<-1SD>M 86-114	1SD>M 115-129	2SD>M 130-144	3SD>M 145-160
L2							
Sto	3	7	27	56	7	0	0
Con	1	14	27	55	3	0	0
Rea	4	6	24	60	6	0	0
Det	4	18	16	58	4	0	0
MId	6	13	24	54	3	0	0
All	0	10	25	65	0	0	0
	3SD<M ≤55	2SD<M 56-70	1SD<M 71-85	1SD<-1SD>M 86-114	1SD>M 115-129	2SD>M 130-144	3SD>M 145-160
L1							
Sto	2	2	9	83	4	0	0
Con	0	7	18	66	9	0	0
Rea	0	4	33	61	2	0	0
Det	0	2	11	76	11	0	0
MId	0	2	16	80	2	0	0
All	0	0	9	91	0	0	0

Note: L2=Italian mother tongue, L1=English mother tongue, M=mean, Sto=Story Comprehension, Con=Concepts, Rea=Reasoning, Det=Details, MId=Main Idea, All=Total TLT.

The L2 group showed many more scores below the normal range (>1SD<m) than the L1 group. Interestingly, unlike the TOLD test, the L2 group showed scores in the lowest range (>3SD<m) in all subtests (except for the overall score) indicating that some children found this test more difficult than the TOLD test. Only one score occured in this range in the L1 group.

Reading ability.

Woodcock Reading Mastery Tests - Revised (WRMT-R)

In Table 4.19 the reading mastery test results are reported in standard scores based on a standard mean of 100 and a standard deviation of 15. Results are given for two basic skills subtests and a basic skills total score, and for two comprehension subtests and a comprehension total score. An overall total test result is also given.

Table 4.19.

WRMT Subtest means, standard deviations, and ranges for the L2 and the L1 language groups

	Mean	SD	Range
L2 (N=71)			
Word Identification	97.04	14.12	63 - 137
Word Attack	97.35	13.40	63 - 135
Basic Skills Total	96.97	14.01	61 - 138
Word Comprehension	92.14	12.14	56 - 125
Passage Comprehension	92.42	13.03	54 - 123
Comprehension Total	91.17	12.53	54 - 125
WRMT Total	94.52	12.36	60 - 131
L1 (N=45)			
Word Identification	103.33	12.67	67 - 138
Word Attack	99.82	11.19	67 - 122
Basic Skills Total	102.31	11.90	68 - 128
Word Comprehension	97.98	12.29	66 - 140
Passage Comprehension	97.38	13.06	64 - 138
Comprehension Total	96.73	13.08	63 - 146
WRMT Total	99.60	11.23	68 - 134

Note: L2=Italian mother tongue, L1=English mother tongue.

The L2 means in the reading subtests were consistently lower than L1 means. In both groups the means were very close to the WRMT standards. The range in both groups

spanned from two SDs below the mean to over three SDs above the mean. Frequency of score distribution was examined for both language groups to note the scores that lie between 1 and 3 SDs below and above test means in each reading area and for the total test. Table 4.20 shows these results.

Table 4.20.

WRMT percentage distribution of scores between 1 & 3 SDs below and above test means in each language group.

	3SD<M ≤55	2SD<M 56-70	1SD<M 71-85	1SD<-1SD>M 86-114	1SD>M 115-129	2SD>M 130-144	3SD>M 145-160
L2							
Bas	0	4	16	72	7	1	0
Com	0	3	25	68	3	0	0
TOT	0	4	16	76	3	1	0
L1							
Bas	0	2	4	81	13	0	0
Com	0	2	13	79	4	0	2
TOT	0	2	9	83	4	2	0

Note: L2=Italian mother tongue, L1=English mother tongue, Bas=Basic Skills, Com=Comprehension Skills, Tot=Total Reading.

While the majority of cases in both groups occured in the normal range (86-114), more scores occurred in the lower ranges in the L2 group than in the L1 group.

Oral language & reading ability group comparisons.

A Oneway Multivariate Analysis of Variance (MANOVA) was performed on the TOLD, TLT, Basic reading, and Reading Comprehension to determine the significance of the performance difference between the L2 and the L1 language

groups on these tests (a 4 x 2 design yielding a language group effect). The results are shown in Table 4.21.

Table 4.21.

Oneway MANOVA of L2 vs L1 language group on TOLD, TLT, Basic & Comprehension of reading

Multivariate Test of Significance (S=1, M=1, N=54 1/2)

Test Name	Value	Exact F	Hypoth.DF	Error DF	Sig. of F
Pillai's	.117	3.670	4.00	111	.008

A significant ($p<.008$) language group effect was determined by Pillai's Trace. Pillai's Trace was chosen as the multivariate test of significance because it is the most robust criterion even when the assumption of homogeneity of variance is violated (Norušis, 1990, p.95 [Advanced SPSS])).

Univariate F-tests were performed in order to establish which of the variables contributed to the significant language group effect. These are reported in Table 4.22.

Table 4.22.

Univariate F-Tests of TOLD, TLT, Basic & Comprehension of reading with (1, 114) Degrees of Freedom

Variable	Hypoth.SS	Error SS	Error MS	F	Sig. of F
TOLD	19514.090	156365.798	1371.630	14.227	.000
TLT	25670.637	384012.604	3368.532	7.621	.007
Basic R	785.196	19971.588	175.189	4.482	.036
Comp R	852.780	18514.772	162.410	5.251	.024

Note: TOLD= Discrete Oral language test, TLT= Integrative Oral language test, Basic R=Basic reading skills, Comp R= Reading comprehension.

The Univariate *F*-tests, with the Bonferroni adjustment ($p<.01=.05$ alpha), showed that only the two oral language tests, the TOLD (highly significant at $p<.001$) and the TLT (significant at $p<.01$), were responsible for the difference between the two language groups. Although the L2 group's mean scores were consistently below those of the L1 group on the Basic Reading and on the Reading Comprehension tests, the differences failed to reach significance at the .05 level (after the Bonferroni adjustment).

Listening ability.

Children's Auditory Processing Performance Scale (CHAPPS)

This scale, based on a questionnaire completed by each child's teacher, yielded a mean rating score for each of the six listening conditions, as well as an overall CHAPPS mean rating per subject (See Appendix H). Language group scores were calculated from the individual scores.

The descriptive results are summarized in Table 4.23. They include means, standard deviations, and ranges for each listening condition: Noise, Quiet, Ideal, Multiple Inputs, Auditory/Sequential Memory, Auditory Attention, and Overall Listening. Table 4.23 shows the CHAPPS descriptive information for each listening condition and the overall scale.

Table 4.23.

CHAPPS means, SDs, and ranges for L2 and L1 language groups

	Mean	SD	Range
L2 N=71			
Noise	.466	1.142	-1 - 4.00
AudMemSeq	.111	1.081	-1 - 3.50
AudAtt	.035	1.057	-1 - 3.75
Quiet	-.079	1.027	-1 - 3.29
Multiput	-.272	.978	-1 - 3.00
Ideal	-.315	.953	-1 - 3.33
Overall	-.009	.964	-1 - 3.26
L1 N=45			
Noise	.184	.816	-1 - 2.43
AudMemSeq	-.091	.840	-1 - 2.88
AudAtt	.060	.851	-1 - 2.50
Quiet	-.076	.821	-1 - 2.43
Multiput	-.245	.780	-1 - 2.00
Ideal	-.363	.710	-1 - 2.00
Overall	-.089	.717	-1 - 2.11

Note. L2=Italian mother tongue, L1=English mother tongue, SD=Standard Deviation, N=Group size, Multiput=Multiple inputs, AudMemSeq=Auditory/sequential memory, AudAtt=Auditory Attention.

The L2 and L1 overall means were very similar. In general, the scores for both groups showed no problem in listening. The noise and auditory memory sequencing

listening conditions were the only scores on which the groups seemed to differ, with the L2 means somewhat elevated compared to the L1 means.

The standard deviations and ranges were considerably larger for the L2 group than the L1 group in all listening conditions, indicating a notably greater variability in scores than the L1 group. The ranges were examined in the following way. The percent of scores for each listening condition was rated as ≥2 (within the 'More Difficult' category), and the percent rated as ≥3 ('Considerably more difficult') was calculated for each language group, and is presented in Table 4.24.

Table 4.24.

CHAPPS percent of 2, 3, & 4 ratings for each listening condition for L2 and L1 language groups

Condition	L1% ≥2	L2% ≥2	L2% ≥3	L2% ≥4	L2% Sum ≥2-≥4
Noise	2	10	3	1	14
AudMemSeq	2	4	3	0	7
AudAtt	2	3	1	0	4
Quiet	2	3	3	0	6
Multiput	2	1	3	0	4
Ideal	2	1	3	0	4
Total	2	3	1	0	4

Note: L2=Italian mother tongue, L1=English mother tongue, 2=More Difficulty, 3=Considerably More Difficulty, 4=Significantly More Difficulty.

The results showed that relatively few individuals' scores were elevated in both language groups. In the L2

group the elevated scores occured in the Noise condition, while the L1 group showed only one case in the 'More Difficulty' range in each listening condition, and none in the higher categories in any listening condition. The L2 group also had one case in the 4 rating category indicating 'Significantly More Difficulty' than others. This too occurred in the Noise listening condition.

Psychosocial-behavioural Variable: home and school. Conners' Teacher Rating Scales (CTRS)

The Conners' consists of seven scales that provide a T-score with a mean of 50 and an SD of 10. A score of 70, (that is, two SDs above the mean) is considered clinically significant. However, scores higher than 65 are considered as being in the "Problem" range behaviourally.

Table 4.25 contains the language groups' means, standard deviations, and ranges in the seven scales: Hyperactivity, Conduct Problem, Emotional-Indulgent, Anxious-Passive, Asocial, Daydream-Attention, and Hyperactivity Index (See Appendix J for details).

Table 4.25.

CTRS L2 and L1 means, SDs, and ranges for all scales

	Mean	SD	Range
L2 (N=71)			
Hyperactivity	49.62	9.49	39 - 84
Conduct Problem	49.44	8.90	43 - 80
Emotional-Indulgent	50.85	9.09	42 - 81
Anxious-Passive	50.06	11.00	38 - 85
Asocial	49.83	10.00	43 - 88
Daydream-Attention	50.09	9.70	41 - 80
Hyperactivity Index	50.23	9.34	40 - 72
L1 (N=45)			
Hyperactivity	50.62	8.86	39 - 72
Conduct Problem	51.18	8.45	43 - 75
Emotional-Indulgent	53.70	12.67	42 - 92
Anxious-Passive	47.73	10.05	38 - 73
Asocial	51.40	10.81	43 - 98
Daydream-Attention	52.22	11.85	41 - 80
Hyperactivity Index	51.20	10.20	40 - 80

Note: L2=Italian mother tongue, L1=English mother tongue.

These descriptive results showed very similar mean scores in all the scales for each language group as well as between the language groups. All means were very close to the scales' mean of 50 or in the "Low/Average" category in both language groups. The ranges in both groups were wide in all scales.

The percent of ratings in the 'problem' category and in the clinically significant category were calculated for each scale and language group, as summarized in Table 4.26.

Table 4.26.

CTRS Percent of T-scores in the 'problem' range and clinical zone

	L2 Percent%			L1 Percent%		
	≥1.5SD	≥2SD		≥1.5SD	≥2SD	
	65-69	70+	Com	65-69	70+	Com
Hyperactivity	6	3	9	4	2	6
Conduct Problem	1	7	8	4	4	8
Emotional-Indulgent	6	6	12	4	9	13
Anxious Passive	4	9	13	7	4	11
Asocial	1	7	8	2	4	6
Daydream-Attention	7	9	16	9	11	20
Hyperactivity Index	11	3	14	4	7	11

Note: L2=Italian mother tongue, L1=English mother tongue, ≥1.5 SD=65-69=problem range, ≥2 SD=70+=clinically significant T-score, Com=problem & clinical zones combined.

The results showed that in the L2 group, the highest percent of 'problem' range scores was in the hyperactivity index scale, while the highest 'clinical' zone occurred in both the Anxious-Passive and the Daydream-Attention ranges. In the L1 group the Daydream-Attention scale showed the highest percent in the 'problem' and 'clinical' zones. Although the 'clinical' zone is usually used to determine a diagnosis, the difference between the two zones seems arbitrary. A more accurate picture can be achieved by combining the two areas. When the two are combined, the Daydream-Attention scale shows the most cases in both groups.

Conners' Parent Rating Scales (CPRS)

The parent scales, like the teacher scales provide T-scores with a mean of 50 and a standard deviation of 10. The scales consist of the following: Conduct Problem, Learning Problem, Psychosomatic, Impulsive-Hyperactive, Anxiety, and Hyperactivity Index. Table 4.27 summarizes the descriptive results for each language group in each of these scales.

Table 4.27.

CPRS L2 and L1 means, SDs, and Ranges for six scales

	Mean	SD	Range
L2 (N=71)			
Conduct Problem	50.42	12.17	35 - 93
Learning Problem	53.90	15.19	36 - 95
Psychosomatic	54.76	13.01	43 - 100
Impulsive-Hyperactive	53.44	11.39	36 - 81
Anxiety	54.25	10.48	40 - 89
Hyperactivity Index	53.00	14.44	35 - 94
L1 (N=45)			
Conduct Problem	51.20	10.78	35 - 74
Learning Problem	52.40	14.93	36 - 97
Psychosomatic	53.60	12.94	43 - 89
Impulsive-Hyperactive	51.11	10.55	32 - 76
Anxiety	52.78	11.60	40 - 89
Hyperactivity Index	51.64	14.01	35 - 91

Note: L2=Italian mother tongue, L1=English mother tongue, N=Group size, SD=Standard Deviation.

As in the CTRS, the CPRS results for both language groups were very similar. The means in all scales for both language groups hovered around 50 (the scales' mean), and the ranges were quite wide. The upper end of the ranges in both groups on the CPRS were slightly higher than on the

CTRS indicating that parents sometimes perceived problems which teachers did not notice.

Table 4.28 contains a summary of the percent of ratings in the 'problem' zone and the percent of ratings in the clinically significant range that were calculated for each scale and language group.

Table 4.28.

CPRS Percent of T-scores in the 'problem' range and clinical zone

	L2 Percent%			L1 Percent%		
	≥1.5SD 65-69	≥2SD 70+	Com	≥1.5SD 65-69	≥2SD 70+	Com
Conduct Problem	3	10	13	7	11	18
Learning Problem	3	20	23	0	13	13
Psychosomatic	3	16	19	0	16	16
Impulsive-Hyperactive	6	10	16	2	9	11
Anxiety	6	9	15	2	9	11
Hyperactivity Index	4	13	17	7	16	23

Note: L2=Italian mother tongue, L1=English mother tongue, ≥1.5 SD=65=problem range, ≥2 SD=70+=clinically significant T-score, Com=problem & clinical zones combined.

As in the CTRS results, a clearer picture is obtained when the 'problem' and 'clinical' zones or ranges are combined. In the L2 group, the Learning Problem scale showed the most cases, followed by the Psychosomatic scale. In the L1 group, the Hyperactivity Index followed by the Conduct Problem scale showed the most cases, indicating that parental concerns in each language group differed.

Class performance.

Screening Instrument For Targeting Educational Risk (SIFTER)

This instrument provides teachers' ratings in five areas that constitute the class performance-academic standing variable. "Pass" scores vary somewhat for each scale. The Academics pass score is 10-15; Attention, 9-15; Communication, 11-15; Class Participation, 9-15; and School Behaviour, 10-15 (See Appendix I for details). Table 4.29 provides the descriptive results in each area for both language groups.

Table 4.29.

SIFTER (all areas) L2 and L1 means, SDs, and ranges

	Mean	SD	Range
L2 (N=71)			
Academics	11.17	3.25	3 - 15
Attention	10.14	3.73	3 - 15
Communication	10.34	3.27	3 - 15
Class Participation	11.25	3.28	3 - 15
School Behaviour	12.56	2.45	7 - 15
L1 (N=45)			
Academics	11.00	2.89	4 - 15
Attention	10.93	3.14	3 - 15
Communication	11.16	2.79	6 - 15
Class Participation	10.96	2.95	5 - 15
School Behaviour	12.16	2.57	6 - 15

Note: L2=Italian mother tongue, L1=English mother tongue, N=Group size.

The L2 group means showed scores in the "Pass" category in all but the Communication area where a "Marginal" performance score was indicated. The L1 group means were in the Pass zone in all areas.

The distribution of scores in each of the three categories was examined and is shown in Table 4.30.

Table 4.30.

SIFTER percentage of scores in the Fail, Marginal, and Pass categories for the L2 and the L1 language groups

	L2 Percent%			L1 Percent%		
	Fail	Marginal	Pass	Fail	Marginal	Pass
Academics	17	20	63	9	31	60
Attention	23	9	68	7	9	84
Communication	23	28	49	4	47	49
Class partici	9	13	78	2	22	76
School Behav	3	11	86	2	22	76

Note: L2=Italian mother tongue, L1=English mother tongue, Class partici=class participation, School Behav=School Behaviour.

The L2 group showed a higher percent of scores than the L1 group in the Fail category in all areas. The L1 group showed a higher percentage of scores than the L2 group in the Marginal zone in all except the Attention area where the percentages were identical. The Communication area showed the lowest percent of cases in the Pass zone in both language groups at 49%. The School Behaviour area contained the highest Pass percent in the L2 group, while the Attention area was the highest for the L1.

Grade retention.

The information on grade retention was obtained via the audiology case history as an additional indicator of

academic standing. The frequency distribution showed the the Grade Retention percent in the L2 was 10% and in the L1 group it was 9%, demonstrating that the language groups were very similar on this variable.

Please note that a summary of the results of the groups' CAP and EDVs performances can be found at the end of this chapter.

4.3 Relationship Between CAP and EDVs

In this section the relationship between the CAP variables and the educational distress variables (EDVs) are reported. In addition, performance profiles of L2 and L1 children are presented. These findings respond to the following specific questions:

5. Is CAP performance related to performance on EDVs (oral language, basic reading skills, reading comprehension, listening, psychosocial behavioural, and academic performance) in the L1 and L2 language groups: a. Can CAP severity be predicted from performance on EDVs? b. Can CAP subtype be predicted from performance on EDVs?

6. Does performance on the EDVs permit the clustering of children with similar profiles?

7. How are language group membership and EDV performance cluster related to CAP severity?

8. Are EDV performance clusters associated with specific CAP subtypes in the L2 and the L1 language groups?

9. What are the performance profiles of L2 and L1 children with low CAP performance, and what are the profiles of those with high CAP performance?

Variables of interest.

For these analyses the EDVs are operationally defined as follows:

1. Oral Language: TOLD total + TLT total.
2. Basic Reading skills: WRMT Basic skills cluster.
3. Reading Comprehension: WRMT Comprehension cluster.
4. Listening Variable: CHAPPS= noise + quiet + ideal + multiple inputs + memory/sequencing + attention span.
5. Psychosocial-Behavioural variable: CPRS (see results for Question 6 below for explanation of use of CPRS alone).
6. Class Performance: SIFTER= Academic + Attention + Communication + Class Participation + School Behaviour.

The CAP variables are operationally defined as

1. SSW Severity= Number Of Errors (NOE).
2. SSW Subtypes= Decode or Tolerance Fading Memory or Integration or Organization or Generalized or Mixed.

Statistical procedures.

The following statistical procedures were used to answer each of the questions.

Question 5. Is CAP performance related to performance on EDVs in the L1 and L2 language groups? This question is composed of two parts: 5a and 5b.

Question 5a. Can CAP severity be predicted from performance on EDVs?

Multiple Regression analyses were used to answer this question which is concerned with the degree of relationship between CAP severity and each of the EDVs. The method used was the stepwise selection of independent variables. The predictor inclusion rule (PIN) in this analysis was that a predictor must be significant at the .05 level to enter the equation (in forward selection; Stevens, 1996, p.81), and the predictor exclusion rule (POUT) was that a predictor must be non-significant at the .10 level to be deleted (in backward selection; Stevens, 1996, p.81). Stepwise selection is a combination of backward and forward selection procedures: after the first variable is selected according to forward selection rules or PIN, the variable is then examined in the backward selection where all variables are considered at once, and those with P values larger than POUT are removed. PIN is smaller than POUT to prevent the same variable from being entered and removed repeatedly (Norušis, 1990, 278-282).

The stepwise multiple regression selects the best predictor, the variable that has the highest correlation

with the dependent variable, first. After partialling out this predictor, it selects the second best predictor. This process continues, and at each step the selected predictors are reexamined to see if they remain or will be removed from the equation. The selection of variables ends when no more variables meet entry or removal criteria.

L2 group multiple regression analyses results.

The first run of the analyses produced a casewise plot of standardized residuals that showed one outlier on the dependent variable (Y), the SSW severity. An examination of this score showed that it was a true outlier rather than an error in data entry. Since an outlier may have a large influence on the results and in these analyses clearly did not fit the model, the case was deleted and the analyses were rerun. Table 4.31 summarizes the L2 stepwise regression results.

Table 4.31.

L2 stepwise multiple regression results using PIN=.05, POUT=.10 with outlier deleted (n=70)

Equation Number 1 Dependent Variable Z score: SSW NOE.

Variables Entered on Step 1. Oral Language

Multiple R	.632		
R Square	.400	R Square change	.400
Adjusted R^2	.391	F Change	45.240
Standard Error	.771	Signif F Change	.0000

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	26.877	26.877
Residual	68	40.399	.594

F= 45.239 Signif F=.0000

Variables Entered on Step 2. Academic Performance

Multiple R	.673		
R Square	.453	R Square change	.053
Adjusted R^2	.437	F Change	6.529
Standard Error	.741	Signif F Change	.013

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	30.464	15.232
Residual	67	36.812	.549

F= 27.723 Signif F=.0000

Summary Table

Step	MultR	R^2	AdjR^2	F	SigF	Rsq	FCh	SigCh
1	.632	.400	.391	45.24	.000	.400	45.24	.000
2	.673	.453	.437	27.72	.000	.053	6.53	.013

	BetaIn	Correl
Step 1 in: Oral language	-.632	-.632
Step 2 in: Academic Performance	-.301	-.583

Oral language was the first variable to enter the equation as it was the most important predictor of SSW severity for the L2 group. It accounted for 40% of the variance on the dependent variable (R^2=.40). Academic performance was the second variable to enter the equation and in combination with oral language it accounted for 45% of the variance on the SSW severity score. Both Oral Language and Academic Performance were significantly ($p \leq .0001$) correlated with SSW severity. The correlation between Oral Language and the SSW was -.63 and with Academic Performance it was -.58. Both indicate moderately strong negative correlations, that is, as the SSW severity score increases, the scores on these two variables decrease.

L1 group multiple regression analyses.

Table 4.32 summarizes the L1 group multiple regression analyses results.

Table 4.32.

L1 stepwise multiple regression results using PIN=.05, POUT=.10 (n=45)

Equation Number 1 Dependent Variable Z score: SSW NOE.

Variables Entered on Step 1. Psychosocial/Behavioural

Multiple R	.466		
R Square	.217	R Square change	.217
Adjusted R^2	.199	F Change	11.926
Standard Error	.723	Signif F Change	.0013

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	6.226	6.226
Residual	43	22.448	.522

F=11.926 Signif F=.0013

Variables Entered on Step 2. Oral Language

Multiple R	.549		
R Square	.301	R Square Change	.084
Adjusted R^2	.268	F Cahnge	5.034
Standard Error	.691	Sig F Change	.030

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	8.629	4.314
Residual	42	20.045	.477

F= 9.040 Signif F=.0005

Summary Table

Step	MultR	Rsq	AdjRsq	F	SigF	Rsq	FCh	SigCh
1	.466	.217	.199	11.93	.001	.217	11.93	.001
2	.549	.301	.268	9.04	.001	.084	5.03	.030

	BetaIn	Correl
Step 1 in: Psychosocial	.466	.466
Step 2 in: Oral Language	-.314	-.448

For the L1 group, the psychosocial/behavioural variable entered the equation in the first step, showing a significant ($p=\leq.001$) moderate correlation (.466) with the SSW. This variable accounted for approximately 22% of the total variance on the SSW severity score. The oral language variable entered in the second step. It accounted for an additional 8% of the total variance, and it showed a significant ($p\leq.03$) moderate negative correlation (-.448) with the SSW.

CAP subtype and EDV performance.

Question 5b. Can CAP subtype be predicted from performance on EDVs?

The point biserial correlation coefficient (r_{pb}), a measure of degree of relationship between a continuous and a dichotomous variable, was used to assess the relationship between the EDVs (continuous variables) and the CAP subtypes (discrete variables). In this procedure, each of the discrete variables was dichotomized by letting 0 stand for absence of a subtype and 1 stand for the presence of a subtype. The two numbers were treated as any other scores, and the Pearson r was then used to compute the correlation between the two variables, resulting in the r_{pb}.

L2 language group

Table 4.33 contains the number of cases per subtype, the mean, and the standard deviation for each EDV in the L2 language sample.

Table 4.33.

L2 SSW subtypes groups' means and SDs in each EDV

Subtype	N	Orallanguage Mean	Orallanguage SD	Basicread Mean	Basicread SD	Readcomp Mean	Readcomp SD
Decode	33	85.17	10.25	93.79	14.31	88.15	13.08
TFM	19	85.47	9.55	94.47	16.86	88.05	13.71
Org	10	85.86	11.15	102.60	15.15	92.90	12.77
Gener	11	85.27	10.76	95.64	13.64	90.64	11.08
Integ	2	84.83	3.06	94.00	1.41	86.00	0.00
Mix	13	83.98	10.14	95.54	18.72	88.15	15.85

		Psychosocial Mean	Psychosocial SD	Academic Mean	Academic SD	Listening Mean	Listening SD
Decode	33	55.60	11.28	10.36	3.04	.15	1.15
TFM	19	51.48	12.57	10.41	2.79	.15	.93
Org	10	49.07	7.12	12.26	2.52	-.27	.69
Gener	11	52.55	7.27	10.82	2.34	.11	.82
Integ	2	62.67	1.89	11.60	3.96	.03	.92
Mix	13	53.05	11.74	10.60	2.82	.05	1.06

Note: TFM=Tolerance Fading Memory, Org=Organization, Gener=Generalized, Integ=Integration, Basicread=Basic reading, Readcomp= Reading comprehension, Mix=≥2 subtypes & part of the count in the case's resulting subtypes.

The calculated r_{pb} for each of the EDVs, the continuous variables, and each subtype, the dichotomous variables, appear in table 4.34.

Table 4.34.

L2 SSW Subtype point biserial correlation (r_{pb}) with each EDV

EDV	DECODE	TFM	ORGANI	GENER	INTEGT	MIXED
Oral	-.203	-.114	-.062	-.089	-.043	-.156
Basic	-.213	-.109	.164	-.041	-.036	-.049
Comp	-.226	-.152	.056	-.018	-.071	-.115
Psych	.122	-.110	-.172	-.032	.160	-.012
Acad	-.241*	-.146	.168	-.042	.031	-.083
List	.156	.103	-.108	.053	.001	.030

Note: *=significant at $p \leq .05$, Oral=oral language, Basic=basic reading, Comp=reading comprehension, Psych=psycho-social, Acad=class performance, List=listening, TFM=Tolerance Fading Memory, ORGANI=Organization, GENER= Generalized, INTEGT=Integration, MIXED=≥2 subtypes.

The only significant r_{pb} in the L2 group was between academic performance and the Decode subtype. A small negative correlation was present, and it accounted for only approximately 6% of the variance on the class performance variable, resulting in a rather small effect size (strength of association between variables, Grimm & Yarnold, 1995, Welkowitz, et al., 1991). In light of the number of correlations, a Bonferroni adjustment renders the above significant results spurious.

L1 language group

Table 4.35 contains the number of cases per subtype, the mean, and the standard deviation for each EDV in the L1 language sample.

Table 4.35.

L1 SSW subtypes groups' means and SDs in each EDV

Subtype	N	Orallanguage Mean	Orallanguage SD	Basicread Mean	Basicread SD	Readcomp Mean	Readcomp SD
Decode	14	90.01	8.45	98.64	13.53	90.71	12.05
TFM	15	91.09	7.90	101.53	8.42	92.40	6.35
Org	10	91.71	7.68	99.20	12.55	94.70	7.30
Gener	4	95.83	5.70	99.25	3.78	94.75	2.99
Integ	1	105.44	0.00	115.00	0.00	123.00	0.00
Mix	13	90.60	8.73	99.23	11.01	92.85	7.29

Subtype	N	Psychosocial Mean	Psychosocial SD	Academic Mean	Academic SD	Listening Mean	Listening SD
Decode	14	55.13	7.60	10.33	2.11	.21	.75
TFM	15	57.60	10.58	10.52	2.17	.01	.66
Org	10	52.25	5.99	11.74	1.94	-.08	.61
Gener	4	53.13	8.20	9.55	2.41	.53	.59
Integ	1	40.17	.00	11.60	.00	-.71	.00
Mix	13	54.62	6.62	10.75	2.04	.08	.58

Note: TFM=Tolerance Fading Memory, Org=Organization, Gener=Generalized, Integ=Integration, Basicread=Basic reading, Readcomp= Reading comprehension.

The calculated r_{pb} for each of the EDVs, the continuous variables, and each subtype, the dichotomous variables, for the L1 group appear in table 4.36.

Table 4.36.

L1 SSW Subtype point biserial correlation (r_{pb}) with each EDV

EDV	DECODE	TFM	ORGANI	GENER	INTEGT	MIXED
Oral	-.300*	-.226	-.132	.074	.205	-.240
Basic	-.210	-.047	.141	-.081	.163	-.167
Comp	-.313*	-.237	-.084	-.048	.306*	-.192
Psych	.219	.420**	.007	.034	-.195	.172
Acad	-.254	-.211	.114	-.220	.023	-.127
List	.287	.101	-.009	.275	-.133	.153

Note: *=significant at $p \leq .05$, **=significant at $p \leq .01$
Oral=oral language, Basic=basic reading, Comp=reading comprehension, Psych=psycho-social, Acad=academic, List=listening, TFM=Tolerance Fading Memory, ORGANI=Organization, GENER= Generalized, INTEGT=Integration, MIXED=≥2 subtypes.

Significant medium sized negative r_{pb} occurred between the Decode subtype and oral language, with a 9% effect size, and a medium sized negative r_{pb} with reading comprehension, and an effect size of about 10%. The TFM subtype was moderately positively associated with the psychosocial variable, and the effect size was approximately 18%. A significant medium sized positive r_{pb} also occurred between the Integration subtype and reading comprehension where the effect size was 9%. As in the L2 group results, the use of the Bonferroni adjustment renders these significant correlations spurious.

4.4. EDV Performance Profile

Question 6. Does performance on the EDVs permit the clustering of children with similar profiles?

Cluster analysis.

Cluster Analysis was used to identify subgroups of EDV performance based on similar performance profiles. This is a statistical technique that allows grouping of entities in a mixed sample or population into homogeneous subgroups on the basis of similarities on a set of attributes or variables (Lorr, 1983; Skehan, 1986). Since the variables in the EDV set differ in the units of measure each uses, a standardized measure was required to make them comparable. Therefore, for these analyses all EDV scores were converted to Z scores so that each variable score had a mean of 0 and a standard deviation of 1. This ensured that measures that use large units were not given undue weight.

In addition, for these analyses, the psychosocial behavioural variable which was made up of the CTRS (Conners' teacher rating scale and the CPRS (parents rating scale) was modified by omitting the CTRS from the score. This was done when a preliminary cluster analysis revealed that the summing of these two instruments, unlike the summing of the other multiple measures, raised questions about the reliability of the psychosocial variable. When the two instruments were separated and the analyses rerun with each

separately, the CPRS proved more effective in the forming of clusters of similar profiles.

The *Agglomerative Hierarchical clustering* procedure which utilizes the 'average linkage between groups' or unweighted pair-group method using arithmetic averages (UPGMA) was chosen to accomplish these cluster analyses. In this procedure the distance between two clusters is defined as "...the average of the distances between all pairs of cases in which one member of the pair is from each of the clusters." (Norušis, 1990, p.361) The procedure uses information about all pairs of distances rather than the nearest or furthest only.

The distance measure chosen for these analyses was the *Cosine of vectors of variables*. A vector is a quantity that has magnitude and direction. Its orientation is determined by its high and low scores. The more similar the profiles of cases, the closer their vectors. The cosine of the angle between the vectors is the actual correlation between the cases (Lorr, 1983). The cosine of vectors is a pattern similarity measure that uses correlation between the scores on a set of variables to reveal the 'shape' or the configuration of scores (Lorr, 1983, p.17, 28), and is summarized by a correlation coefficient score. The cosine similarity coefficient matrix is generated from these scores to reveal the degree of similarity between cases. The cosine measure was preferred in these analyses over the

squared Euclidean distance, a dissimilarity measure, for the following reason: When the scores are standardized (e.g. Z-scores), information regarding the elevation (mean level of scores), and the scatter (the variation in scores) is lost (Lorr, 1983, p.30). The remaining information shows which scores are high and which are low relative to each other in each case's performance, that is, information regarding the shape of the profile remains. The correlation coefficient reflects the profile shape rather than elevation and scatter. The Euclidean distance measure, a measure depending on elements such as elevation and scatter may therefore fail to uncover existing natural clusters when Z scores are used, as in this instance.

The Agglomerative Hierarchical clustering procedure allows the identification of homogeneous groups based on their hierarchical level of performance. The procedure initially treats each participant or case as a unique cluster because for all cases, group membership is unknown at the outset. In this study, therefore, for the L2 group the procedure commenced with 71 cases and for the L1 group with 45 cases. It then proceeded to reduce the number of clusters by grouping the closest cases (those with the highest correlation between them) into bigger and bigger clusters. The hierarchical clustering creates independent clusters by ensuring that cases will not be separated from a cluster once they have been assigned.

Cluster analyses results.

Using the cosine similarity coefficient matrix data, the clustering procedure was summarized in a vertical icicle plot that allowed the identification of clusters at each step, and an agglomeration schedule showing the highest to lowest correlation between cases (Norušis, 1990, p.353, 355). Based on these, and substantive knowledge regarding the cases in the clusters, a seven cluster solution seemed reasonable in each language group. Following the seven cluster solution, each cluster's size, mean z-score, and standard deviation for each variable was obtained.

L2 language group.

The seven clusters, their means, standard deviations, and case numbers are displayed in Table 4.37.

Table 4.37.

L2 means and standard deviations for each EDV, and case numbers for seven clusters

Cluster		Orallanguage		Basicread		Readcomp	
	N	Mean	SD	Mean	SD	Mean	SD
One	5	-1.01	.43	0.00	.40	-.41	.38
Two	23	.25	.46	.24	.57	.23	.46
Three	26	-.86	.51	-1.11	.78	-1.07	.71
Four	10	.73	.56	1.19	.83	1.08	.72
Five	3	.08	.26	.39	.23	.13	.34
Six	2	.44	.41	-.19	.05	.44	.11
Seven	2	-.23	.02	-.04	.58	.40	.27

Cluster		Psychosocial		Academic		Listening	
	N	Mean	SD	Mean	SD	Mean	SD
One	5	.45	.84	.37	.47	-.49	.14
Two	23	-.52	.37	.85	.29	-.69	.31
Three	26	.47	.84	-1.01	.49	1.00	.98
Four	10	.28	.60	.59	.41	-.57	.43
Five	3	-.81	.38	.08	.22	.52	.25
Six	2	.47	.28	-.46	.31	-.06	.59
Seven	2	-.51	.09	-.67	.34	-.65	.34

Note: Orallang=Oral language, Basicread= Basic reading, Readcomp= Reading comprehension.

The seven cluster solution produced two large groups (n=23 & 26), a medium sized group (n=10), one small group (n=5), and three groups with fewer than four cases. An examination of Cluster 5 with three cases, showed that it contained a set of twins. Both clusters 6 & 7 contained only two cases. The icicle plots showed that each of the cases in these groups was essentially unique, joining other cases only near the end of the analysis.

The seven L2 clusters' means are displayed in Figure 1. It is important to reiterate that cluster formation was based on profile shape. However, the graphs displayed in Figure 1 are based on the resulting clusters' means on the EDVs. An examination of these means revealed each cluster's relative strengths and weaknesses on the EDVs, and allowed for cluster comparisons.

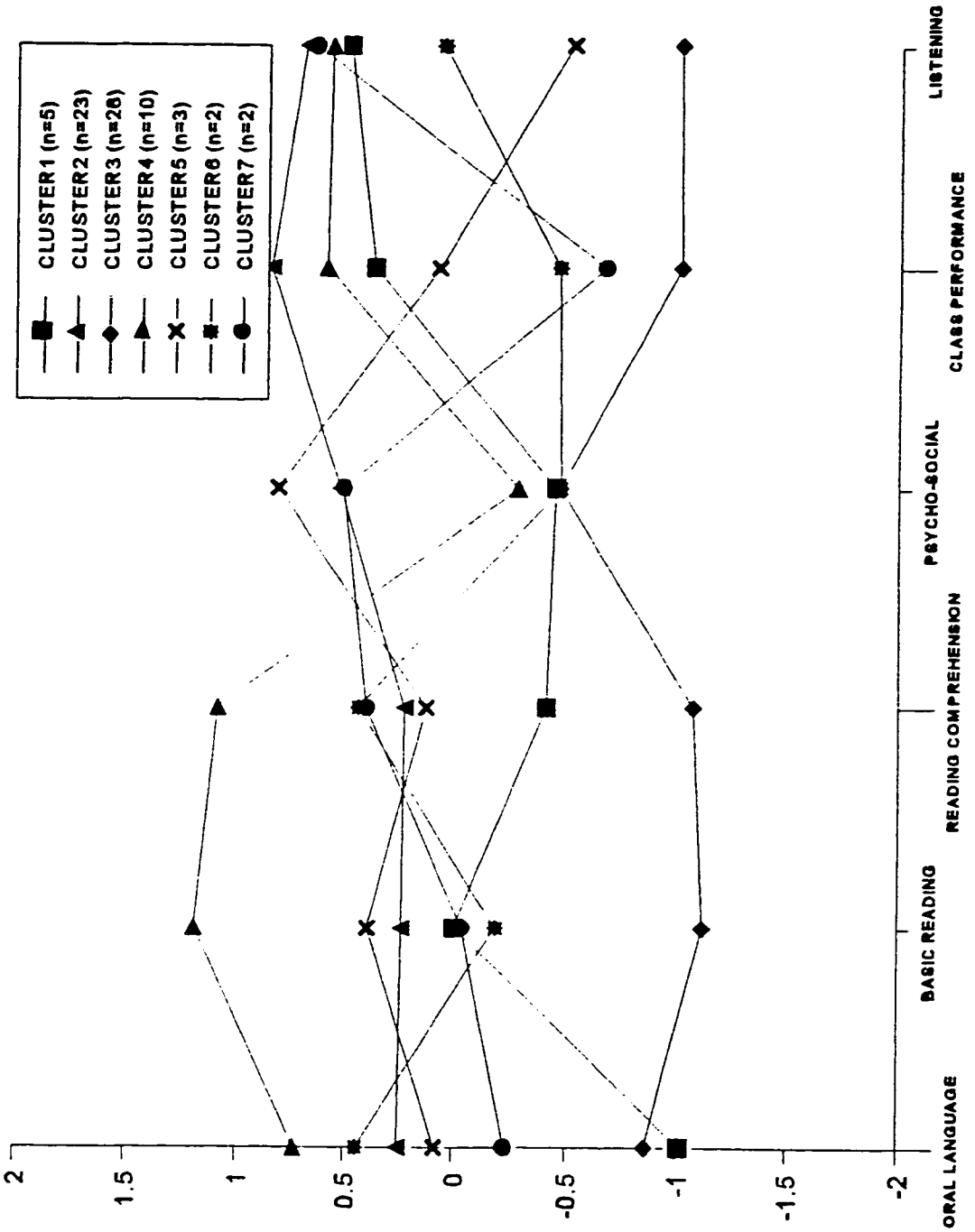

Figure.1 L2 seven cluster solution.

L1 language group.

Table 4.38 displays the seven clusters which emerged in the L1 sample, the size, means and standard deviations.

Table 4.38.

L1 means and standard deviations for each EDV, and case numbers for seven clusters

Cluster		Orallanguage		Basicread		Readcomp	
	N	Mean	SD	Mean	SD	Mean	SD
One	4	-.51	.50	.35	.32	-.57	.37
Two	18	.71	.56	.87	.52	.96	.99
Three	5	.49	.57	-.26	.19	.21	.21
Four	7	-.16	.27	-.37	.99	-.64	.89
Five	3	-.53	.51	-1.24	.53	-.44	.72
Six	4	.22	.58	-.60	.37	-.20	.49
Seven	4	.58	.47	-.98	.24	.57	.55

Cluster		Psychosocial		Academic		Listening	
	N	Mean	SD	Mean	SD	Mean	SD
One	4	-.06	.55	-.82	.32	.40	.30
Two	18	-.47	.42	.76	.35	-.63	.39
Three	5	.18	.43	-.69	.34	.94	.28
Four	7	1.19	.43	-.71	.34	.63	.76
Five	3	-.57	.33	-.26	.21	.20	.12
Six	4	-.44	.51	.49	.59	-.84	.14
Seven	4	.09	.56	-.58	.41	.29	.18

Note: Orallang=Oral language, Basicread= Basic reading, Readcomp= Reading comprehension.

The clustering procedure for the L1 language sample resulted in one large cluster (constituting 40% of the sample), three clusters with four cases each, one with five, one with seven, and one with only three cases.

The seven L1 clusters' means are displayed in Figure 2. As in the L2 sample, the clusters' means were used to examine strengths and weaknesses on the EDVs, and the

relative position of the clusters to each other on each of the EDVs.

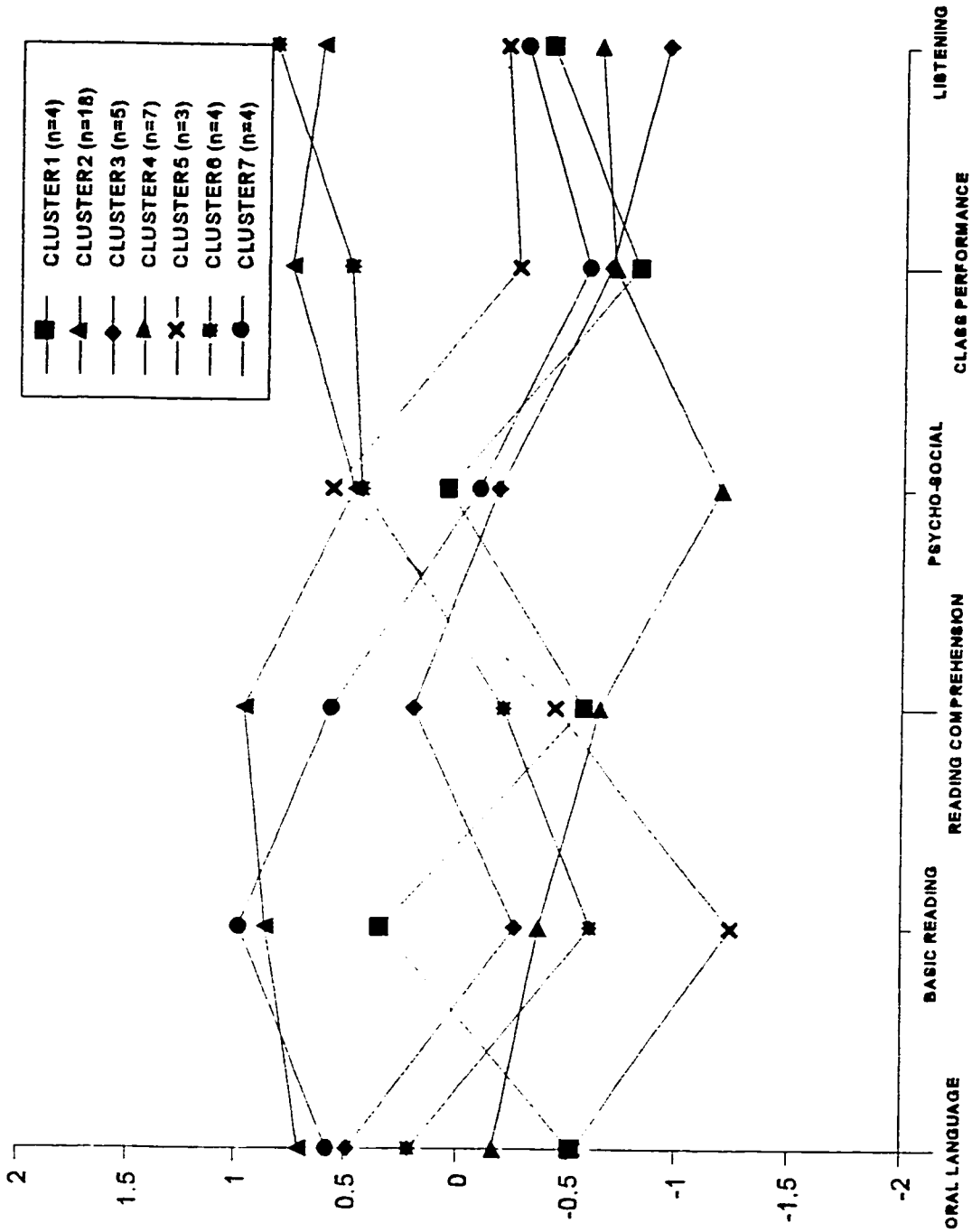

Figure 2. L1 Seven Cluster Solution.

Discriminant analysis.

For each language group, discriminant analysis was used to determine whether the clusters were significantly different from each other, and to determine the accuracy of the classification of the cases into the various clusters.

Discriminant analysis is a statistical technique used to study the differences between two or more groups with respect to a set of discriminating variables simultaneously (Klecka, 1975, 1980, Stevens, 1986, 1996), and to assign cases to groups which they most resemble. In this technique there is no direction of dependence between the groups and the variables. The technique mathematically linearly combines variables so that the resulting combinations, or discriminant functions, maximally differentiate between the groups. The discriminant functions, representing unobserved traits, and the discriminant function-variable correlations were used here to evaluate how well the set of variables discriminated between the clusters, and which characteristics were the most powerful discriminators. As well, they were used to determine how well cases were assigned to clusters. According to Stevens (1986, p.248) "... a subject most closely resembles group i if the vector of scores for that subject is closest to the vector of means (centroid) for group i."

Discriminant analysis: L2 language group results.

Because clusters 5, 6, and 7 contained fewer than four cases, they were eliminated from the discriminant analyses, and the cases (seven) in these clusters were added during the classification procedure as an unclassified group for classification to groups which they most resembled. Figure 3 depicts the four clusters which were given the following descriptive names. Cluster 1 students were named the 'Pretenders' since their oral reading is probably fluent but they derive little meaning from their reading; cluster 2 students were named the 'High Achievers' because of their excellent scores on all the EDVs; cluster 3 students were named the 'Strugglers' because they showed poor scores across the board; and cluster 4 students were named the 'Trouble makers' because of low psychosocial performance.

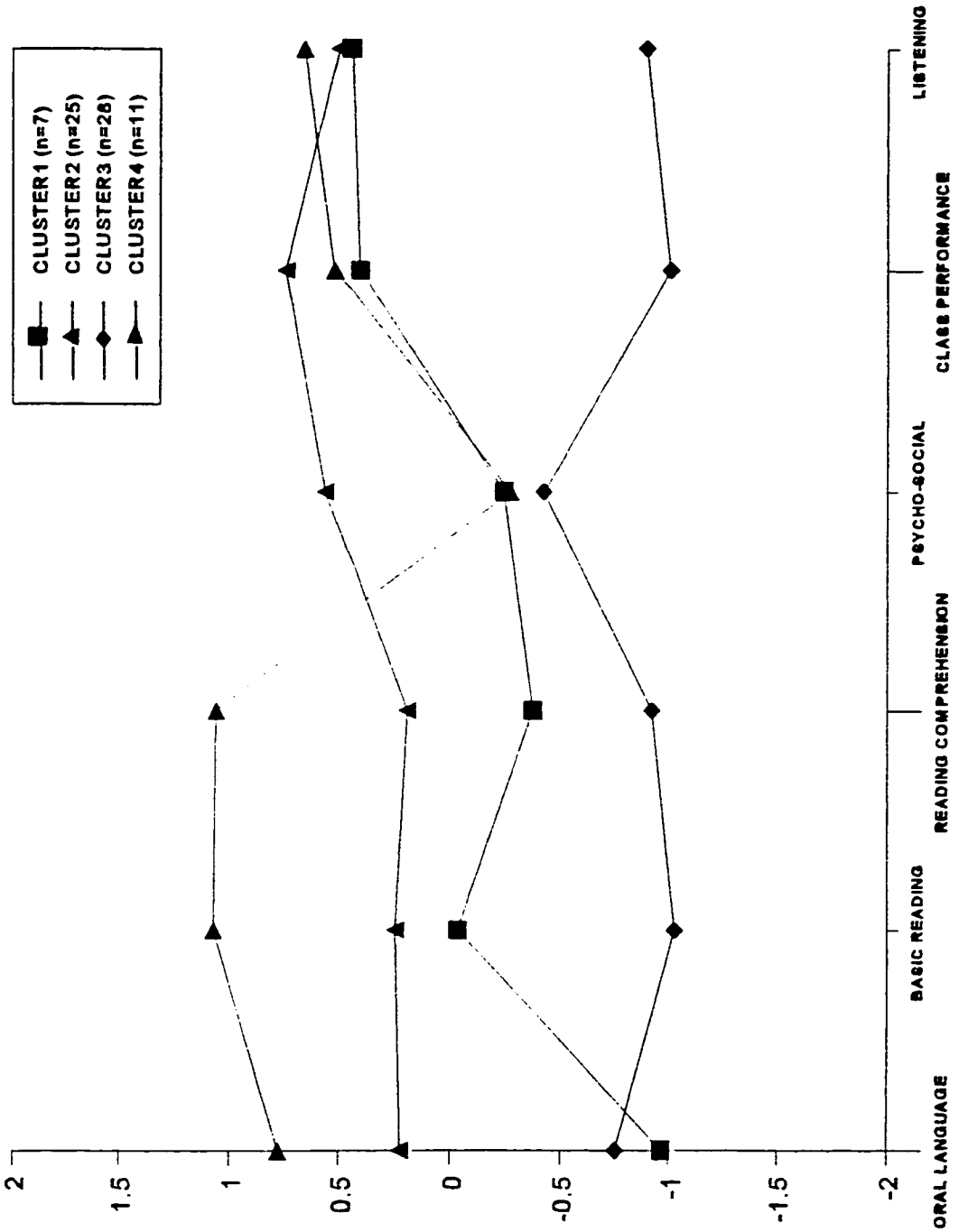

Figure 3. L2 four cluster solution - reclassified data.

The statistical differences between the four resulting clusters are are summarized in table 4.39.

Table 4.39.

L2 Wilks'lambda and univariate F-ratio (3, 60) for four clusters

Variable	Wilks'Lambda	F
Oralang	.348	37.45***
Basic	.390	31.22***
Comprehen	.356	36.13***
Psychsoc	.655	10.55***
Academic	.176	93.60***
Listen	.394	30.76***

Note: ***=p<.0001, oralang=oral language, basic=basic reading skill, comprehen=reading comprehension, psychsoc=psychosocial behavioural variable, academic=academic performance variable, listen=listening variable, Wilks'Lambda=U-statistic.

The results showed that the EDVs significantly differentiated between the clusters in the L2 language group. This was indicated by the small lambdas (the smaller the lambda, the larger the discriminating power) for each variable, and the highly significant *F*s (p<.0001).

The analyses resulted in three canonical discriminant functions (mathematical linear combinations of the discriminating variables). Table 4.40 shows the

discriminant functions and their discriminating power for the L2 group.

Table 4.40.

L2 canonical discriminant functions, their eigenvalues, Wilks' Lambda, Chi-square, and significance levels

Function	Eigenvalue	%Variance	Canonical Correlation
1.	6.203	84.78	.928
2.	.670	9.15	.633
3.	.444	6.07	.555

After Function	Wilks' Lambda	Chi-square	df	Significance
0	.058	165.560	18	.0000
1	.415	51.038	10	.0000
2	.693	21.311	4	.0003

The analyses derived three functions. The first one accounted for a very large portion of the total variance (85%), with a strong canonical correlation of .93, the second function accounted for a little more than 9% but showed a moderately strong canonical correlation of .63, and the third accounted for slightly more than 6% with a .56 moderate canonical correlation. The very small Wilks' Lambda (.035) before any functions are removed showed that the variables used had considerable discriminating power. All three functions were statistically highly significant.

In order to facilitate the interpretation or naming of the discriminant functions a varimax rotation of the standardized discriminant function coefficients was

performed. Table 4.41 summarizes the results of the varimax transformation.

Table 4.41.

L2 rotated standardized discriminant function coefficients and the variables ordered by size of coefficient within function

VARIABLES	Function 1	Function 2	Function 3
Academic	1.002*	-.223	.028
Orallang	-.175	.974*	-.235
Psysocial	.008	-.135	.860*
Basic Read	.196	.299	.679*
Listen	-.055	-.079	-.294*
Read Comp	-.126	-.009	.152*

Note: *=largest absolute coefficient between each variable and the discriminant function.

The largest coefficient for function 1 was defined by the academic performance variable, function 2 was defined by the oral language variable, while function 3 was defined by a combination of psychosocial, basic reading, listening, and reading comprehension variables. Table 4.42 summarizes the correlations between the variables and the rotated functions.

Table 4.42.

L2 Correlations between rotated canonical discriminant functions and discriminating variables

VARIABLES	Function 1	Function 2	Function 3
Orallang	.073	.931	-.104
Basic Read	.178	.373	.538
Read Comp	.135	.588	.401
Psychsocial	-.364	-.157	.610
Academic	.965	.164	-.083
Listen	-.552	-.022	-.092

A strong correlation of .965 existed between the academic variable and function 1, a very strong correlation of .931 was shown between oral language and function 2, while function 3 had a moderate relationship with the psychosocial (.610) and basic reading (.538), variables. Although reading comprehension and function 3 had a moderate correlation of .401, the very small coefficient (.152) indicated that this variable may be considered redundant as it contributed very little to this discriminant function.

L2 results of classification.

The classification of the cases into their respective clusters was examined next. For this procedure, the seven cases that were kept out of the discriminant analyses (those that formed groups with less than four cases) were added in this procedure as an unclassified group so that they could be classified into the clusters whose vector of means (centroid) most resembled their own vector of scores. Table

4.43 summarizes the groups' centroids for each function against which each case was assessed.

Table 4.43.

L2 Canonical discriminant functions evaluated at group centroids

GROUP	FUNCTION 1	FUNCTION 2	FUNCTION 3
1	1.245	-1.648	1.207
2	1.944	.875	-.135
3	-2.442	-1.274	-.790
4	1.255	2.125	1.762

Table 4.44 shows the number of correct classifications in the L2 group.

Table 4.44.

L2 maximized hit rate (% CORRECT) in the classification of cases in their respective clusters

			predicted group membership			
actual GROUP	number OF CASES		1	2	3	4
1	5		5	0	0	0
		%	100	0	0	0
2	23		1	21	0	1
		%	4.3	91.3	0	4.3
3	26		1	0	25	0
		%	3.8	0	96.2	0
4	10		0	1	0	9
		%	0	10	0	90
Ungrouped Cases	7		0	3	3	1
		%	0	42.9	42.9	14.3

Of the "grouped" cases, 93.75% cases were classified correctly, indicating a high hit rate. However, because the

classification procedure is set up to maximize the hit rates (Stevens, 1986, p.253) a cross check was required. In order to obtain a more realistic estimate of the hit rate, the entire sample was randomly split into two, and the classification analysis was rerun on each of the approximately 50% randomly selected samples.

In the L2 group 37 cases were used in the analysis, with a resulting 97.30% correct classification rate. The classification rate for the 34 cases excluded from the analysis was 88.89%. The cross-check also resulted in a high hit rate.

Discriminant analysis: L1 group results.

Because Cluster 5 was the only cluster with fewer than four cases it was eliminated, and the analyses proceeded with the remaining six clusters (the three cases in that cluster were included later in the classification phase of the analyses). Figure 4 depicts the six clusters which were given the following descriptive names. Cluster 1 students were named the 'Low Achievers' because of their poor class performance scores; cluster 2 students were named the 'High Achievers' because of their excellent scores in all areas; cluster 3 students were named the 'Frustrated Students' because their academic performance is undermined by poor reading decoding skills; cluster 4 students were named the 'Strugglers' because of their low scores across the board;

cluster 5 students were named the 'Hard Workers' because despite their reading difficulties they maintained intact class performance; and cluster 6 students were named the 'Underachievers' because despite adequate oral language and reading skills they showed poor class performance.

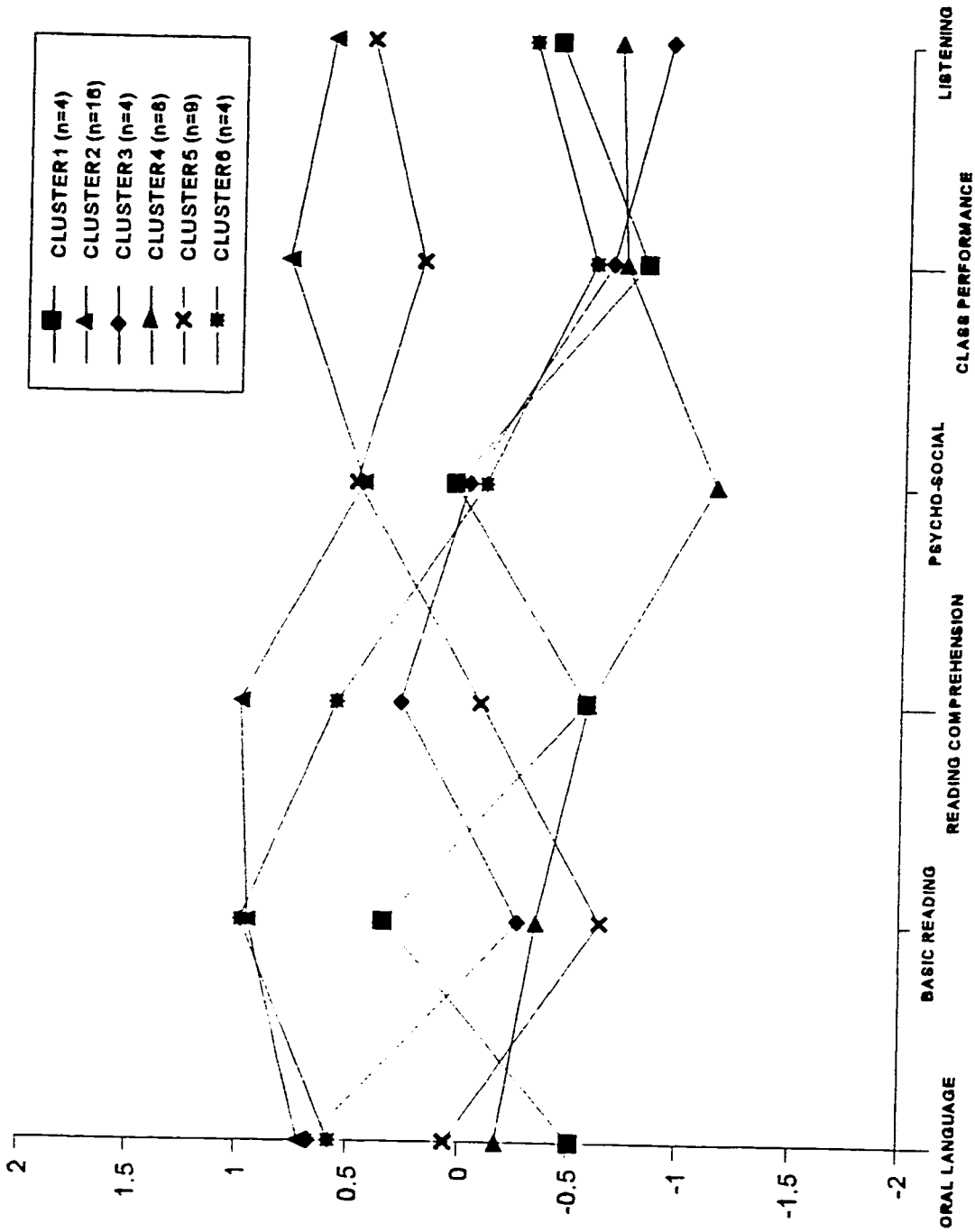

Figure 4. L1 six cluster solution - reclassified data.

Table 4.45 summarizes the statistical differences between the clusters based on the six EDVs.

Table 4.45.

L1 Wilks'lambda and univariate F-ratio with 6 degrees and 38 degrees of freedom for seven clusters

Variable	Wilks'Lambda	F	significance
Oralang	.548	5.943	.0004
Basic	.427	9.657	.0000
Comprehen	.562	5.611	.0006
Psychsoc	.312	15.876	.0000
Academic	.186	31.561	.0000
Listen	.274	19.125	.0000

Note: oralang=oral language, basic=basic reading skill, comprehen=reading comprehension, psychsoc=psychosocial behavioural variable, academic=academic performance variable, listen=listening variable, Wilks'Lambda=U-statistic.

The results showed that the EDVs significantly differentiated between the clusters in the L1 language group. This was indicated by the small lambdas (.186-.562) for each variable, and the significance levels ($p \leq .001$-.0001).

The discriminant analysis revealed five discriminant functions for the L1 language group. Only the first four functions proved to be statistically significant.

Table 4.46 summarizes the discriminant functions and their discriminating power in the L1 group.

Table 4.46.

L1 canonical discriminant functions, their eigenvalues, Wilks' Lambda, Chi-square, and significance levels

Function	Eigenvalue	%Variance	Canonical Correlation
1.	6.891	66.43	.935
2.	2.072	19.97	.821
3.	.928	8.95	.694
4.	.398	3.83	.533
5.	.086	.83	.281

After Function	Wilks' Lambda	Chi-square	df	Significance
0	.014	149.158	30	.0000
1	.111	76.854	20	.0000
2	.342	37.577	12	.0002
3	.659	14.598	6	.0236
4	.921	2.885	2	.2363

These results showed that function 5's contribution to the total variance was <1%, (canonical correlation=.281) and so dropped out of the equation. The total lambda before any of the remaining four functions were removed was extremely small (.014) indicating that the variables were very powerful discriminators between the clusters. After the first three statistically highly significant functions were removed, lambda increased to .659 but remained significant (p=.024). However, after function four was removed, a dramatic increase of Lambda to .921 showed that this function was non-significant (p≤.236) in its discriminating power.

In order to facilitate the interpretation or naming of the discriminant functions, a varimax rotation of the

standardized discriminant function coefficients was performed. Table 4.47 summarizes the results of the varimax transformation.

Table 4.47.

L1 rotated standardized discriminant function coefficients and the variables ordered by size of coefficient within function

VARIABLES	Fun.1	Fun.2	Fun.3	Fun.4
Academic	1.030*	.071	.037	.011
Listen	.197	1.103*	-.025	.231
Psysocial	.071	-.020	1.129*	-.135
Basic Read	.063	.433	-.277	1.642*
Read Comp	.055	.026	.230	-1.147*
Oral lang	.051	-.129	.315	.024

Note: *=largest absolute correlation between each variable and the discriminant function.

The largest coefficient for function 1 was defined by the academic performance variable, function 2 was defined by the listening variable, while function 3 was defined by the psychosocial variable, basic reading and reading comprehension variables defined by function 4. Table 4.48 summarizes the correlations between the variables and the rotated functions.

Table 4.48.

L1 Correlations between rotated canonical discriminant functions and discriminating variables

VARIABLES	Fun.1	Fun.2	Fun.3	Fun.4
Orallang	.002	.068	-.094	-.025
Basic Read	.165	.005	-.033	.733
Read Comp	.223	.196	-.155	.101
Psychsocial	-.041	-.031	.938	.160
Academic	.977	-.188	-.055	-.005
Listen	-.133	.919	.027	-.290

A strong correlation of .977 existed between the academic variable and function 1, a strong correlation of .919 was shown between listening and function 2, while function 3 had a strong relationship (.938) with the psychosocial variable. A moderately strong correlation of .733 occurred between function 4 and basic reading variable.

L1 results of classification.

The classification of the cases into their respective clusters was examined next. For this procedure, the 3 cases that were kept out of the discriminant analyses (cluster 5) were added so that they could be classified into the clusters whose vector of means (centroid) most resembled their own vector of scores. Table 4.49 summarizes the groups' centroids for each function against which each case was assessed.

Table 4.49.

L1 Canonical discriminant functions evaluated at group centroids

GROUP	FUN 1	FUN 2	FUN 3	FUN 4
1	-2.317	1.289	-1.027	1.450
2	1.825	-.948	-.903	.454
3	-1.678	1.925	.661	-1.142
4	-1.779	1.092	2.830	-.786
6	.730	-2.553	-.812	-2.309
7	-1.416	1.212	.124	1.622

Table 4.50 shows the number of correct classifications in the L1 group.

Table 4.50

L1 maximized hit rate (% CORRECT) in the classification of cases in their respective clusters

			PREDICTED GROUP MEMBERSHIP					
ACTUAL GROUP	NUMBER OF CASES		1	2	3	4	6	7
1	4		4	0	0	0	0	0
		%	100	0	0	0	0	0
2	18		0	16	0	0	2	0
		%	0	88.9	0	0	11.1	0
3	5		0	0	4	1	0	0
		%	0	0	80	20	0	0
4	7		0	0	0	7	0	0
		%	0	0	0	100	0	0
6	4		0	0	0	0	4	0
		%	0	0	0	0	100	0
7	4		0	0	0	0	0	4
		%	0	0	0	0	0	100
Ungrouped	3		0	0	0	0	3	0
Cases		%	0	0	0	0	100	0

Of the "grouped" cases, 92.86% were classified correctly indicating a high hit rate.

The L1 sample was split randomly into two, and the classification analyses was rerun to check the accuracy of the classification hit rate. In the first analysis, using 26 cases, the classification hit rate was 100% correct. The analysis ran on the 19 excluded cases 81.25% were classified correctly. The cross-check also exhibited a high hit rate.

4.5 EDV Performance Cluster & CAP Severity

Question 7. How are language group membership and EDV performance cluster related to CAP severity?

A Oneway ANOVA was used to investigate the relationship between CAP severity as defined by the SSW NOE (the dependent variable) and EDV performance cluster (the independent variable). The misclassfied cases that were uncovered in each of the language groups during the classification procedure of discriminant analyses were placed in their appropriate clusters for these analyses.

L2 language group ANOVA results.

The four clusters and total group means, standard deviations and standard errors used in the oneway ANOVA procedure are shown in Table 4.51.

Table 4.51.

L2 four clusters' means used for ANOVA

CLUSTER	CASES	MEAN	SD	SE
1	7	7.83	2.65	1.00
2	25	4.31	3.00	.60
3	28	9.26	4.98	.94
4	11	2.97	2.93	.89
Total	71	6.40	4.62	.55

Table 4.52 shows the results of the Oneway ANOVA for the L2 group.

Table 4.52.

L2 Oneway ANOVA SSW NOE x four EDV Clusters

GROUPS	D.F	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROBABILITY
Between	3	481.24	160.41	10.60	.0000
Within	67	1013.90	15.13		
Total	70	1495.13			

The Oneway ANOVA between the SSW and the L2 EDV clusters showed a highly significant difference ($p<.0001$) between the clusters. The Tukey HSD (Honestly Significant Difference) Multiple range test (with significance level= $\leq .05$) showed that cluster 3 (poor across the board) was

significantly different from clusters 2 (strong academically and behaviourally) and 4 (strong readers but low psycho-socially).

L1 Language group ANOVA results.

Table 4.53 depicts the six clusters and total group means, standard deviations and standard errors use for the ANOVA.

Table 4.53.

L1 six clusters' means used for ANOVA

CLUSTER*	CASES	MEAN	SD	SE
1	4	5.33	4.61	2.30
2	16	3.48	3.26	.82
3	4	4.68	3.43	1.71
4	8	6.18	2.79	.99
6	9	3.68	3.89	1.30
7	4	5.20	4.04	2.03
Total	45	4.42	3.48	.52

Note: *=cluster 5 was eliminated: see the discriminant analyses procedures described earlier.

Table 4.54 shows the results of the Oneway ANOVA for the L1 group.

Table 4.54.

L1 Oneway ANOVA SSW NOE x Six EDV Clusters

GROUPS	D.F	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROBABILITY
Between	5	49.73	9.95	.80	.554
Within	39	482.49	12.37		
Total	44	532.22			

The Oneway ANOVA between the SSW and the EDV clusters showed a non-significant difference ($p>.55$) between the EDV clusters with regard to the SSW NOE.

4.6. EDV Performance Cluster & CAP Subtype

Question 8. Are EDV performance clusters associated with specific CAP subtypes in the L2 and the L1 language groups?

Cross-tabulation

The Crosstabulation procedure was used for each language group to determine the frequency and percentage of audiology subtype in each EDV cluster. The Pearson chi-Square (χ^2) test of independence was used to test whether there is a statistically significant relationship between CAP subtype and EDV performance cluster.

L2 crosstabulation results.

The Crosstabulation resulted in 24 cells made up of six audiology subtypes (rows) and four EDV clusters (columns). Table 4.55 displays these cells.

Table 4.55.

L2 Crosstabulation of audiology subtype x EDV cluster

Subtype		Cluster				
		1	2	3	4	Row TOT
Decode		1	7	11	3	22
	%	2.6	7	10.3	2.2	36.7
TFM		0	5	4	0	9
	%	1.1	2.9	4.2	0.9	15
Orgn		1	2	0	0	3
	%	0.4	1	1.4	0.3	5
General		1	3	5	2	11
	%	1.3	3.5	5.1	1.1	18.3
Integ		1	0	1	0	2
	%	0.2	0.6	0.9	0.2	3.3
Mixed		3	2	7	1	13
	%	1.5	4.1	6.1	1.3	21.7
Col TOT		7	19	28	6	
	%	11.7	31.7	46.7	10	

Note: TFM=Tolerance Fading Memory, Orgn=Organization, General=Generalized, Integ=Integration, Mixed=≥2subtype combinations, Row TOT=Row total frequencies and %, Col TOT=Column total frequencies and %.

The Pearson χ^2 value (15.93, df=15) resulted in a large observed significance level ($p>.39$). This indicated that the audiology subtype and the EDV cluster are

independent variables, that is, EDV clusters in the L2 language group are not associated with a specific subtype.

L1 crosstabulation results.

The Crosstabulation resulted in 36 cells made up of six audiology subtypes and six EDV clusters. Table 4.56 displays these cells.

Table 4.56.

L1 Crosstabulation of audiology subtype x EDV cluster

Subtype		Cluster						
		1	2	3	4	5	6	Row TOT
Decode		1	1	0	2	1	0	5
	%	0.5	1.5	0.6	1.3	0.8	0.3	16.1
TFM		1	1	0	3	1	0	6
	%	0.6	1.7	0.8	1.5	1	0.4	19.4
Orgn		0	2	0	0	0	0	2
	%	0.2	0.6	0.3	0.5	0.3	0.1	6.5
General		0	1	2	1	0	0	4
	%	0.4	1.2	0.5	1	0.6	0.3	12.9
Integ		0	1	0	0	0	O	1
	%	0.1	0.3	0.1	0.3	0.2	0.1	3.2
Mixed		1	3	2	2	3	2	13
	%	1.3	3.8	1.7	3.4	2.1	0.8	41.9
Col TOT		3	9	4	8	5	2	
	%	9.7	29	12.9	25.8	16.1	6.5	

Note: TFM=Tolerance Fading Memory, Orgn=Organization, General=Generalized, Integ=Integration, Mixed=≥2subtype combinations, Row TOT=Row total frequencies and %, Col TOT=Column total frequncies and %.

The Pearson χ^2 value (20.97, df=25) resulted in a large observed significance level ($p>.69$), indicating that the hypothesis of independence of audiology subtypes and EDV

clusters can not be rejected. That is, audiology subtype is not associated with EDV cluster in the L1 language group.

4.7 Summary of Results

While the two language groups did not differ from each other in terms of cognitive ability nor SES, the results showed some interesting differences between the groups.

Question 1 asked how L2 children's performance on central auditory processing tests compared with test norms (obtained from L1 populations), and how an L1 sample drawn from the same educational system as the L2 group performed on these tests, while question 2 asked whether the language groups showed different severity levels and subtypes of CAPD.

The WDS and the DDT were the less challenging of the four audiological tests; both groups performed within test norms, and were not significantly different from each other. However, the low end of the range of performance in the L2 group was markedly lower than in the L1 group, showing that some individual L2 children performed very poorly on these tests, a finding that is consistent in all test results. The auditory figure-ground subtest of the SCAN proved to be more challenging. Both groups performed well below test norms. There was no significant difference between the groups.

The SSW was the most challenging of the audiological tests. Both groups' performances were notably below the test norms, and while both groups showed a very wide range of performance, the L2 range was much wider. The L2 group's performance was worse than that of the L1 group. A significant difference occurred between the groups on the NOE mean or CAP severity. In addition, although there was a significant difference between left and right ear responses (the left ear NOE was higher) in each group, the difference between the ears in the L2 group was significantly larger than in the L1 group, showing that this listening condition was more challenging for the L2 group. No association was found between group membership and the SSW subtypes.

Questions 3 and 4 respectively asked: How do L2 children and L1 peers (drawn from the same school system) perform on the EDVs: oral communication, basic reading, reading comprehension listening, psychosocial-behavioural measures, and class performance tests and instruments standardized on L1 populations? and how do the two language groups compare to each other on the EDVs? Both groups performed below test standards on the tests of oral language. In addition, the L2 group performed significantly worse than the L1 group on these tests. On the reading tests, both language groups performed within test norms. They were not significantly different from each other with a Bonferroni adjustment, but without the adjustment they

differed significantly on basic reading skills consisting of sight vocabulary and decoding skills, and on reading comprehension. In the listening variable, while the teacher ratings showed relatively few individuals with problems in either language group, those in the L2 group showed difficulty in the Noise condition (typical classroom noise). The L1 children showed virtually no difficulties on this listening condition.

The psychosocial variable results showed that on CTRS, when the 'problem' and 'clinical' zone were combined, the Daydream-Attention scale showed the most cases in both groups. When the 'problem' and 'clinical' zones or ranges were combined on the CPRS results, the L2 group showed the most cases on the Learning Problem scale, followed by the Psychosomatic scale. In the L1 group, the Hyperactivity Index followed by the Conduct Problem scale showed the most cases, indicating that parental concerns in each language group differed. When the CTRS & the CPRS were compared, the parents tended to identify more problems than teachers.

The class performance variable showed that the Communication area was seen as a problem for both groups. While School Behaviour was rarely noted for the L2 group, Attention was the least problematic for the L1 group. More children in the L2 group were rated as 'Fail' in all areas, while in the L1 group, more children were given a 'Marginal'

rating. Actual school reports showed no difference between the groups on the incidence of grade retention.

Question 5 asked whether CAP performance was related to performance on EDVs in the L1 and L2 language groups, and specifically, a. Can CAP severity be predicted from performance on EDVs? and b. Can CAP subtype be predicted from performance on EDVs? In the L2 group Oral Language and Class Performance showed moderately strong but, significant negative correlations with SSW severity, that is, as the SSW severity score increased, the scores on these two variables decreased. In the L1 group, the psychosocial/behavioural variable was the most important predictor of SSW severity while oral language was the second but much smaller predictor. Both variables showed moderate, but significant negative correlations with the SSW. The SSW subtypes were not found to be significantly associated with the EDVs in either language group when a Bonferroni adjustment was taken into account.

Question 6 asked whether performance on the EDVs permitted the clustering of children with similar profiles. Distinct clusters were identified in both groups, four in the L2 group, and six in the L1 group. These were confirmed by discriminant analysis and classification procedures. Each cluster was given a descriptive name based on the students' EDV performance profile. These are described in detail in the Discussion chapter.

Question 7 asked: how are language group membership and EDV performance cluster related to CAP severity? In the L2 group, cluster 3 whose students were named the 'strugglers' and whose scores were poor across the board, was significantly different on the SSW NOE from students in cluster 2, the 'High Achievers, and cluster 4, the 'Trouble Makers'. In the L1 group the EDV clusters were not significantly different with regard to the SSW NOE.

Question 8 dealt with the relationship between the clusters and the SSW subtypes. No association was found between EDV clusters and SSW subtypes in either group.

Question 9 was, what are the performance profiles of L2 and L1 children with low CAP performance, and what are the profiles of those with high CAP performance? Yin's (1989) case study approach was used to answer this question. Since the case study represents an in-depth view of low and high CAP performance in children from both language groups, an extensive study resulted, and a separate chapter is devoted to the case study report. Chapter 5, therefore, contains the methodology, results, and actual profiles of low and high CAP performance children from both the L2 and L1 language groups.

CHAPTER 5

MULTIPLE EMBEDDED CASE STUDIES

5.1 Performance Profiles of Children with Low and High CAP Efficiency

Question 9. What are the performance profiles of L2 and L1 children with low CAP efficiency, and what are the profiles of those with high CAP efficiency?

This question is concerned with construction of children's profiles based on CAP performance or auditory efficiency which is operationally defined as SSW severity. Therefore, a 'no problem' designation indicates a very low severity score and represents high CAP efficiency, while a high severity score is interpreted as low CAP efficiency. CAP and EDV (educational distress variables) performance results, and parental and teachers responses on the audiology case histories and school histories were used to construct the profiles.

The approach in constructing these profiles (guided by Yin's, 1989, case study research methods) is a multiple case studies method that utilizes analytic generalization to compare these results to those reported in the literature regarding CAPD profiles. The design involves four subgroups and three comparisons: Low CAP versus High CAP efficiency in the L2 language group, and Low versus High CAP efficiency in the L1 language group, and L2 Low CAP versus L1 Low CAP.

Response patterns and personal and academic histories of cases at each end of the CAP efficiency continuum were noted, and similarities and differences between cases at either end were also examined. Consequently five cases were chosen from each end of the continuum in each language group to highlight the clinical profiles of children with low CAP efficiency and those with high CAP efficiency.

Case study questions.

The case study addresses the following specific research questions.

9a. What characterizes L2 children who perform poorly on the SSW in terms of oral and written language test results, medical, developmental, familial, and academic histories?

9b. What characterizes L1 children who perform poorly on the SSW in terms of oral and written language test results, medical, developmental, familial, and academic histories?

9c. What variables are the best predictors of a poor performance on the CAP battery in these L2 and L1 children?

Case study format.

The first part of the case study for each language group provides data that are meant to compare the No Problem group with the CAPD or problem group. All data are displayed in tables, and these contain ranges of scores to facilitate comparisons. Explanations follow each table.

The second part of the case study examines each case separately by reviewing actual school grades, teachers' comments, general functioning, and relevant information from audiology case histories. The cases in the No Problem group are described briefly but sufficiently so that the reader may have a conceptual sketch of the children in this group for comparison with those in the CAPD group.

Case study samples.

Twenty children were chosen according to their results on the SSW CAP test. Five children from each language group who obtained the highest score in standard deviations above the mean, indicating the most severe CAPD result, formed the groups with CAPD, and five children from each language group who showed no problem (whose SSW score was less than half a standard deviation above the mean) represented the groups without CAPD or the No Problem group. Table 5.1 shows for each case, the gender, SSW severity score, age (years and months) and cognitive ability (score on the TONI) for each child in the four groups.

Table 5.1.

L2 and L1 CAPD & No Problem cases: SSW, Age & Cognitive ability

L2	NO PROBLEM			CAPD			
Case	SSW	Age	TONI	Case	SSW	Age	TONI
F.1	-.67	8.4	112	M.1	22.00	10.1	106
F.2	.00	9.2	103	F.2	17.50	10.11	89
F.3	.00	10.7	89	M.3	17.20	9.8	103
M.4	.20	9.8	99	M.4	16.50	10.9	112
M.5	.33	8.2	102	M.5	15.25	10.1	89
L1							
Case	SSW	Age	TONI	Case	SSW	Age	TONI
F.1	-.33	8.1	112	M.1	11.50	10.11	93
M.2	.33	8.2	112	F.2	11.33	11.4	123
M.3	.20	9.5	114	M.3	11.00	9.3	105
F.4	.20	9.11	106	F.4	9.67	11.2	93
F.5	.33	8.11	105	F.5	9.60	9.3	99

Note: M=Male, F=Female, SSW=Staggered Spondaic Words Test, TONI=Nonverbal Cognitive Ability.

In the L2 sample the CAPD group consisted of one female and four males, whereas the No Problem group contained three females and two males. Their age ranges overlapped with the No Problem group, containing the younger cases. The cognitive ability ranges were identical (89 to 112). In the L1 sample both the CAPD and the No Problem groups consisted of three females and two males. The age ranges in the No Problem group were narrower and contained the younger cases. The CAPD groups were older in general. The range of cognitive ability scores in the CAPD group (93 to 123)

overlapped that of the NO Problem group (105 to 114) but was notably wider. The CAPD group actually included the lowest score and the highest score of both groups. However, the large overlap of the two ranges indicated that this measure of cognitive ability does not distinguish the two groups.

Case study parameters.

The following characteristics were examined in the case study: linguistic ability as measured by the TOLD (discrete language measure), TLT (integrative language measure) and the Classroom TLT teacher questionnaire, reading ability as measured by the WRMT, psycho-social-behavioural component as measured by the Conners teacher and parent questionnaires, academic standing as measured by the SIFTER, and listening ability as measured by the CHAPPS.

The results on the following audiology tests were also examined: word discrimination, dichotic digits, and the SCAN figure-ground subtest. Information regarding otitis media, speech and walking onset were also examined. School reports were examined for grade retention histories, grades and relevant teacher comments. Audiology case histories were reviewed. CAPD severity as well as subtype for each student in the problem groups were noted.

5.2 L2 sample: No Problem versus CAPD Linguistic Ability.

Table 5.2 contains the linguistic ability data as measured by the TOLD for each of the cases in the comparison groups: students with low error scores on the SSW, the No Problem group, and students with high error scores on the SSW, the CAPD group.

Table 5.2

L2 No Problem & CAPD groups' linguistic ability: TOLD

	No Problem						CAPD				
	SLQ	lis	spk	sem	syn		SLQ	lis	spk	sem	syn
F.1=	94	96	94	91	98	M.1=	76	81	74	83	72
F.2=	96	98	96	100	94	F.2=	76	83	72	79	76
F.3=	96	100	94	87	106	M.3=	71	83	64	81	66
M.4=	106	102	109	102	109	M.4=	75	85	68	76	76
M.5=	95	91	100	85	106	M.5=	67	76	61	70	68

	No Problem Ranges	CAPD Ranges
SLQ	94 - 106	67 - 76
Lis	91 - 102	76 - 85
Spk	94 - 109	61 - 74
Sem	85 - 102	70 - 83
Syn	94 - 109	66 - 76

Note: TOLD mean=100, SD=15, SLQ=spoken language quotient, Lis=listening quotient, Spk=speaking quotient, Sem=semantic quotient, Syn=syntax quotient.

The TOLD Spoken Language Quotient, derived from the four subtests, showed that the CAPD group range (-2.2 SD to

-1.6 SD) was well below the mean, indicating a marked problem. In the No Problem group all scores were well within the mean (-.4 SD to +.4 SD). The groups' ranges showed no overlap, indicating a complete separation between the two groups on the TOLD SLQ.

In the Listening quotient, the CAPD group range was well below the mean as well (-1.6 SD to -1 SD). In the No Problem group the range was within the mean (-.6 SD to +1 SD), indicating average performance in all cases. Here the groups were separated by 0.9 standard deviations.

In the Speaking quotient, all cases in the CAPD group showed a low quotient (<75), and the range (-2.6 SD to -1.7 SD) was well below the mean. The No Problem group's range (-.4 SD to +.6 SD) was within normal limits. No overlap occurred between the groups, and they were separated by 1.3 standard deviations.

Performance on the Semantic quotient showed the CAPD group range as below the mean (-2 SD to -1.1 SD). The No Problem group range as well was slightly below the mean (-1 SD to +.1 SD). The groups were separated by a mere 0.1 standard deviations. The Syntax quotient indicated that the CAPD group range was below the mean (-2.3 SD to -1.6 SD) while the No Problem group range was within the normal range (-.4 SD to +.6 SD). The groups were clearly separated by 1.2 standard deviations.

The two groups were examined by comparing cognitive ability and linguistic ability measures. The results are summarized in Table 5.3.

Table 5.3

L2 Difference Between Performance on TONI and TOLD in SDs

	No Problem				CAPD		
	TONI	TOLD	DIF T/L		TONI	TOLD	DIF T/L
F.1=	.8	-.4	1.2 T	M.1=	.4	-1.6	2.0 T
F.2=	.2	-.3	.5 T	F.2=	-.7	-1.6	.9 T
F.3=	-.7	-.3	.4 L	M.3=	.2	-1.9	2.1 T
M.4=	-.1	.4	.5 L	M.4=	.8	-1.7	2.5 T
M.5=	.1	-.3	.4 T	M.5=	-.7	-2.2	1.5 T

Note: F=female, M=male, T=in favour of TONI, L=in favour of TOLD or language.

The CAPD group showed a notably higher TONI than TOLD score in all cases. The No Problem group, on the other hand, showed a small difference between TONI and TOLD in four out of five cases, and within these, in two cases, the TOLD or language score was higher than the TONI.

One case in the NO Problem group (F.1) showed a large gap between the TONI and the TOLD, indicating a possible language delay which is most likely not due to auditory perceptual problems as shown by a No Problem designation and other audiology results that were well within normal limits.

Next, the two groups were compared on the TLT, the integrative language measure. Table 5.4 contains the TLT results.

Table 5.4.

L2 No Problem & CAPD group integrative linguistic ability: TLT

	No Problem							CAPD					
	TOT	M.I	DET	CON	REA	S.C		TOT	M.I	DET	CON	REA	S.C
F.1=	105	98	106	108	109	95	M.1=	91	103	101	96	79	79
F.2=	96	95	106	95	91	88	F.2=	<55	<55	79	67	71	55
F.3=	88	80	86	84	86	103	M.3=	63	64	67	61	74	75
M.4=	111	112	119	106	117	87	M.4=	71	60	79	67	86	89
M.5=	105	103	117	91	98	104	M.5=	78	75	84	75	59	110

	No Problem Ranges	CAPD Ranges
TOT	88 - 111	<55 - 91
M.I	80 - 112	<55 - 103
DET	86 - 119	67 - 101
CON	84 - 108	61 - 96
REA	86 - 117	59 - 86
S.C	87 - 104	55 - 110

Note: TLT standard=100 & SD=15, TOT=Total test score, M.I=main idea, DET=details, CON=concepts, REA=verbal reasoning, S.C=story comprehension.

In the CAPD group, case M.1 showed scores that were well within normal limits in the first four scores shown above. His low scores occurred in the verbal reasoning and the story comprehension subtests. In the No Problem group, case F.3 showed rather depressed scores compared to the others in the group. Because of these two cases the groups' ranges of performance tended to overlap in all scores, although in the verbal reasoning scores, the two ranges share a border rather than overlap as shown by an examination of each subtest individually.

The TOT score in the CAPD group was below the normal range (≥85) in four out of five cases, while in the No Problem group one case showed a low score (≤85) as well. This produced an overlap between the groups' ranges: In the CAPD group the range was -3 SD to -.6 SD while the No Problem group's range was -.8 SD to +.7 SD. An overlap of 0.2 SDs resulted.

The Main Idea subtest score showed a similar pattern. Because one case in the No Problem group was low, and one case in the CAPD group was well within the mean, an overlap in group ranges occurred. The CAPD group's range was -3 SD to +.2 SD, while the No Problem group range was -1.3 SD to +.8 SD resulting in a large overlap of 1.5 SDs.

In the Details subtest the CAPD group range was -2.2 SD to +.1 SD. The No Problem group range was -.9 SD to +1.3 SD, resulting in a 1.3 SDs overlap.

In the Concepts subtest the range in the CAPD group was -2.6 SD to -0.3 SD. The No problem group's range was -1.1 SD to +.5 SD, resulting in an overlap of .8 SDs.

The Reasoning subtest performance was somewhat different compared to the other subtests. The CAPD group range was -2.7 SD to -0.9 SD, while the No Problem group range was -.9 SD to +1.1 SD. This showed that although the upper extreme limit of the CAPD group range and the lower extreme limit of the No Problem group coincided, the two groups were virtually separated.

In the Story Comprehension the CAPD group range was -3 SD to +.7 SD. The No Problem group exhibited a range of -.9 SD to +.3 SD. The overlap that resulted was .2 SD showing that this subtest was not completely successful in separating the two groups.

Integrative language ability within the classroom was examined using a teacher questionnaire (See Appendix H.2 for description). The results are displayed in Table 5.5

Table 5.5

L2 Classroom TLT: A Teacher questionnaire

	No Problem				CAPD		
	Score /20		S.D>/<Mean		Score /20		S.D>/<Mean
F.1=	10	=	-1.08	M.1=	9	=	-1.10
F.2=	20	=	.99	F.2=	5	=	-1.71
F.3=	18	=	.71	M.3=	3	=	-2.50
M.4=	20	=	1.09	M.4=	3	=	-2.08
M.5=	20	=	1.09	M.5=	8	=	-1.30
	Score Range				Score Range		
	10 - 20				3 - 9		

The TLT Classroom questionnaire showed a difference in performance between the groups. All students with CAPD were identified as having a difficulty, and this result corresponded with their actual performance on the TLT test (one CAPD student identified as M.1, performed poorly on only two out of the five TLT subtests: reasoning and story comprehension). In the No Problem group, the questionnaire

result corresponded to the actual performance of the student on the TLT test in four out of five cases, and in these cases no difficulty was noted by the teacher. The groups' score ranges showed a complete separation indicating that this scale was able to discriminate between the two groups.

However, it is important to note that in the one case in the No Problem group, identified by the teacher as showing a difficulty, the student's actual performance on the test ranged from 98 to 108 indicating a 'false positive' result or a discrepancy between the teacher's observations and the actual performance. This student's scores on the test were obviously more than adequate, indicating no difficulty in the area of receptive integrated language abilities. Nevertheless, the discrepancy between the teacher's perception and the student's performance put the adequacy of the TLT questionnaire in doubt.

Reading ability.

Reading ability was examined using the WRMT. This test assesses both basic and comprehension reading skills. The scores for each group are reported in Table 5.6.

Table 5.6

L2 Reading Abilities: Woodcock Reading Mastery Tests (WRMT)

	No Problem Group						
	T	B	C	W	A	O	P
F.1=	111	105	112	106	104	105	116
F.2=	105	108	98	109	107	98	100
F.3=	96	95	99	91	100	91	108
M.4=	100	98	104	98	97	101	105
M.5=	119	117	116	121	112	109	120

	CAPD Group						
	T	B	C	W	A	O	P
M.1=	73	68	80	71	67	80	83
F.2=	83	90	76	92	86	73	83
M.3=	62	61	62	65	63	56	69
M.4=	77	80	73	78	86	78	73
M.5=	59	63	54	63	69	59	54

	No Problem Ranges	CAPD Ranges
T=	96 - 119	59 - 83
B=	95 - 117	61 - 90
C=	98 - 116	54 - 80

Note: T=total reading score, B=basic reading skill, C=reading comprehension combined, W=word identification subtest, A=word attack subtest, O=word comprehension subtest, P=passage comprehension subtest.

The Total reading score showed the CAPD group range to be -2.7 SD to -1.1 SD while the No Problem group's range was -.3 SD to +1.3 SD. The groups' ranges differed on the Total reading score.

The Basic Skills score showed that the CAPD group range was -2.6 SD to -.7 SD, while the No Problem group range was -.3 SD to +1.1 SD. The groups were separated on the Basic Skills score.

In the Comprehension combined score the range of the CAPD group was -3.1 SD to -1.3 SD while the No Problem group's range was -.1 SD to +1.1 SD. This score as well distinguished between the groups.

The subtests, from which the combinedscores were derived, were analyzed as well. The Word Identification subtest showed the CAPD group range to be -2.5 SD to -.5 SD and the No Problem range was -.6 SD to +1.4 SD. An overlap of .1 SD resulted showing that this subtest was not completely successful in separating the groups. In the Word Attack subtest, the CAPD group range was -2.5 SD to -.9 SD while the No Problem group's was -.2 SD to +.8 SD showing a separation of .7 SDs between the groups. This indicated that the Basic skills (made up of Word Identification and Word Attack) score's ability to show separate group performance was due to the Word Attack subtest only.

The Word Comprehension subtest results showed the CAPD group range as -2.9 SD to -1.3 SD, and the No Problem group range as -.6 SD to +.6 SD. A .7 SD separation resulted.

The Passage Comprehension subtest performance showed that the CAPD group range was -3.1 SD to -1.1 SD while the No Problem range was 0 to 1.3 SD. A 1.1 SD separation was shown here indicating that this subtest was successful in discriminating between the groups.

The reading and the linguistic abilities were compared in each group. The comparison is shown in Table 5.7.

Table 5.7.

L2 Difference Between WRMT and TOLD Performance in SDs

	No Problem					CAPD				
	WRMT	TOLD	DIF	R/L		WRMT	TOLD	DIF	R/L
F.1=	.7	-.4	1.1	R	M.1=	-1.8	-1.6	.2	L
F.2=	.3	-.3	.6	R	F.2=	-1.1	-1.6	.5	R
F.3=	-.3	-.3	0	N	M.3=	-2.5	-1.9	.6	L
M.4=	0	.4	.4	L	M.4=	-1.5	-1.7	.2	R
M.5=	1.3	-.3	1.6	R	M.5=	-2.7	-2.2	.5	L

Note: F=female, M=male, WRMT=reading, TOLD=language, DIF R/L=difference between reading and language.

In the CAPD group the reading and language scores were consistently low (>1SD<m) and the differences between them were rather small (<1SD), favouring language or reading randomly. In the No Problem group where the scores in reading and language were average or better (-.4 SD to +1.3 SD), a reading advantage occurred in three out of five cases (two of these showed a difference of ≥1SD), one case showed no difference and another showed a language advantage. The difference measure was not a good group separator in the L2 sample.

Psychosocial-behavioural component.

This component was measured by both the Conners teacher questionnaire and the Conners parent questionnaire. Both instruments' scales have a mean of 50 and a standard deviation of 10. Scores that are 1.5 SDs or more above the

mean (≥65) are considered clinically significant and indicate a problem in the area measured by the scale. Table 5.8 displays the teacher questionnaire results for both groups.

Table 5.8.

L2 No Problem & CAPD groups' Conners Teacher Questionnaire (CTRS)

	No Problem Group						
	Hyp	Con	EMo	Anx	Aso	D.A	HyI
F.1=	49	45	52	39	45	48	53
F.2=	42	45	43	41	44	42	42
F.3=	45	47	52	41	44	48	44
M.4=	46	45	48	38	43	41	46
M.5=	48	48	45	42	52	45	49

	CAPD Group						
	Hyp	Con	EMo	Anx	Aso	D.A	HyI
M.1=	45	46	55	54	60	55	44
F.2=	53	49	61	83	49	54	52
M.3=	66	62	67	54	64	55	66
M.4=	84	80	65	70	76	80	72
M.5=	54	48	48	57	43	46	52

	No Problem Ranges	CAPD Ranges
Hyp	42 - 49	45 - 84
Con	45 - 48	46 - 80
Emo	43 - 52	48 - 67
Anx	38 - 42	54 - 83
Aso	43 - 52	43 - 76
D.A	41 - 48	54 - 80
HyI	42 - 53	44 - 72

Note: Hyp=Hyperactivity scale, Con=conduct problem, Emo=emotional-indulgent, Anx=anxiety, Aso=asocial, D.A=daydream-attention, HyI=hyperactivity index.

The No Problem group ranges were rather narrow and well within the 'normal' range in all scales. The CAPD group

ranges were very wide and included some clinically significant scores. An examination of individual scales showed that in the hyperactivity scale only two out of five cases in the CAPD group showed a high score indicating a problem, but the rest of the scores resembled those of the No Problem group which showed no cases in the problem area. As well, the CAPD group showed only two out of five cases that were ≥65 in the anxiety, emotional-indulgent, and the hyperactivity index scales. The rest of the scales showed only one case with a difficulty. The two groups' ranges showed an overlap in all but the anxiety scale, indicating that only this scale differentiated between the groups' performance.

The parent responses on the Conners questionnaire were examined and the results are displayed in Table 5.9.

Table 5.9

L2 No Problem & CAPD groups' Conners Parent Questionnaire (CPRS)

	No Problem					
	Con	Lea	Sam	Imp	Anx	HyI
F.1=	93	64	71	64	60	76
F.2=	42	45	44	45	55	44
F.3=	53	39	62	53	46	44
M.4=	66	52	43	72	41	60
M.5=	41	58	55	64	50	59

	CAPD					
	Con	Lea	Sam	Imp	Anx	HyI
M.1=	76	67	+100	72	89	74
F.2=	63	78	62	49	59	61
M.3=	53	91	43	76	62	80
M.4=	59	76	53	60	46	67
M.5=	49	76	43	60	68	62

	No Problem Range	CAPD Range
Con	41 - 93	49 - 76
Lea	39 - 64	67 - 91
Sam	43 - 71	43 - +100
Imp	45 - 72	49 - 76
Anx	41 - 60	46 - 89
HyI	44 - 76	61 - 80

Note: CON=conduct problem, Lea=learning problem, Sam= psychosomatic, Imp=impulsive-hyperactive, Anx=anxiety, HyI=hyperactivity index.

In the No Problem group, the conduct scale showed a problem in two out of five cases. The somatic, impulsive, and hyperactivity index scales showed a problem in one case only. The learning and the anxiety scales showed no cases with difficulties. In the CAPD group the hyperactivity index scale showed three out of five cases with a problem,

the anxiety and impulsive scales uncovered a problem in two out of five cases, the somatic and conduct scales showed a problem in one case, but the learning scale showed that parents identified a problem in all cases.

The learning problem scale was the only one in which a problem was identified with 100% accuracy. Interestingly, the learning scale was also the only scale in which the two groups' ranges were completely separated.

Class performance.

This parameter was measured by the SIFTER. The rating scales in this instrument show the following values that constitute failures or questionable performance: in Academics, ≤9, in Attention, ≤8, in Communication, ≤10, in Class Participation ≤8, and in school behaviour, ≤9. Table 5.10 displays the two groups' results on these scales.

Table 5.10

L2 No Problem & CAPD Class Performance: SIFTER

	No Problem				
	ACD	ATT	COM	CLP	SCB
F.1=	15	12	14	13	15
M.2=	15	14	12	13	15
M.3=	13	9	12	12	12
F.4=	15	11	15	15	11
F.5=	15	14	15	15	15

	CAPD				
	ACD	ATT	COM	CLP	SCB
M.1=	9	8	8	9	10
F.2=	7	5	6	7	11
M.3=	6	4	6	5	10
F.4=	5	3	3	4	7
F.5=	7	7	7	9	13

	No Problem Ranges	CAPD Ranges
ACD	13 - 15	5 - 9
ATT	9 - 14	3 - 8
COM	12 - 15	3 - 8
CLP	12 - 15	4 - 9
SCB	11 - 15	7 - 13

Note: ACD=academics, ATT=attention, COM=communication, CLP=class participation, SCB=school behaviour.

The No Problem and the CAPD groups scores showed no overlap on any but the School Behaviour scale. This instrument was quite accurate in distinguishing between the two groups.

Listening ability.

This parameter was measured by the CHAPPS. In this instrument the teacher rates the student's listening ability

compared to his class peers, in a variety of listening situations. The results are shown in Table 5.11.

Table 5.11.

L2 No Problem & CAPD class listening: CHAPPS

	No Problem					
	NOI	QUI	IDL	MUL	MES	ATT
F.1=	-.1	- 1	-1	-1	0	0
M.2=	-.7	-.7	-1	-1	- 1	-1
M.3=	0	- 1	-1	-1	-.5	0
F.4=	- 1	- 1	-1	-1	- 1	-1
F.5=	- 1	- 1	-1	-1	- 1	-1

	CAPD					
	NOI	QUI	IDL	MUL	MES	ATT
M.1=	.4	.4	0	0	0	0
F.2=	2.9	2.7	1.3	1	2.1	1.5
M.3=	1.6	.6	0	-.33	.9	1.6
F.4=	3	3.3	3	3	3.5	3.8
F.5=	-.3	-1	-.7	-.7	0	-.1

Note: Noi=noise, Qui=quiet, IDL=ideal, MUL=Multiple inputs, MES=Memory & sequencing, ATT=attention.

None of the CHAPPS listening conditions was found to be a reliable group separator. Although the No Problem group showed no cases with difficulties in any of the conditions, the CAPD group also had two cases in which no difficulty was noted in any of the conditions. Two other cases in this group showed a problem in all listening conditions, and another case showed a problem in the noise and attention condition only. Because no consistent problem was shown in at least four out of five cases in the CAPD group, the

CHAPPS could not be considered an adequate scale for showing group differences.

Audiology.

Word Discrimination (WDS): This test examines the ability to comprehend words in a white noise background. Table 5.12 summarizes the two groups' performance on this test.

Table 5.12

L2 No Problem & CAPD Word Discrimination (WDS) in %

	No Problem					CAPD			
	Quiet		Noise			Quiet		Noise	
	RE	LE	RE	LE		RE	LE	RE	LE
F.1=	100	96	84	88	M.1=	96	96	64	60
M.2=	96	100	88	76	F.2=	100	100	68	76
M.3=	100	100	95	95	M.3=	100	100	84	72
F.4=	100	88	60	72	F.4=	88	92	72	76
F.5	100	92	100	88	F.5=	100	100	72	88

	Range			
	RE	LE	RE	LE
Quiet	96 - 100	88 - 100	88 - 100	92 - 100
Noise	60 - 100	72 - 88	64 - 84	60 - 88

Note: RE=Right Ear, LE=Left Ear

The performance of the two groups was very similar in the quiet condition in the WDS test, in both the right and the left ears. All children in each group performed well on this test, and the ranges overlapped almost completely. In the noise condition as well, the ranges showed an overlap between the two groups, indicating that none of the SPD test conditions was successful in separating the two groups.

However, four out of five cases in the CAPD group actually did perform worse than the No Problem group by as much as 11 to 28%.

It was noted that one child in the No Problem group actually performed worse than the CAPD children in the noise condition in the right ear. This may have indicated that an attentional component was operating that was not associated with auditory perceptual difficulties. A review of teachers' remarks on official class reports showed that indeed, consistency of attention span was considered to be the student's weakest characteristic in kindergarten, and excessive talkativeness which was interpreted as showing lack of self-control was noted in all subsequent grades. However, the attention problem did not appear to interfere with the student's academic abilities, as it was noted that he was an above average student.

Therefore, the right ear results in the noise condition was associated with a CAPD in 80% of the cases, and it identified a problem in one case in the No Problem group. This showed that this listening condition signals the presence of a problem in the L2 group, and indicates that further testing may be necessary. However, the results also show that a good score on this test does not exclude the possibility that a problem may actually exist.

Dichotic Digits (DDT Measured in %): Table 5.13 displays the results of this test.

Table 5.13

L2 No Problem & CAPD DDT results

	No Problem					CAPD			
	SINGLE		DOUBLE			SINGLE		DOUBLE	
	RE	LE	RE	LE		RE	LE	RE	LE
F.1=	100	100	98	83	M.1=	100	85	55	65
M.2=	100	100	93	83	F.2=	100	90	78	48
M.3=	100	100	95	95	M.3=	100	95	78	60
F.4=	100	100	100	98	F.4=	95	95	83	53
F.5=	100	95	100	95	F.5=	100	100	78	65

	DDT Range			DDT Range	
	RE	LE		RE	LE
Single	100-100	95-100	Single	95-100	85-100
Double	93-100	83- 95	Double	55- 83	48- 65

Note: DDT=Dichotic Digits Test, RE=Right Ear, LE=Left Ear.

The single digits right and left ear test condition did not show a difference of performance between the two groups as indicated by a marked overlap of the groups' ranges. In the double digits test condition the CAPD group ranges in both the right and the left ear showed no ovelap with the No Problem group ranges, effectively demonstrating a separation between the two groups. As well, in the CAPD group, in the double digits subtest, in four out of five cases a marked difference occurred between the ears, showing a right ear advantage (better scores). A considerable ear advantage may

be used to confirm a CAPD diagnosis with a possible developmental delay (Keith, 1986, p.24).

Auditory Figure-Ground Ability: The SCAN was used to assess this, and the results are displayed in Table 5.14.

Table 5.14

L2 No Problem & CAPD SCAN Test

	No Problem SS		CAPD SS
F.1=	7	M.1=	3
M.2=	12	F.2=	5
M.3=	12	M.3=	5
F.4=	11	M.4=	3
F.5=	9	M.5=	3
	Range		Range
	7 - 12		3 - 5

Note: SS=Standard Score, SCAN SS=10, SD=3.

The ranges of the two group's standard scores were well separated indicating that the SCAN's figure-ground subtest was effective in showing the performance difference between the two groups. It is important to note that this subtest is different from the speech discrimination noise condition, in that the noise component in the WDS test is composed of environmental or white noise (similar to a shower noise), whereas the SCAN subtest uses real speech or 'cocktail party' type ground noise (also known as Pink noise).

Otitis media and grade retention history.

The results on these parameteres are shown in Table 5.15.

Table 5.15

L2 No Problem & CAPD O.M.E & Grade Retention

	No Problem			CAPD	
	O.M.E Y/N	Grade Ret Y/N		O.M.E Y/N	Grade Ret Y/N
F.1=	Y	N	M.1=	N	N
M.2=	N	N	F.2=	Y	Y
M.3=	N	N	M.3=	N	Y
F.4=	N	N	M.4=	N	Y
F.5=	Y	N	M.5=	N	Y
Total	2/5	0/5		1/5	4/5

Note: Y=yes, N=no, O.M.E=otitis Media with effusion, Grade Ret=grade retention.

The O.M.E factor did not show a difference between the two groups. Both groups tended to show students with and without middle ear disease history. However, it is important to note that this information was obtained from parental reports only and that no verification or in depth study was made of this variable using actual physicians' reports or medical files.

The grade retention history showed a difference between the groups. No cases in the No Problem group had a grade retention history, whereas in the CAPD group four out of five had repeated a grade.

Speech and walking onset (in months).

Results on these parameter, based on parents' reports, are shown in Table 5.16.

Table 5.16

L2 No Problem & CAPD Speech & Walking Onset in months

	No Problem			CAPD	
	Speech	Walking		Speech	Walking
F.1	12	12	M.1	18	12
M.2	12	15	F.2	24	13
M.3	18	12	M.3	36	12
F.4=	15	12	M.4	18	13
F.5=	24	12	M.5	30	9
	Range	Range		Range	Range
	12 - 24	12 - 15		18 - 36	9 - 13

The CAPD group showed a later onset of speech in three out of five cases (≥24 months), however, since the speech onset ranges tended to overlap the groups can not be considered as separate and distinct as far as this variable is concerned. The walking onset ranges overlapped as well, showing that the groups did not differ on this variable either. Again, it is important to note that the information is from parents' memory, some years after the fact.
A summary of these findings can be found at the end of this chapter.

5.3 L2 School Reports & Audiology Case History

The following section includes a biography of each child in the case study. For the sake of brevity, a very short summary will be given for the No Problem group cases, and only information that shows a problem will be elaborated on. In the CAPD group, more elaboration will be included.

In addition to assessments of academic performance, the children's actual school reports were examined. The evaluation consists of A's (90-100%), B's (80-89%), C's (70-79), D's (60-69 shows a weakness), and F's (Fail). The kindergarten report, specifically, includes the evaluation of motor, social, language or academic skills, while later classes include grades in each subject (based on the note system shown above). The reports also include information regarding personal components such as self-image, independence, attention span, adaptation to change, creativity, sense of responsibility, reaction to failure; and social components such as acceptance by others, participation in group, courtesy and respect for others, etc. Teacher comments are included where relevant.

The audiology case history includes information reported by the parents regarding walking, speech & language onset, relevant medical data, and family history of ear, hearing, and learning problems.

L2 No Problem Group.

Student F.1 (L2NPF1) The report for this student showed excellent work in all language arts, French, and Math in all grades. The last teacher comment was: "L2NPF1 is a very bright student ... expresses herself well orally as well as in her written work. She has a good sense of responsibility".

Her case history indicated fluctuating hearing problems because of ear infections which were treated with antibiotics. Mother reported that she began to talk before 12 months of age, and walked at one year. No family history of learning problems was noted.

Student F.2 (L2NPF2) This student's marks ranged between A and B all through the grades, while the last report showed only A's in all subjects. Some of the teacher comments: "L2NPF2 has produced great work all year and deserves this outstanding report ... Excellent work L2NPF2".

No ear infections were noted throughout infancy or childhood. She began to talk at 12 months and walk at 15 months. No family history of learning problems was present.

Student F.3 (L2NPF3) This student showed normal development in all areas in kindergarten, and average achievement throughout the grades. Some teacher comments pointed to a slight problem with time organization and assignment

completion in the first few grades, but by the fifth grade an improvement was noted. The kindergarten teacher's comment regarding this child was: "L2NPF3 is a very bright student. She enjoyed coming to kindergarten very much ..." and by grade 5: "L2NPF3 continues to take pride in her school work ... she is cooperative and dependable ... I've enjoyed having her in my class this year ..."

The case history showed that she began to talk at 18 months and walk at 12 months. No ear or hearing problems were noted, nor was there a family history of learning problems.

Student M.4 (L2NPM4) This student showed very good social, motor, language, and math development in kindergarten, and excellent academic skills in the later grades.

The kindergarten teacher's comment: "L2NPM4 is very bright and mature for his age level. However, he talks constantly and interrupts the teacher all the time. He has to change his behaviour ... L2NPM4 is hyperactive ... he talks and fidgets constantly ..." by the end of kindergarten the comment was: "L2NPM4 is doing well both in school and in his behaviour." The comment in the fourth grade was: "Although L2NPM4 is an above average student he must be constantly reminded to keep on task. He's very easily distracted and distracts those around him ...", and

the last comment: "Some improvement has been made in this area".

The case history showed no ear and hearing problems. He began to talk at 15 months and walk at 12 months. No family history of learning problems was noted.

It is interesting to note that although the comments on the school reports suggested a conduct problem and a hyperactivity problem, the Conners Teacher questionnaire did not indicate these problems. However, the Conners Parent questionnaire identified a difficulty on the conduct, somatic, and the hyperactivity index scales. This may be because these problems were actually worse at home than at school, where L2NPM4 tried harder to exert self-control. However, none of these problems interfered with his academic achievement in any way.

Student M.5 (L2NPM5) This student's social-emotional, motor, language, and math developments were all noted as very adequate in the early grades. The grades in all classes were within or above the normal range in all subjects. The listening area in both English and French appeared weaker than speaking according to marks in these areas. The teacher's comment at the end of kindergarten was: "L2NPM5 has done well in kindergarten. He is ready for grade 1 ... he is cooperative and reliable in extra activities ... good pupil." In grade 3, the last comment the teacher noted the

following: "... he is a very good student ... he's conscientious and always eager to learn ... very pleasant and well-mannered child ... tends to be very talkative in class."

The case history indicated ear infections throughout childhood, but no family history of ear and hearing problems. It was noted that he started talking at 2 years and walking at 1 year. As well, he was described as somewhat prone to accidents, hyperactive, and sometimes as exhibiting a short attention span.

It is important to note that none of these problems interfered with his academic achievement in any area except in English Listening in which he got his lowest grade, a C (70 to 79%).

L2 CAPD group.

Student M.1 (L2CAPM1) This student's SSW error score of 22 S.D above the mean, the highest of the entire L2 sample, is considered as indicating a severe CAPD. His CAPD subtype was Mixed: Decode and TFM (Tolerance Fading Memory).

His social-emotional development was noted as low in kindergarten. Weakness was reported in adaptation to school, interest in learning, and in independence as a learner. In large motor development a specific difficulty with skipping, hopping, and balance was mentioned. The fine motor development was also noted as weak. In language

development: oral expression, listening, emerging reading, attempts to write, and understanding and using new concepts were noted as weak. Math development was found to be problematic, and low math interest and skills were noted.

The teacher's comment during and at the end of the first half of kindergarten was: "He is weak in some readiness skills, recounting stories ... L2CAPM1 needs some help in language development... He is a quiet child who works very hard in class. In grade 4, the marks ranged between C and D in English language arts, French speaking, reading, and writing. French listening was rated as a B, his strongest mark. In math L2CAPM1 achieved marks in the 90's in all grades. The teachers' comments throughout the grades indicated a serious learning problem in reading comprehension, speech problems, and insecurity. He was tested by the school psychologist who confirmed weak academic skills. He was seen by a speech-language pathologist for speaking difficulties, but according to the teacher no pronounced change was noted, and he was tutored academically from grade 1.

His case history indicated no ear or hearing problems, and no family history of these problems. He began to talk at 18 months and walk at 1 year. He tended to be confused in noisy environments, easily distracted, sensitive to loud noises, tended to daydream, and had difficulty following directions. It was noted that language arts (reading,

writing, speaking, listening) were the most difficult for him, and that math was the easiest.

In summary, L2CAPM1 exhibited difficulties from early kindergarten. The Conners parent questionnaire showed a significant difficulty in all scales, but the teacher's questionnaire did not identify any problems. In the CHAPPS L2CAPM1 showed more problems than others in the Noise condition; he showed low scores in the speech discrimination noise condition in both ears; he showed low scores in the DDT in both ears, and in the SCAN test. In the reading test his scores showed a lag of more than two years, and very depressed scores in verbal reasoning and story comprehension. He showed a large gap between the TONI and the TOLD in favour of the TONI.

Student F.2 (L2CAPF2) This student's SSW result was 17.50 SD above the mean, indicating a severe CAPD. The subtype was Decode. Her social-emotional development in kindergarten was rated as average. However information on reading development showed the following: Total reading=55%, Story interpretation=7/15=47%, Visual Perception=6/20=30%, Rhyming Words=4/10=40%, Word Recognition=7/20=35%, Letter recognition=20/25=80%, Following Directions=9/15=60%, and Initial Consonants=9/15=60%. This showed very weak reading readiness skills in kindergarten. Difficulty persisted

throughout the grades where low marks were noted in all subjects including math.

The teacher's comments in grade 1 were: "L2CAPF2 has great difficulty in listening and paying attention. As a result she cannot respond to questions. Another reason for this is that she has difficulty understanding a story. She also does not know all her letters, the sounds they make, and how they are put together to make words...She has great difficulty expressing herself...her vocabulary and language development are very weak...". In grade 3 the comment was: "L2CAPF2 is a very hard worker and has shown considerable progress this year, but it has been recommended that she do a make-up year to give a stronger base." In grade 4: "placement in grade 5, provisional that L2CAPF2 continues to follow the special education language arts program. Extra help required in math next year..." and in grade 5: "...very hard worker, excellent student". It is important to note that she continued to be part of the special education class and was integrated partially in a regular class throughout grade 5.

The case history did not identify ear and hearing problems, however, perceptual problems were identified by a school psychologist. As well, L2CAPF2's older sister showed learning problems in the early grades and weaknesses throughout elementary school. L2CAPF2 received help in speech-language pathology and was tutored academically. It

was reported that she began talking at 24 months, and walking at 13 months. Although she was a full term baby she was somewhat low in weight at birth.

In summary, L2CAPF2 was a delayed talker, and exhibited serious learning problems from early kindergarten but no behavioural problems. She showed problems in all listening conditions on the CHAPPS, DDT left ear double digits conditions, and both ears in the speech discrimination noise condition, and the SCAN. All her language and reading test results were significantly low, and a gap of 1 SD was noted between the cognitive ability and language results in favour of cognitive ability.

Student M.3 (L2CAPM3) This student's SSW result was 17.20 SD above the mean indicating a severe CAPD. He was classified as a Decode subtype. In kindergarten this student's social-emotional development was evaluated as marginal, and his large motor development was better than fine motor development. A weakness was noted in all areas of language development: oral expression, listening, interest in books, emergent reading, and attempts to write. In math development a weakness in all skills and a low interest was noted. The kindergarten teacher's comment: "He has a speech Problem ... slow learner ... frustrates easily ... he is very weak in all readiness skills ... he seems to enjoy and work better in math" and finally: "L2CAPM3 has a speech

problem and has had help all year. He is slow in learning new concepts and has not mastered his readiness skills. He will need extra help in grade 1." His marks in all grades were very weak, and reading showed a failure, but math was noted as excellent (93%). Some of the following teachers' comments were noted: "L2CAPM3 tried hard this year but there was no significant change in language arts ... he is a good boy, very polite, and gets along well with his peers ... L2CAPM3 is extremely poor in language arts and definitely needs help in reading and written skills on an individual basis ... (he) was integrated for language arts in the special education class ... very quiet boy."

His case history showed no problem with ears or hearing and no family history of such problems. He was retained in grade 1 despite help from a speech pathologist. It was reported that he began talking at 3 years, and walking at 1 year. He was described as easily distracted, hyperactive, having a short attention, and a difficulty following directions. He also received tutoring in school. No family history of learning problems was reported.

In summary, L2CAPM3 was a very late talker, and exhibited language and learning problems from the beginning of his academic career. His CHAPPS showed that he had more difficulty than others in noise, in quiet, and auditory attention. DDT left ear double digits was very low, as was the left ear noise condition of the speech discrimination

test, and the SCAN. Low results were noted in all the language tests including reading. Both the Conners teacher and parent questionnaires identified problems with several scales including the hyperactivity index.

Student M.4 (L2CAPM4) This student's SSW score was 16.50 SD above the Mean, indicating a severe CAPD. His CAPD subtype was Decode. His available school reports, from grades 3 and 4, showed very weak and failing marks in the English language listening, speaking, reading, and writing. French language skills were also weak (read/write was 61%). Math appeared as the strongest subject (78%). His mother indicated that he attended grades 1 and 2 in another school board but was in an English program. She had decided to switch schools when he showed considerable learning problems. In grade 3 he was given the Metropolitan Achievement Test in reading and his comprehension score was 33% showing a severe reading problem. His evaluation showed that he functioned below grade level in all language subjects, but was making progress in math.

The following teachers' comments were noted in grade 3: "... extreme difficulty in language arts ... very disruptive in class ... alternative homework not done ... L2CAPM4 est souvent distrait et souvent un temps derrière le groupe ... il est très bavard et distrait son entourage".

The case history showed no personal or family history of ear and hearing problems. It was reported that he has worn glasses since age 2. His medical history was uneventful. He was described as hyperactive, distractible, having a short attention span, little motivation, forgetful, and impulsive. It was noted that he had repeated grade 1, and had been tutored in school. Reading comprehension and writing compositions were noted as the most difficult for him. No family history of learning problems was mentioned. He began talking at 18 months, and walking at 13 months.

In summary, early academic problems were described by the parents. In the CHAPPS he was rated as having considerably more problems than his classmates; his speech discrimination results in the noise condition in both ears were low, as was the double digits DDT left ear result, and the SCAN. A difference of 2.5 standards was noted between his language and cognitive abilities in favour of the latter. The Conners teacher questionnaire identified a problem on every scale, but the parent questionnaire showed a problem on the learning scale and the hyperactivity index only.

Student M.5 (L2CAPM5) The SSW result for this student showed a severe CAPD at 15.25 SDs above the mean. The noted subtype was Mixed: TFM & Decode. His reports indicated that he attended kindergarten and half of grade 1 in a French

language school, but because of learning problems he was switched to the English sector. His report from the French school confirmed this: oral communication=33%, reading=33%, writing=34%, Math=25%, Measurement=15%, plastic arts=B. His subsequent report cards confirmed a weakness in academic achievement. In English language arts, religion and social science his grades alternated between Cs and Ds. Math was weak at the end of his first grade 1 year, and in the subsequent repeated year it was quite acceptable at 87%. He performed well in French listening and speaking, but no grades were given in reading and writing. It is interesting to note that in plastic arts, music, handwriting, and physical education he was given a B rating, showing some strengths when no language skills were involved.

The first grade teacher commented: " ... a make up year is necessary due to his lack of language and of reading skills". In the repeat grade 1, the following comments were noted: "L2CAPM5 is weak in phonics...has difficulty blending sounds together...still does not understand the concepts of 'more' or 'less' ... weak in reading comprehension ... L2CAPM5 has had problems all year in reading, phonics, comprehension, and written expression. He needs extra help in all areas. He is a good boy and is anxious to learn ... promoted to grade 2, however, he must do some reading and written expression during the summer holidays or else he will have difficulty coping with the grade 2 program ..."

In grade 2, L2CAPM5 was placed in a special education class and he remained in a special education class in grade 3 as well. Some comments were: "L2CAPM5 must continue to work hard. He is still experiencing difficulty in comprehension and written expression ... He must continue to work harder and apply more effort and concentration to do better. He tends to talk a lot in class."

The case history showed no personal or family history of ear and hearing problems. It was reported that he began talking at 2.6 years and walking at 9 months. He was described as distractible, hyperactive, and as having a short attention span. English and French language arts were noted as most difficult for him. No family history of learning problems was reported.

In summary, L2CAPM5, a late talker, exhibited learning problems from the beginning of his academic life in both a French and an English milieu. His grade repetition and the special education program did not significantly help him overcome his learning problems although his performance in math improved. His CHAPPS result showed no specific problems in any listening conditions, however, his speech discrimination score in noise in the right ear was low, as were the scores for both ears in the double digits DDT, and the SCAN. A difference of 1.5 SDs was noted between the language and the cognitive ability in favour of the latter. The Conners teacher questionnaire did not identify any

problems. However, on the parent questionnaire, the learning and anxiety scales indicated problems.

5.4 L1 Sample: No Problem versus CAPD

This part of the case study focuses on the research question dealing with the L1 group. Variables examined in the L2 sample are also examined here.

Linguistic ability.

Table 5.17 contains the linguistic ability data as measured by the TOLD for each of the cases in the comparison groups: the No Problem group, and the CAPD group.

Table 5.17.

L1 No Problem & CAPD groups' Linguistic ability: TOLD

	No Problem						CAPD				
	SLQ	lis	spk	sem	syn		SLQ	lis	spk	sem	syn
F.1=	95	94	98	91	100	M.1=	75	81	72	83	70
M.2=	114	117	109	117	109	F.2=	101	98	104	102	100
M.3=	108	109	106	115	100	M.3=	83	94	74	96	72
F.4=	100	104	96	98	102	F.4=	87	96	81	96	81
F.5=	96	102	91	98	96	F.5=	85	87	85	83	89

	No Problem Ranges	CAPD Ranges
SLQ	95 - 114	75 - 101
Lis	94 - 117	81 - 98
Spk	98 - 109	72 - 104
Sem	98 - 117	83 - 102
Syn	96 - 109	70 - 100

Note: TOLD mean=100, SD=15, SLQ=spoken language quotient, Lis=listening quotient, Spk=speaking quotient, Sem=semantic quotient, Syn=syntax quotient.

In general the CAPD group scores seemed to be considerably lower than the No Problem group scores, however, overlap of ranges occurred in all subtests.

The SLQ result in the CAPD group, showed four out of five cases in which the quotients were at least one SD below the mean, and the group range was -1.7 SD to +.1 SD. The No Problem group showed scores that were within normal limits in all cases, and the group range was -.3 SD to +.9 SD. Although the actual performance in the No Problem group showed consistent normal range performance, the two groups' ranges showed an overlap of .4 SD indicating that the SLQ is not a reliable group performance separator.

The groups were not markedly different on the Listening quotient. The CAPD group range was -1.3 SD to +.1 SD. The NO Problem group's range was -.4 SD to +1.1 SD. Although the majority of cases in the groups were separated considerably, there was a slight overlap of .3 SDs between the groups.

The Speaking quotient was not reliable in showing separate performances either. In the CAPD group the range was -1.9 SD to +.3 SD. In the NO Problem group the range was -.6 SD to +.6 SD. An overlap of .3 SD between the groups showed that the groups' performance was not mutually exclusive.

The Semantic quotient was also found to be poor as an indicator of group differences. The CAPD range was -1.1 SD

to +.1 SD, and in the No Problem group the range was -.6 SD to +1.1 SD. This resulted in an overlap of .5 SDs.

The Syntax quotient results showed that the CAPD group range was -2 SD to 0 SD, and the No Problem range was -.3 SD to +.6 SD. An overlap of .3 SD indicated that this quotient as well was not successful in showing a difference between the groups.

The two groups were examined by comparing cognitive ability and linguistic ability measures. The results are summarized in Table 5.18.

Table 5.18

L1 Difference Between Performance on TONI and TOLD in SDs

	No Problem				CAPD		
	TONI	TOLD	DIF T/L		TONI	TOLD	DIF T/L
F.1=	.8	-.3	1.1 T	M.1=	-.5	-1.7	1.2 T
M.2=	.8	.9	.1 L	F.2=	1.5	.1	1.4 T
M.3=	.9	.5	.4 T	M.3=	.3	-1.1	1.4 T
F.4=	.4	0	.4 T	F.4=	-.5	-.9	.4 T
F.5=	.3	-.3	.6 T	F.5=	-.1	-1.0	.9 T

Note: F=female, M=male, T=in favour of TONI, L=in favour of TOLD or language.

The CAPD group's difference between the TONI and the TOLD or language score was consistently in favour of the TONI in all cases, and relatively large (≥.9 SDs) in four out of five cases. In the No Problem group, the difference was small (≤.6 SD) in four cases, and in one case the difference, although very small, was in favour of language.

In case F.1 in the No Problem group and case F.2 in the CAPD group where a 1.1 SD and a 1.4 SD difference in favour of the TONI occurred, the actual TOLD performance was well within the average range in both cases. However, because the cognitive score indicated a higher potential, the TOLD results may be considered as indicating an oral language lag which was not associated with auditory perceptual problems in the F.1 case in the No Problem group, but was associated with an auditory perceptual problem in the second case, in the CAPD group.

Next, the two groups were compared on the TLT, an integrative language measure. Table 5.19 shows the results.

Table 5.19

L1 No Problem & CAPD group integrative linguistic ability: TLT

	No Problem							CAPD					
	TOT	M.I	DET	CON	REA	S.C		TOT	M.I	DET	CON	REA	S.C
F.1=	112	113	123	102	103	104	M.1=	63	81	72	59	86	55
M.2=	118	108	128	114	109	109	F.2=	94	106	97	89	86	93
M.3=	109	83	116	114	104	112	M.3=	96	102	106	83	71	112
F.4=	97	102	90	107	84	100	F.4=	87	88	104	107	78	69
F.5=	110	111	97	105	120	104	F.5=	94	76	100	83	110	100

	No Problem Ranges	CAPD Ranges
TOT	97 - 118	63 - 96
M.I	83 - 113	76 - 106
DET	90 - 128	72 - 106
CON	102 - 114	59 - 107
REA	84 - 120	71 - 110
S.C	100 - 112	55 - 112

Note: TLT standard=100 & SD=15, TOT=Total test score, M.I=main idea, DET=details, CON=concepts, REA=verbal reasoning, S.C=story comprehension.

Although generally the CAPD scores were lower than the No Problem group scores in most of the subtests, none of the TLT subtests showed differences in performance between the groups. The CAPD range in the total quotient was -2.5 SD to -.3 SD while the No problem group's range was -.2 SD to +.8 SD. An overlap of .5 SD resulted indicating that the total quotient was not successful in completely separating the groups.

The Main Idea subtest results were the following: The CAPD group range was -1.6 SD to +.4 SD while the No Problem group range was -1.1 SD to +.9 SD. An overlap of 1.5 SDs

indicated that this subtest was not good at separating the groups' performances.

The Details subtest ranges in the CAPD group was -1.9 SD to +.4 SD, and in the NO problem group -.7 SD to +1.9 SD, resulting in an overlap of 1.1 SDs.

The Concepts subtest results showed that the CAPD group range was -2.7 SD to +.5 SD and the No Problem group's was .1 SD to +.9 SD. An overlap of 0.6 SD showed that this too was not a good group performance separator.

The Reasoning subtest showed that the CAPD group range was -1.9 SD to +.7 SD and the No Problem group range was -1.1 SD to +1.3 SD. This resulted in an overlap of 1.8 SDs.

The Story Comprehension subtest showed that the CAPD group had a range of -3 SD to +.8 SD while the No Problem group range was 0 SD to +.8 SD. An overlap of .8 SD confirmed that this subtest is not a good performance discriminator either.

Integrative language ability within the classroom was examined using a teacher questionnaire. The results are displayed in Table 5.20.

Table 5.20

L1 Classroom TLT: A Teacher questionnaire

No Problem				CAPD			
	Score /20		SD>/<Mean		Score /20		SD>/<Mean
F.1=	20	=	1.1	M.1=	9	=	-1.0
M.2=	20	=	1.1	F.2=	15	=	0.0
M.3=	20	=	1.0	M.3=	10	=	-1.1
F.4=	19	=	0.9	F.4=	20	=	1.0
F.5=	20	=	1.0	F.5=	10	=	-1.1
	Score Range				Score Range		
	19 - 20				9 - 20		

The Classroom TLT teacher questionnaire was not found to be a good group performance discriminator. While it showed that every case in the No Problem group was functioning above the mean, in the CAPD group, only three out of five cases were noted as exhibiting a problem. In this group case F.4's rating was one standard deviation above the mean while her actual TLT results showed a problem and weakness in at least four out of the six subtests. Also, in the same group, although case F.2's rating was at the mean, her actual TLT performance showed weaknesses in several subtests. This confirmed the observation that in the L1 language sample, this rating scale was not a good performance discrimination tool.

Reading ability.

Reading was assessed with the WRMT. Both basic as well as comprehension skills were examined, and the results are summarized in Table 5.21.

Table 5.21

L1 Reading Abilities: Woodcock Reading Mastery Tests (WRMT)

	No Problem						
	T	B	C	W	A	O	P
F.1=	124	123	120	124	122	120	117
M.2=	138	128	146	138	113	140	138
M.3=	107	111	99	114	106	106	97
F.4=	91	88	92	89	88	88	97
F.5=	106	104	103	108	100	103	107

	CAPD						
	T	B	C	W	A	O	P
M.1=	95	108	79	100	114	84	79
F.2=	94	97	92	96	98	88	100
M.3=	95	100	91	106	92	88	96
F.4=	104	110	96	109	105	99	93
F.5=	96	94	99	95	92	95	101

	No Problem Ranges	CAPD Ranges
T=	91 - 138	94 - 105
B=	88 - 128	94 - 110
C=	92 - 146	79 - 99

Note: T=total reading score, B=basic reading skill, C=reading comprehension combined, W=word identification subtest, A=word attack subtest, O=word comprehension subtest, P=passage comprehension subtest.

The Total Reading score showed that the CAPD group's range was -.4 SD to +.3 SD while the NO Problem group range was -.6 SD to +2.5 SD. This resulted in the total inclusion of the CAPD range within that of the No Problem group,

indicating that this subtest has no ability to discriminate between the two groups' performances. However the upper range of the No Problem group was at least 20 points higher than the CAPD's upper range. As well, four out of five scores in the No Problem group were higher than the CAPD's best score.

The Basic Subtests result showed that the CAPD group range was -.4 SD to +.7 SD. The No Problem group range was -.8 SD to +1.9 SD. These ranges coincided completely, showing the subtest to be a very poor performance discriminator.

The Comprehension Combined score resulted in the following: the CAPD group range was -1.4 SD to +.1 SD while the No Problem group range was -.5 SD to +3.1 SD. A .4 SD overlap indicated that the Comprehension cluster is not a good performance separator. But the difference in the two groups' lower and upper range scores was quite obvious.

The individual subtests were also examined. In the Word Identification subtest the CAPD group range was -.3 SD to +.6 SD, and the No Problem group's was -.7 SD to +2.5 SD. Again, a complete integration of the CAPD group range into that of the No Problem group was evident.

The Word Attack subtest showed the CAPD group's range to be -.5 SD to +.9 SD and the No Problem group's range was -.8 SD to +1.5 SD. Here too a complete overlap occurred.

The Word Comprehension subtest showed that the CAPD group's range was -1.1 SD to -.1 SD while the No Problem group's was -.8 SD to +2.7 SD. A .7 SDs overlap was shown, again indicating that this subtest was not a good test for showing group differences.

In the Passage Comprehension subtest the CAPD group's range was -1.4 SD to +.1 SD, and the No Problem group's was -.2 SD to +1.1 SD. Here, a .3 SDs overlap again showed an unsuccessful separation of the groups, but a great difference in ranges. It was concluded that none of the WRMT subtests can be used to differentiate completely between the CAPD and the NO Problem groups' performance in the L1 language sample.

Reading ability and linguistic ability were compared in each group. The results are shown in Table 5.22.

Table 5.22.

L1 Difference between WRMT and TOLD Performance in SDs

	No Problem				CAPD		
	WRMT	TOLD	DIF R/L		WRMT	TOLD	DIF R/L
F.1=	1.6	-.3	1.9 R	M.1=	-.3	-1.7	1.4 R
M.2=	2.5	.9	1.6 R	F.2=	.4	.1	.3 R
M.3=	.5	.5	0 N	M.3=	.3	-1.1	1.4 R
F.4=	-.6	0	.6 L	F.4=	.3	-.9	1.2 R
F.5=	.4	-.3	.7 R	F.5=	-.3	-1	.7 R

Note: WRMT=reading, TOLD=language, DIF R/L=difference between reading and language.

The scores in the CAPD group tended to be average in reading and mainly (in four out of five cases) low in language. The difference in performance on reading and language in the this group although not impressively large, was in favour of reading in all cases, and in three of these the difference was greater than one standard unit. In the No Problem group, where all scores were mainly in the average range, three cases showed a reading advantage (in two of these it was ≥1.5 SDs), in one case there was no difference, and in another there was a language advantage. The reading/language difference measure was to some degree successful in demonstrating differences between the groups.

Psychosocial-behavioural component.

This component was measured by the Conners teacher and parent questionnaires (Mean= 50, SD= 10), and the results are reported in Table 5.23.

Table 5.23

L1 No Problem & CAPD groups' CTRS

	No Problem						
	Hyp	Con	Emo	Anx	Aso	D.A	HyI
F.1=	43	45	43	39	45	42	44
M.2=	42	43	42	39	44	41	44
M.3=	43	49	55	41	56	41	44
F.4=	46	45	49	39	44	54	46
F.5=	42	45	43	39	45	42	42

	CAPD						
	Hyp	Con	Emo	Anx	Aso	D.A	HyI
M.1=	67	65	74	54	47	60	69
F.2=	57	71	92	47	98	78	52
M.3=	56	62	62	54	64	55	55
F.4=	43	45	52	53	44	42	42
F.5=	45	45	43	62	53	48	42

	No Problem Ranges	CAPD Ranges
Hyp	42 - 46	43 - 67
Con	43 - 49	45 - 71
Emo	43 - 55	43 - 92
Anx	39 - 41	47 - 62
Aso	44 - 56	44 - 98
D.A	41 - 54	42 - 78
HyI	42 - 46	42 - 69

Note: Hyp=Hyperactivity scale, Con=conduct problem, Emo=emotional-indulgent, Anx=asocial, D.A=daydream-attention, HyI=hyperactivity index.

The No Problem group showed no cases with a difficulty in any of the scales. In the CAPD group results were not consistent. The Hyperactivity, Asocial, Daydream-Attention, and the Hyperactivity Index scales uncovered only one case with a problem. The Conduct and the Emotional-Indulgent

scales showed a problem in two cases, while the Anxiety scale showed no cases with a problem.

The groups' ranges were examined in each scale to determine if they were able to discriminate between the groups' performances. Only the Anxiety scale showed a complete separation between the ranges (CAPD group range: 47 to 62, No Problem group range: 39 to 41), indicating that this scale alone was an adequate performance separator in this questionnaire.

Next the Conners's parent questionnaire was examined and the results reported in Table 5.24

Table 5.24

L1 No Problem & CAPD groups' CPRS

	No Problem					
	Con	Lea	Som	Imp	Anx	HyI
F.1=	35	45	52	38	45	39
M.2=	41	36	44	39	40	35
M.3=	56	38	43	43	46	37
F.4=	39	39	44	41	50	35
F.5=	35	38	52	32	45	36

	CAPD					
	Con	Lea	Som	Imp	Anx	HyI
M.1=	43	52	82	56	73	58
F.2=	53	52	71	49	63	49
M.3=	53	71	72	76	41	78
F.4=	46	39	62	53	63	41
F.5=	63	52	62	49	59	52

	No Problem Ranges	CAPD Ranges
Con	35 - 56	43 - 63
Lea	36 - 45	39 - 71
Som	43 - 52	62 - 82
Imp	32 - 43	49 - 76
Anx	40 - 50	41 - 73
HyI	35 - 39	41 - 58

Note: Con=conduct problem, Lea=learning problem, Sam= psychosomatic, Imp=impulsive-hyperactive, Anx=anxiety, HyI=hyperactivity index.

The No Problem group showed no difficulties on any of the scales. Some problems were shown in the CAPD group but responses were not consistent. For example, no problems occurred in the Conduct, Learning, Impulsivity, and Anxiety scales. The Hyperactivity Index showed only one case with a problem. The Somatic scale was the only one to show three

out of five clinically significant scores (> 65), and two elevated scores (1 SD>M).

However, the group ranges in each scale did yield results which indicated that some of the scales are able to discriminate between the two groups' performances. In the Somatic scale the CAPD range was 62 to 82, while the No Problem range was 43 to 52. In the Impulsive scale the CAPD range was 49 to 76, but the No Problem range was only 32 to 43. The Hyperactivity Index showed the CAPD range was 41 to 78, while the No Problem range was very low at 35 to 39. A separation between the groups' ranges occurred in all three scales. The Conduct, Learning, and Anxiety scales showed an overlap between the ranges.

Class performance.

This parameter was assessed by the SIFTER and the results are reported in Table 5.25.

Table 5.25

L1 No Problem & CAPD Class Performance: SIFTER

	No Problem						CAPD				
	ACD	ATT	COM	CLP	SCBE		ACD	ATT	COM	CLP	SCBE
F.1=	15	15	15	15	15	M.1=	6	9	7	7	9
M.2=	15	15	15	15	15	F.2=	12	15	13	13	8
M.3=	15	15	15	13	9	M.3=	9	9	9	9	9
F.4=	9	13	9	9	13	F.4=	12	13	11	14	15
F.5=	15	15	15	15	15	F.5=	9	9	9	9	12

	No Problem Ranges	CAPD Ranges
ACD	9 - 15	6 - 12
ATT	13 - 15	9 - 15
COM	9 - 15	7 - 13
CLP	9 - 15	7 - 14
SCB	9 - 15	8 - 15

Note: ACD=academics, ATT=attention, COM=communication, CLP=class participation, SCB=school behaviour.

The CAPD group's range in the Academic scale was 6 to 12 while the No Problem group range was 9 to 15. An overlap between the ranges showed that this scale was not able to separate the groups according to performance.

In the Attention scale the CAPD range was 9 to 15, and the No Problem one was 13 to 15. A complete absorbtion of the No Problem into the CAPD range showed that this scale was a poor group separator.

The Communication scale resulted in a range of 7 to 13 in the CAPD group, and 9 to 15 in the No Problem group, indicating that this scale was inadequate as well. The Class Participation scale as well was unsuccessful in

discriminating between the groups' performance: The CAPD group's range was 7 to 13, and the No Problem group range was 9 to 15, exhibiting a large overlap.

The School Behaviour scale showed that the CAPD group range was 8 to 15, and the No Problem group range was 9 to 15. Again, a large overlap resulted confirming that this scale as well is a poor group performance discriminator.

Listening ability.

This parameter was measured by the CHAPPS, and the results are shown in Table 5.26.

Table 5.26

L1 No Problem & CAPD Class listening: CHAPPS

	No Problem							CAPD					
	NOI	QUI	IDL	MUL	MES	ATT		NOI	QUI	IDL	MUL	MES	ATT
F.1=	-.4	-1	-1	-1	-1	-.8	M.1=	1.3	0	-1	-1	.1	.6
M.2=	0	0	0	0	0	0	F.2=	0	-1	-1	-1	-1	-1
M.3=	-.6	-.7	-1	-1	-1	-1	M.3=	0	0	0	0	.5	.5
F.4=	-.7	-.7	-1	-1	-.8	-1	F.4=	-.7	-1	-1	-1	-1	-1
F.5=	- 1	-1	-1	-1	-1	-1	F.5=	1.3	1	.3	.3	.6	.5

Note: Noi=noise, Qui=quiet, IDL=ideal, MUL=multiple inputs, MES=memory & sequencing, ATT=attention.

None of the CHAPPS listening conditions was found to be a reliable performance discriminator between the groups. Although the No Problem group showed no cases that had difficulty in any of the conditions, the CAPD group also had some cases in which no difficulty was noted in any of

the conditions. The other cases in this group showed a problem in some listening conditions, and only one case showed a problem in all the conditions. Because there was no consistent problem in all or at least four cases in the CAPD group, it was felt that the CHAPPS was not a good tool for showing differences between groups in the L1 language sample.

Audiology.

Word Discrimination Test (WDS)

This test examines the ability to comprehend words in quiet and in white noise background. The results are shown in Table 5.27.

Table 5.27

L1 No Problem & CAPD Word Discrimination (WDS) in %

No Problem				CAPD			
Quiet		Noise		Quiet		Noise	
RE	LE	RE	LE	RE	LE	RE	LE
F.1=100	100	80	84	M.1= 96	100	56	60
M.2= 91	100	64	84	F.2= 92	92	76	84
M.3=100	92	100	88	M.3=100	100	80	88
F.4=100	100	96	96	F.4=100	100	84	76
F.5= 88	92	64	80	F.5=100	100	84	88

	Range		Range	
	RE	LE	RE	LE
Quiet	88-100	92-100	92-100	92-100
Noise	64-100	80- 96	56- 84	60-88

Note: RE = Right Ear, LE = Left Ear.

The Quiet condition in the WDS test, in both the right and the left ears, was not able to differentiate between the two groups' performance. All cases in each group performed well on this test, and the ranges were almost completely overlapped in the right ear, and totally overlapped in the left ear. In the Noise condition as well, the ranges showed an overlap between the two groups, indicating that none of the SPD test conditions was successful in differentiating between the two groups on this performance.

In addition, when the cases were examined individually, the CAPD group showed an actual problem in the Noise condition in the right ear in only three cases (≤ 80%), and in the left ear in only two cases. The No Problem group as well showed three cases that had a problem in the noise condition in the right ear, and two cases in the left ear. Here, however, the results were not associated with any listening or learning problems in any of these cases. The WDS's listening conditions in either ear was obviously unable to differentiate between the two groups in the L1 language sample.

Dichotic Digits (measured in %)

This test's results are shown in Table 5.28.

Table 5.28

L1 No Problem & CAPD DDT

	No Problem					CAPD			
	SINGLE		DOUBLE			SINGLE		DOUBLE	
	RE	LE	RE	LE		RE	LE	RE	LE
F.1=	100	98	95	75	M.1=	100	95	80	93
M.2=	100	85	88	69	F.2=	100	100	90	78
M.3=	100	100	95	95	M.3=	95	80	90	50
F.4=	100	90	100	82	F.4=	100	100	78	50
F.5=	100	100	100	88	F.5=	100	95	90	43

	DDT Range			DDT Range	
	RE	LE		RE	LE
Single	100-100	85-100		95-100	80-100
Double	88-100	69- 95		78- 90	43- 93

Note: DDT = Dichotic Digits Test, RE = Right Ear, LE = Left Ear.

The single digits right and left ear test condition was a poor performance separator as was shown by the marked overlap between the two groups' ranges. The same result was noted in the double digits test condition. It was concluded that the DDT was not able to show differences in performance between the two groups.

Figure-Ground auditory ability: SCAN

Tabel 5.29 shows the results of the SCAN word discrimination in a speech background.

Table 5.29

L1 No Problem & CAPD SCAN Figure - Ground

	No Problem SS		CAPD SS
F.1=	11	M.1=	4
M.2=	7	F.2=	3
M.3=	11	M.3=	5
F.4=	6	F.4=	4
F.5=	5	F.5=	3
	Range 5 - 11		Range 3 - 5

Note: SS = Standard score, Standard = 10, SD = 3.

The range in the CAPD group was 3 to 5 whereas in the No Problem group it was 5 to 11. Although the upper limits of the CAPD range and the lower limits of the No Problem group coincided, a complete separation of the groups' ranges occurred. This showed that the SCAN was an adequate group performance differentiator.

Otitis media and grade retention history.

Table 5.30 depicts the results on these parameters.

Table 5.30

L1 No Problem & CAPD O.M.E & Grade Retention

	No Problem			CAPD	
	O.M.E Y/N	Grade Ret Y/N		O.M.E Y/N	Grade Ret Y/N
F.1=	Y	N	M.1=	N	N
M.2=	Y	N	F.2=	Y	N
M.3=	Y	N	M.3=	Y	N
F.4=	Y	N	F.4=	N	N
F.5=	N	N	F.5=	N	N

Note: Y=yes, N=no, O.M.E=otitis media with effusion, Grade Ret=grade retention.

The O.M.E factor was not found to be different in the two groups as both groups tended to show students with and without a history of middle ear disease.

The grade repetition or retention history also was unsuccessful in showing a separation between the groups. Neither group showed cases with a grade retention history.

Speech and walking onset (in months).

Table 5.31 contains the results on these parameters.

Table 5.31

L1 No Problem & CAPD Speech & Walking Onset (in months)

	No Problem			CAPD	
	Speech	Walking		Speech	Walking
F.1	15	12	M.1	24	12
M.2	9	11	F.2	24	11
M.3	18	10	M.3	36	11
F.4	12	12	F.4	18	11
F.5	10	11	F.5	24	18
	Range	Range		Range	Range
	9 - 18	10 - 11		18 - 36	11 - 18

In the speech onset variable, the upper limit of the No Problem group's range and the lower limit of the CAPD group's converged, however, the groups' ranges were separated showing that they differed on this variable. In four cases, speech onset in the CAPD group was ≥24 months, whereas in the NO Problem group all cases showed onset at ≤18 months. The groups' ranges of walking onset showed an overlap, indicating that they do not differ on this variable.

5.5 L1 School Reports & Audiology Case History

This section includes biographies of the children in the No Problem and the CAPD groups.

L1 no problem group.

Student F.1 (L1NPF1) This student's reports show an excellent academic record from early on. In kindergarten her prereading abilities were evaluated at 98.6%, and all her social-emotional developmental markers were superior as well. Her marks in all the grades were mainly A's and some B's. A typical teacher remark was: "L1NPF1 is an excellent student, a pleasure to have in class." Her case history indicated no family history of hearing or learning problems, but some ear infections as an infant. She began to talk at 15 months and walk at 12 months.

Student M.2 (L1NPM2) This student's academic history shows superior achievement from the beginning. His kindergarten prereading skills were given a 98.6% mark, and all his grades subsequently showed mainly A's and some B's. The only weakness noted in early school was in sensory-motor development, in manipulation of scissors. Both French and English teachers' remarks are typified by the following: "L1NPM2 is eager to learn...he works seriously...I'm pleased with his progress." The case history indicated ear infections in early childhood but no family history of hearing and learning problems. He began talking at 9 months and walking at 11 months.

Student M.3 (L1NPM3) This student's reading readiness in kindergarten was 96%, and all subsequent grades were all 'A' marks with some 'B's. Normal social-emotional development was noted. However, some of the teachers' remarks noted a reluctance in class participation in the early grades. This did not seem to interfere with his academic progress as shown by the following teacher's remark: "L1NPM3 is an excellent student...very fine report card...(he) is a very good French reader..." His case history shows ear infections and family history of frequent otitis media. He began talking at 18 months and walking at 10 months.

Student F.4 (L1NPF4) This student showed normal social-emotional development and average academic skills. Her early evaluation in kindergarten indicated average reading readiness and oral language skills, but slightly lower math abilities. Her grades in the last year examined shows mainly B's with some A's and C's in English writing, and French speaking and writing. Her teachers comments were: "L1NPF4 usually works hard ... participates well in French ... having difficulty with basic facts and multiplication ..." Despite some concerns, her actual math mark in the last grade examined was 86%, a solid B. Her case history showed ear infections in early childhood but no family history of hearing and learning problems. She began talking and walking at 12 months.

Student F.5 (L1NPF5) This student's kindergarten prereading skills were 98.6%, showing an excellent readiness. All her subsequent reports were excellent, and the last report showed only one B, and the rest all A's. Typical teacher comments were: "L1NPF5 is working hard ... She always works seriously ... excellent student ... a pleasure to have ..." Her case history shows no ear infections and no family hearing and learning problems. She began talking at 10 months, and walking at 11 months.

L1 CAPD group.

Student M.1 (L1CAPM1) This student's SSW result was 11.50 SD>m, and his subtype was a Mixed category, a combination of Decode and Tolerance Fading Memory. His social-emotional development showed a decline from A's and B's to mainly C's and some B's by the last grade examined. The kindergarten reading readiness skills were evaluated at 81.6%. Difficulties were noted in visual-perception, initial consonant sounds, and the lowest score was in word recognition (60%). His kindergarten teacher's last remark heralds a difficult academic career: "L1CAPM1 will have to work very hard next year if he is going to be able to follow grade 1".

His subsequent report cards showed almost consistent C's and D's in all English language arts, and failing marks in French language arts up to grade 4, when his marks went

up to at least 60%, a bare passing grade. His grade 3 reading comprehension skills were evaluated at 38% with a grade equivalent of 2.4. Throughout the reports the teachers noted that he is a hard worker and is well behaved, nonetheless the comments include remarks that encourage him to work harder.

Furthermore, it was noted that he received additional help in school and tutoring at home, and that a threat of grade retention loomed over him but was not actually carried out.

His case history indicated breathing problems at birth, and later, eye surgery. He was fitted with eye-glasses after that. Although he had no ear infections, a family history of hearing problems was present: his grandmother and his brother were severely hearing impaired because of auditory nerve damage, and in his brother's case, this occurred from birth. A family history of learning problems was also reported.

L1CAPM1's mother described him as underactive, lacking motivation, and as having difficulties following directions. She noted that he began talking at 2 years and walking at 12 months.

In summary, L1CAPM1 a student with a family history of hearing and learning problems, exhibited late speech and language onset, early signs of learning problems and persisting academic difficulties. His TOLD and TLT showed a

performance of approximately 2 SD<m, and his TLT classroom scale also showed poor performance at 1SD<m. A large gap was noted between his TONI result and the TOLD in favour of cognitive ability. In reading, although his basic skills were well within average range, his comprehension skills were greater than 1 SD<m. His word comprehension score showed a grade equivalent of 3.4 while his passage comprehension was at 2.9 (his actual grade at time of testing was 5.9). A serious lag of three grades was present, but more importantly, his reading skills were not sufficient for acquiring information, and therefore could not support a grade appropriate academic program.

Both the teacher and parent Conners questionnaires showed significant problems. Interestingly, his parents did not identify learning as an area of difficulty on this questionnaire. In the CHAPPS he showed a problem in the Noise and Attention listening conditions. On the WDS in audiology he showed a serious problem in both ears in the noise condition. A slight problem was noted on the DDT in the Double digits, right ear condition, and the SCAN score was only 4 SS (2 SD<m).

Student F.2 (L1CAPF2) This student's SSW score was 11.33 SD>m, and her subtype was Mixed: a combination of Decode and TFM. Although no early reports were available, her mother indicated that she changed schools from a French school to

an English/bilingual program because of difficulties in the French school. Her report cards from grade 2 showed excellent marks in all but French listening, reading, and writing skills. The teacher's remarks in grade 4 showed a problem with English writing skills as well that were not reflected in the reported grades: "We are working on L1CAPF2's written work ... L1CAPF2 is making good progress ..." Her math skills, in contrast were excellent from the very beginning.

The case history showed that L1CAPF2 had suffered from otitis media from early childhood. All her siblings and her father also showed these problems. Her hearing was noted as normal in early grades, but an auditory perceptual problem was diagnosed by an audiologist, and obviously persisted even to age 11.4 (the time of participation in this study). No family history of learning problems was noted. Her mother reported that she was under a tremendous amount of stress during pregnancy, and that L1CAPF2 was born by cesarian section. She noted that L1CAPF2 began talking at 2 years and walking at 11 months. She described her as accident prone, and noted that she has difficulties in spelling, and French writing.

In summary, this student showed late speech and language onset with persisting auditory perceptual problems. Although her academic work appeared more than satisfactory, some evidence of difficulties was noted. Her cognitive

ability (1.5 SD>m) was very much higher than her language skills (average at 0.1 SD>m). Her reading performance was also mediocre, and actually showed a weakness in word comprehension, a marker for limited vocabulary or word knowledge. The Conners teacher questionnaires showed problems in conduct, emotional-indulgent, asocial, and attention scales. The parent questionnaire showed a problem in the psychosomatic scale. School behaviour was noted as a problem also on the SIFTER. In audiology, the SPD results showed a weakness in the noise condition in the right ear, and the DDT showed a low score in the double digits left ear. The SCAN score of 3 SS, was 2.3 SD<m.

Student M.3 (L1CAPM3) This student's SSW score was 11 SD>m, and his subtype was Generalized CAPD (no specific error patterns were noted). His reading readiness score in kindergarten was 84%. His weaknesses appeared in story interpretation, visual perception, following directions, and initial consonants. His subsequent grades showed marks that consisted of mainly B's, some A's and in his last report, a D in English writing. His math grades were consistently average. His teachers' comments indicated a persisting problem with attention: "L1CAPM3 is easily distracted: Try to control yourself more ... L1CAPM3 is too easily distracted ... there are times when L1CAPM3 is very good so I know he can do it ..."

His case history showed ear infections and subsequent surgery to remove tonsils and adenoids. No family history of hearing and learning problems was reported. At birth he showed problems with swallowing and sucking. By grade 1 he was diagnosed as ADHD (attention deficit and hyperactivity disorder) and was given medication (Ritalin). His mother noted that he began talking at 3 years and walking at 11 months.

In summary, L1CAPM3 showed very late speech & language onset, and persistent otitis media requiring drastic intervention such as tonsillectomy-adenoidectomy. He was diagnosed as ADHD which was controlled by medication (he was on medication during all his evaluations for this study). A large gap was noted between his cognitive ability (0.3 SD>m) and his TOLD spoken language quotient (1.1 SD<m). His TLT results showed specific problems in the Concepts and Reasoning subtests, but an excellent result on Story Comprehension. His classroom TLT scale confirmed a language weakness (1.1 SD<m). His reading results showed average skills, but better basic skills than comprehension, the latter lagging approximately 0.7 of a grade behind his actual grade level. A weakness in word comprehension was the source of this problem. Context obviously helped his reading comprehension as he showed a more appropriate level in the passage comprehension subtest.

The Conners teacher questionnaire showed no problems. The parent questionnaire showed a problem in learning, psychosomatic, impulsivity, and the hyperactivity index scales. This may indicate a greater sensitivity of the parent to his difficulties or less tolerance than the school environment. Since L1CAPM3 was reported as being on medication at all times, a parental weakness in his management may also be considered. The SIFTER identified academic, communication, and school behaviour as areas of weakness. However, on the CHAPPS, no difficulties with listening were noted in any of the conditions. In audiology, a slight problem was indicated in the SPD noise condition in the right ear, and on the DDT double digits left ear. The SCAN result was 5 SS or 1.7 SD below the mean.

Student F.4 (L1CAPF4) This student's SSW result was 9.67 SD>m, and her subtype was Organization. Her social-emotional development appeared well within normal limits through all the grades. Although no reading readiness information was available from kindergarten the report cards through all the grades showed very good skills in English language arts, and average skills in French. Her math marks ranged from 85% to 96% indicating more than adequate skills. Although her class grades were excellent in every subject, some of the teacher comments in grade 4 showed a possible

weakness in writing: "We are working on L1CAPF4's written work...L1CAPF4 is a very responsible girl...Her work is coming along fine." As well, it was noted that she was rated as 'making progress' in her reading skills, an indication that it was an area of weakness.

The case history showed only one episode of an ear infection, and no family history of hearing and learning difficulties. She exhibited some feeding problems at birth but otherwise had an uneventful medical history. The reported onset of speech and language was at 18 months, and walking at 11 months. No school subjects were reported as being difficult for her.

In summary, L1CAPF4 showed a somewhat delayed speech and language onset, but no academic difficulties. Her TONI result showed only a slight superiority over her TOLD result. Although the overall TOLD showed a weak but average score, a more serious weakness was shown in the speaking and syntax quotients (>1SD<m). The TLT result also indicated difficulties in reasoning (1.5 SD<m) and story comprehension (2.1 SD<m). The reading results, in comparison, showed much more consistent results where average or better scores were shown in the basic and comprehension quotients. However, an examination of the subtest showed a one year lag in her Passage Comprehension subtest (her grade equivalent was 4.6 whereas her actual grade was 5.9). The classroom TLT scale

showed an excellent performance and did not match L1CAPF4's actual performance on the TLT test.

Both the Conners teacher and parent questionnaire showed no difficulties in any of the scales. Neither did the SIFTER nor the CHAPPS. Her audiology results showed a difficulty in WDS in noise in the left ear, and in the DDT double digits in both ears. Her SCAN showed a difficulty as well (2 SD<m). It was concluded that L1CAPF4 is able to compensate for the CAPD relatively well academically because of her perseverance and tenacity, as noted by her teachers: "L1CAPF4 works very hard ... works at her best ... good sense of humour."

Student F.5 (L1CAPF5) This student's SSW score was 9.6 SD>m, and her subtype was Mixed: a combination of Decode and Organization. Her social-emotional development was well within the average range in all grades, and her early development showed normal landmarks in intellectual and math abilities. A weakness was noted in her physical development: she had difficulty catching a ball, maintaining balance, skipping, and handling scissors. The kindergarten teacher's comments were: "L1CAPF5 is quiet and well behaved ... (she) continues to be quiet and well behaved at school". At the end of kindergarten her teacher felt that she had acquired most of the readiness skills needed for grade 1. A standardized reading evaluation in grade 1 indicated

excellent reading ability at 91% and a grade equivalent of 2.8. Her oral language was also noted as more than adequate. Her reported marks through grade 2 showed very good skills in English language arts and math, (A's mainly) but more mediocre results in French language arts. A weakness was evident in all other subjects as shown by C's. This did improve by grade 2. Her teachers' comments showed a hard working but messy girl who was making good progress. However, by grade 3 her marks had slipped to mainly B's, and a weakness was shown in speaking, and in grade 4 in listening. A failure was noted in social studies.

Her case history showed no ear problems and no family history of hearing and learning problems. Her birth and medical history were uneventful, but she did begin to talk at 24 months and walk and 18 months. Her mother described her as easily distracted, forgetful, lacking motivation, having difficulty following directions and a short attention span. She did not feel that L1CAPF5 had difficulty in any subjects in school.

In summary, L1CAPF5 was a somewhat late talker and walker. These are consistent with her 'quietness' and her physical lag in kindergarten. Her actual performance on the TOLD showed a lag of 1 SD<m, and a 1 SD difference between her cognitive ability and the TOLD. All areas of the TOLD were weak. She performed better on the TLT where integrative language skills were required. A difficulty in

the main idea (1.6 SD<m) and concepts (1.1 SD<m) subtests was noted. The classroom TLT scale confirmed that a problem was noted by the teacher (score was 1.1 SD<m). Her reading results were in contrast quite average, but her word attack skills only reached 2.8 grade equivalence while her actual grade was 4.1. Her best performance was in passage comprehension indicating that she uses context clues well.

Both the Conners teacher and parent questionnaires showed no significant problems but scores were elevated in the anxiety scale in the teacher questionnaire, and conduct and psychosomatic scales in the parent one. The SIFTER identified a weakness in academics and communication. The CHAPPS showed a problem with listening in noise, quiet, and tasks requiring auditory memory and sequencing. In audiology, no problems were noted in the WDS test in any condition, but the DDT showed a serious problem in the double digits left ear. The SCAN too showed a very low score at three standard scores (2.3 SD<m). It was concluded that as the academic load increased with the advancement to higher grades, L1CAPF5, unable to compensate for her auditory perceptual problems and language weaknesses, was beginning to show signs of academic distress.

5.6 Summary Of Findings

The case study was undertaken to answer the question about the characteristics of L2 and L1 children who perform

poorly on audiological variables in terms of oral and written language test results, medical, developmental, familial, and educational histories.

Although there were children in both L2 and the L1 groups whose SSW results indicated a 'severe' CAPD, the error rates in the L2 group were markedly higher than those in the L1 group, indicating that the test was significantly more challenging for the L2 children. In both the L2 and the L1 samples, the CAPD children and the No Problem group exhibited similar cognitive ability. However, the L2 CAPD group performed consistently worse than the L2 No Problem group on the TOLD, the discrete language skills test, and all its quotients: listening, speaking, semantics, and syntax. As well, children in the L2 CAPD group showed a large difference between their cognitive ability (as measured by the TONI) and their language ability (as measured by the TOLD), consistently in favour of cognitive ability. The L1 CAPD group, on the other hand, did not differ from the L1 No Problem group on any of the quotients of the TOLD. However, as in the L2 CAPD sample, the children did show a difference between their cognitive ability and language skills in favour of cognitive ability.

Performance on the integrative language test, the TLT, showed that except for the Reasoning Ability subtest where scores were markedly low (from 1 to 3 SD<m), the L2 CAPD group performed very similarly to the L2 No Problem group.

Also, the CAPD group was rated poorly on the Classroom TLT questionnaire. This scale, based on teachers' assessments, matched actual TLT performance in each student. The L1 CAPD group did not differ from the L1 No Problem group on any of the TLT subtests nor the classroom TLT questionnaire, suggesting that they are able to compensate for their CAPD.

The L2 CAPD group showed poor basic and comprehension reading abilities, and they performed worse than the No Problem group on all subtests except for Word Identification, a sight vocabulary measure. The L1 CAPD group showed no differences from the No Problem group on any of the reading subtests, again suggesting that their language abilities were not as affected by their CAPD as were those of L2 children.

The L2 CAPD group tended to show high anxiety in school but were similar to the No Problem group on all other measures. Their parents perceived them as having a learning problem, but parents' perceptions on the other measures did not differ from the No Problem group. The L1 CAPD group were also perceived as showing a high anxiety rate compared to their No Problem peers in school. Their parents, unlike the L2 group's, did not recognize a learning problem. Instead, parents had concerns which were reflected on the Psychosomatic, Impulsive, and Hyperactivity Index scales.

The SIFTER indicated that the L2 CAPD group had notable difficulties in academics, attention, communication, and

class participation. No problems were noted on school behaviour, suggesting that their behaviour or relationships with peers were intact. As well, their listening behaviour in the classroom, as measured by the CHAPPS, was not different from that of the No Problem group in any listening condition. The L1 CAPD group did not differ from their No Problem peers in any of the areas of the SIFTER or CHAPPS. Thus showing that they are resourceful in coping with their CAPD.

The word discrimination test showed that only the right ear noise condition was able to accurately identify a problem in both the L2 CAPD and the L2 No Problem group. None of the listening conditions was able to distinguish between the two groups, thus indicating that the two groups tended to perform similarly. In the L1 sample no differences were noted between the CAPD and the No Problem group on any of the listening conditions. This again showed that the children in this group were better able to cope with their CAPD than those in the L2 group.

The DDT tasks showed that the L2 CAPD group performed poorly on the double digits right and left ear tasks, as well as on the SCAN figure-ground subtest. In the L1 sample, the groups' did not perform differently on any of the DDT conditions, but on the SCAN, the CAPD group showed markedly poorer results.

The OME variable did not show a difference between the groups in either language samples. A history of OME was just as likely to be present in a No Problem as in a CAPD child.

Parents' of the L2 CAPD group did not report marked difference in speech onset from the No Problem group, but the L1 CAPD group did differ from their No Problem peers on this variable. The walking onset variable, on the other hand, showed no differences between the groups in either language sample.

The actual report cards indicated that the L2 CAPD children experienced consistent distress throughout their educational careers, and that grade retention did not improve this condition (four out of five had a grade retention history), nor did the extra tutoring that the school and the parents provided. The children's difficulties covered all areas of academic life. In some, the problems included math skills, but in others math was one of the few areas of success. As well, for most children in the CAPD group, teachers' comments indicated that they were seen as hard working and motivated.

In the L1 sample, the CAPD children tended to show academic weakness from early on, but parents rather than teachers were more likely to note learning problems and try to seek solutions. Teachers' comments showed tolerance of academic weaknesses provided the child did not exhibit

behaviour problems. Also, in this group, it was apparent that some children were able to compensate for their difficulties in early grades and only in later grades did they buckle under the academic load, whereas others showed educational distress in early years but later were able to cope better. In these latter cases, some sort of intervention occured, but grade retention did not occur in this group. As well, it was noted that the the L1 group, children's problems were not all inclusive, but rather seemed to be more selective. For example, the total language and reading scores were low in most cases but it was due to a weakness in some of the subtests such as semantics, word comprehension, reasoning, etc., rather than poor results on all subtests.

In both the L2 and the L1 samples, none of the children's case histories, in either group, revealed outstanding prenatal, natal, postnatal, or medical problems that may herald a later academic problem. However, only children in the CAPD group had reported family histories of academic problems, that is, either grandparents, parents, or siblings, were identified as having similar problems.

5.6 Profiles of CAPD Children

L2 group profile.

In this study, the L2 children with the most severe CAPD are portrayed by the following profile. They exhibit

an average or better cognitive ability, and normal developmental milestones such as speech, language, and walking onsets. They show problems in learning from the very beginning of their academic careers. They are made to repeat a grade and are given extra assistance either in their classes or in partial integration in special education classes, without much improvement as is shown by their low achievements on school report cards. When tested formally, a marked problem in oral language,reception and expression, and in syntax and semantics is noted, as well as in auditory verbal reasoning skills. Verbal-Cognitive skills such as identifying the main idea, details and concepts, and story comprehension do not seem to pose a problem for them.

In reading, both basic and comprehension skills are notably low in the L2 CAPD children. Specifically, they have a problem decoding words, they show restricted or limited word knowledge, and are poor in utilizing context clues in connected text. They are generally described by their teachers as being hard working and showing high anxiety. They are noted as showing problems in academics, communication, attention, and class participation but not as exhibiting behavioural disorders. Their parents too note a learning problem. Their classroom listening behaviours seem to be intact, but audiological testing showed that they have a difficulty with the speech discrimination right ear task

in noise, as well as in both ears in the DDT, and the auditory figure-ground subtest of the SCAN.

L1 group profile.

In the L1 CAPD children the following profile is depicted. They show average or better cognitive abilities, but delayed speech and language onset, as well as family histories of learning problems. They show selective problems in school from the beginning but their parents tend to be more concerned over these than their teachers.

They tend to show overall weak oral language skills compared to their cognitive abilities, but their verbal-cognitive or integrative language skills are usually intact. Their reading abilities tend to be better than their oral language abilities. Their teachers describe them as having high anxiety but their parents note problems in the psychosomatic, impulsive, and hyperactivity index scales. Although their classroom listening skills are generally intact, they show difficulties on the SCAN figure-ground subtest.

Conclusions.

CAPD as measured by the SSW total error rate, was able to identify with 100% accuracy L2 children who also had documented learning problems and poor performance on most language based tasks. In the L1 sample, the association

between the CAPD and the learning or language difficulties was more subtle and less readily identifiable by the school, and as a result their school reports were less likely to document problems.

Also, in the L2 CAPD group, academic intervention such as grade retention did not improve the students' situation as was clear from the persistent academic difficulties following the retention year. This brings into question the efficacy of grade retention in L2 children with an underlying auditory perceptual problem. In addition, for these students, extra tutoring and even speech pathology interventions that did not directly address their underlying CAPD did not seem to be effective in changing the course of their educational distress.

As well, considering that in both language samples, the five most severe scores of CAPD were chosen for the case study, the L2 children's SSW severity range (15 to 22 SD>m) when compared to that of the L1's range (9.6 to 11.50 SD>m) showed clearly that the L2 group had considerably higher scores, indicating a more severe problem. It is possible that the SSW's ability to stress the auditory system may be amplified in an L2 child, and this interaction may have caused this disparity between the groups. However, this disparity leaves open the question of whether children with more comparable CAPD severities would yield more similar profiles for CAPD children in the two language groups.

CHAPTER 6.

DISCUSSION

6.1 Characteristics Of Participants

Numerous studies of educational settings and curriculums for L2 children focus on the relationship between their L2 status and their academic achievement (Collier, 1989; Saville-Troike, 1992; Cummins' 1994). Educators and parents generally believe that children's communicative proficiency in the language of instruction is evidence of sufficient L2 skills for the classroom (Collier, 1989). Academic problems that proliferate in L2 populations are generally blamed by educators on insufficient proficiency in the language of instruction (Cummins, 1984, 1994; Genesee, 1994; McKeon, 1994). Indeed, as Cline and Frederickson (1996) note, in the age of mass migration all countries with developed economies are educating bilingual children, many of whom may not have a mature level of competence in any of their languages. However, many children from ethnic and linguistic minorities (L2 children) born in Canada to parents who may have been born here as well, are perceived as competent English language users by both their parents and teachers who see them, in essence, as no different from L1 children. This is evidenced by the fact that in many educational settings no accommodations are

made for them in the curriculum or in educational assessments (Cummins, 1994; Frederickson & Cline, 1996). These L2 children, as in this study, form a majority in many classrooms across Canada (Genesee, 1994; Cummins, 1994). However, even for these children, when educational distress is uncovered, their L2 status becomes their most salient characteristic for all concerned.

The grouping of children for this study was based on a language variable defined by mother's mother tongue. The use of mother's mother tongue to label the children's relationship to English as L1 or L2 proved sufficient to separate the two groups of children. Significant differences were found between these groups on many of the measures used in this study, but especially, on a variety of oral language measures. This is particularly remarkable in light of the fact that the children had been in English schooling for 3-5 years at the time of testing.

In this research the L2 children were not referred to as 'bilingual' because, as Genesee (1994, p.1) notes, the term focuses on an attribute that may not be applicable to all. In fact, except for informal parental reports of some knowledge and use of their home language, no formal assessment of this language was carried out. And yet, the children's minority language status determined partially by identification of mother's mother tongue (and use of it in the home) resulted in formation of groups whose performance

on a variety of measures was significantly different. Why should mother's mother tongue enable the identification of a child's linguistic status? And why are there linguistic differences between two groups of children, born in the same city, and sharing a similar SES and an educational setting? Obviously, important variables such as 'age of arrival' and 'length of residence' that operate in immigrant children's SLA are not at issue here since many if not all of the L2 children are exposed to the school language from birth via their parents, school-aged siblings, and neighbourhood friends.

Many studies of normal and impaired language development in young children are based on observations and recordings of mother/infant or child dyads (Conti-Ramsden & Friel-Patti, 1983; Crago & Cole, 1991; Lasky & Klopp, 1982; Wells, 1981). More recently, studies include comparisons of conversations between mother/child dyads to father/child dyads in monolinguals (Conti-Ramsden, Hutcheson, & Grove, 1995; Girolametto & Tannock, 1994) and in bilinguals (Goodz, 1994). Mothers are generally found to be the principal facilitators for language acquisition in normally developing children. Indeed, as Conti-Ramsden and Friel-Patti (1983) note, language which adults use in addressing young children was for some years referred to in the literature as *motherese*. This language has been described as having more linguistic redundancy, more use of intonation, greater

clarity, and is slower than speech addressed to adults. From this it appears that in North American middle class families (as Crago & Cole, 1991, have noted, most of the studies are based on white middle-class North American children) *mother* is considered as the prime care giver, socialization agent, and mediator for communicative and linguistic experience. On the other hand, Goodz (1994), believes that in bilingual children, it is not the parental gender that determines which language will be more advanced but rather the characteristics of the speech directed to the child that make one language more salient than the other.

Although parental language input was not examined in this study, the results in this study seem to confirm the importance of mother's language in language development in both groups of children. The finding may reflect a general societal reality of child rearing practices that cross socio-cultural and linguistic boundaries: Mothers are the primary caregivers and so spend more time communicating with their children than do fathers. As a result, their language has a more profound impact on their children's language development (Baker, 1995). L2 mothers in this study reported using two or even three languages in communicating with their children. Thus, English language use time is considerably lessened when compared with that in homes where English is the only language spoken. In addition, the variety of English used by the L2 mother may be less

congruent with the variety used in the educational setting when compared to the L1 mother's language (Saville-Troike, 1992). As a result, when they enter school, the L2 children's language skills are not as well matched to the language of instruction as are the L1 children's skills (Wong-Fillmore,1992).

It is well known that development in the school years is based on development during the preschool years. In preschool years language is paramount for interpersonal communication, but during school years language development for academic purposes determines educational outcomes. Academic language development and cognitive development are interdependent in first language development (Vygotsky, 1986), and as Collier's (1989) research synthesis indicates, cognitive development is also linked to SLA. In this study, despite the fact that the two groups of children differed in oral language performance, they did not differ on a nonverbal cognitive measure.

Cummins (1984) for example, found that second language learners may take up to seven years from initial exposure to acquire 'academic language' to the same degree as native speakers of the same age. Collier (1989) notes that for young L2 children schooled entirely in L2, a minimum of five years was needed to reach the 50th NCE (normal curve equivalent) on standardized tests even when these children were from high education, middle SES families. Cummins and

Swain (1986) explained the essence of 'academic language' using a two dimensional model involving cognitive demand and context embeddedness. Typical 'academic language' is characterized by high cognitive demand in a reduced context. Accordingly, L2 children may exhibit 'surface' linguistic proficiency in cognitively undemanding and context embedded tasks, but show a lag in the cognitively demanding and context reduced linguistic tasks that are more typical in the classroom and in standardized tests. This may explain Collier's findings of a lag in performance of young L2 learners on standardized tests.

In the present study when the two tests used to assess the children's language skills were examined from Cummins' two dimensional model of language proficiency, they were found to contain linguistic tasks with mainly high but also low cognitive demands, but in a reduced context only. Therefore, despite equivalent non-verbal cognitive ability between the two groups, the children's skills in their L2 may not yet have permitted them to perform well in context reduced linguistic tasks.

It is important to note that although as a group the L2 children were lagging behind their L1 peers on the oral language measures, this was not true for every individual. Many L2 children performed as well as or even surpassed their L1 peers. This underlines the importance of considering individual variability. Factors such as quality

and quantity of L2 exposure and use before entering school, and individual learner characteristics and talents that may hinder or enhance L2 development and consequent educational performance, play an important role in creating a unique learner.

Cummins' two dimensional model may also be used to explain the ability of the screening tool named 'The Thinking Test' (see chapter 3, Procedure) used in the second selection of students to distinguish students without academic difficulties from those with problems. The tool, a reading task in an obviously reduced context, taps classification or categorization abilities that clearly place a high cognitive demand on the child.

Categorization is based on successful comparison, differentiation, and discrimination skills. The ability to categorize is vital and basic to logical-verbal operations. It is a form of symbolic encoding whereby the child moves from establishing relationships among single items to projecting relationships among wider concepts. Those children with reading decoding problems and/or restricted verbal-cognitive skills found this task difficult and performed less well than those with greater verbal-cognitive maturity. Their performance on this task matched their teacher ratings of their academic standing compared to their class peers.

6.2 Audiology

Word discrimination & DDT tests.

The audiological testing of the children from both L1 and L2 groups resulted in some interesting findings regarding test norm appropriateness for diverse populations. For example, the WDS (word discrimination test) results showed very similar, normal performance for both the L2 and the L1 language groups in the quiet condition. In the noise condition (background composed of white or non-speech noise) the L2 group showed a greater variability of performance than the L1 group at the lower end of the range for both right and left ears. Nonetheless, the performance of both groups was well within normal limits and matched test norms. On the other hand, the SCAN (the auditory figure-ground or word discrimination test where the background is composed of speech or 'cocktail party' type noise) showed quite different results.

On the SCAN auditory figure-ground subtest, both the L2 and L1 language groups, whose ranges and means were similar, performed significantly worse than the test norming population. Word discrimination tests where the ground noise is composed of speech emulate actual classroom listening conditions. The fact that L2 children perform more poorly than L1 children on such tests has been uncovered elsewhere (eg. Crandell, 1996; Crandell & Smaldino, 1996). However, the reason for the L1 group's

poor performance on this test is not as easily explained. It is possible that the nature of the linguistic situation in Montreal, a city located in Quebec, where French is the dominant language, creates an ecology where all children are inevitably exposed to at least two languages, English and French, possibly in their homes, in their neighbourhoods, and certainly in their schools where French is taught in all English sector schools on a daily basis. This may result in L1 children whose language systems are unlike those of children whose ecologies represent a linguistic match with their L1. The difference may be expressed in a lowered tolerance for unclear speech caused by the language-like masking noise. This factor was suggested by Crandell & Smaldino (1996) as operating in L2 children's poorer performance on figure-ground auditory tests.

Interestingly, the teacher ratings on the CHAPPS, the classroom listening behaviour scale confirmed the finding that L2 children do not perform well in noisy listening conditions. More L2 children than L1 children were noted as exhibiting difficulties listening in 'noise' and in tasks requiring auditory memory and sequencing. As well, teachers' ratings in class performance showed an astonishing 32% of L2 children as having an 'attention' problem compared to 16% of L1 children. This may reflect the greater difficulties L2 children have in listening and attention in unfavourable acoustic environments due to poor signal/noise

ratios and reverberations that are typical of classrooms across this continent (Crandell, 1996; Crandell & Smaldino, 1996).

Because group results on the SCAN were available in this study, children whose performance was significantly poorer than the group means were easily identified in both language groups. The SCAN in its entirety is often recommended as an effective tool in determining the need for a comprehensive CAP assessment (e.g. Bellis & Ferre, 1996). However, as the results demonstrated, the test norms were not appropriate for the children in this study. Therefore, any clinical application that ignores the difference in performance between the norming group and that of a different group of children must result, inevitably, in a high percentage of false positive diagnoses of problems in these children, and a disservice to them. Both the L2 and especially the L1 children's results on the SCAN highlight the need for norming tests on local populations. These norms would assist in avoiding an assumption of auditory system deviance, where in reality language system difference may exist.

The results on the DDT in both language groups demonstrated a right ear advantage (more errors occurred on the left ear condition) in both the single and double digit listening conditions, confirming the efficiency of the contralateral neuroauditory pathway to the left hemisphere,

even when minimal verbal processing is required. This direct listening path of right ear → left hemisphere where language is centered is superior to that of the left ear → right hemisphere, the non-preferred hemisphere for language (Brunt, 1972, pp. 350-351). Verbal messages that arrive from the left ear to the right hemisphere transfer via the corpus callosum to the left hemisphere. This results in extra processing time and more inaccuracies. The range of performance in both groups showed the inefficacy of the single digits listening condition (for both right and left ears) in stressing the CANS sufficiently to uncover difficulties. The double digits left ear condition was more revealing. Although no significant differences in means were found between the groups, the wider ranges in the double digits condition attested once again to the greater variability of performance in the L2 group, a finding also noted in Crandell and Smaldino's (1996) study with Spanish/English bilingual children.

SSW Test.

The performance results on the SSW were rather surprising. The NOE analysis, according to Katz (1996) was designed to determine how well an individual processes compared to an age-matched control. Because the children were not selected from a clinical population, it was predicted that most of them would 'pass' this test, a major

component of the CAP assessment battery. Instead, in both the L1 and the L2 samples, only a small number obtained a 'No Problem' rating, while the remaining scores showed a continuum of performance ranging from 'extremely mild' to 'severe' CAPD. The range of NOE scores indicated that the SSW, a dichotic test designed to assess central auditory integrity and auditory processing is sensitive to individual variations in auditory efficiency. Obviously, central auditory system efficiency normally does not represent an all-or-none phenomenon, but rather a continuum of performance, much like visual system efficiency. As in visual system efficiency even where 20/20 visual acuity is determined, a continuum of ocular-motor and visual perceptual efficiencies exists. The performance range will surely include various degrees of mild impairments, moderate problems, and serious disability; so in auditory system efficiency the continuum will include extreme levels of performance as well. Ultimately, the effectiveness of the organism in interacting with auditory stimuli depends on individual neuroauditory integrity, and variations and degrees of effectiveness will be dictated by this idiosyncratic system.

Although both groups showed a wide range of performance, here too, the L2 group showed significantly greater variability in the upper end of the NOE continuum and therefore, a greater severity range. The significant

differences in performance between the two groups underline the effectiveness of using mother's mother tongue in determination of the children's status as L1 or L2, for clearly, the L2 status did relate to responses on the SSW. Another finding that underscores this relationship is the following. As in the DDT, a significant right ear advantage was found on the SSW in both groups. Interestingly, the right ear effect or left ear disadvantage in the L2 group was significantly higher than that in the L1 group.

One explanantion for the difference in L1 and L2 performance is that the SSW, a test that measures cortex level auditory pathways, does have a language factor attached to it, and this factor most probably interacted with the L2 status. Again, as in the SCAN auditory figure-ground results, the interaction between the increased auditory verbal stress and the less favourable neuroauditory route (left ear → right hemisphere → left hemisphere), affected the L2 group more profoundly. The SSW test consists of highly familiar spondees that are maximally intelligible over a wide range of intensities and highly resistant to distortion compared to monosyllabic words (Brunt, 1972). Despite their robustness, their dichotic delivery was able to stress the L2 group's CANS in a more profound way than that of the L1 group.

Recently, it was shown that responses of apparently balanced bilingual adults (Spanish mother tongue/ English as

a second language) on the English version of the SSW) were wider in range than on a Spanish version of the test, and the adults reported that they required more concentration for the English version (Saul & Diaz, 1996). Crandell and Smaldino (1996), who used sentences in their speech perception study of L2 children, hypothesized that because L2 children's linguistic knowledge of their second language is not as complete as L1 children's knowledge, increased listening stress reduces their performance on perceptual abilities tasks. In both these studies, an L2 status produced an increase in errors under adverse or stressful listening conditions.

The SSW, in part, stresses the language processing system; specifically, it taps the phonological/semantic component. It is plausible that under ambiguous listening conditions, as caused by the dichotic presentation of the words, the L2 children's attempts to access correct matches for the ambiguous auditory stimuli from their diverse and perhaps incomplete phonological/semantic repertoires resulted in many more errors than in the L1 group. The L2 children's performance on the SSW may partially reflect their, as yet, incomplete acquisition of their second language, a hypothesis that is in accordance with researchers' observations that complete mastery of a second language by minority children may take up to seven or even nine years (Collier, 1989; Cummins, 1984). Indeed, studies

of balanced bilinguals, those with the ability to use both languages rapidly and accurately under normal speaking and listening conditions, showed slowed word retrieval, reduced automaticity, and slower cognitive processes when reading in the L2 (Segalowitz, 1986).

The L1 group performance although less severe in range than that of the L2 group, was still notably different from the test norming population. In many diagnostic tests a performance score that is at least 2 standard deviations above the mean is considered clinically significant: 69% of the scores in the L1 group and 82% of the L2 scores fell in the clinically significant range, a highly unexpected occurrence given that these children were not selected from clinical populations. One plausible explanation for the discrepancy may be that the SSW norms were based on a selected sample of children who 'passed' the test (Katz, 1994), and therefore portray only a small portion of the continuum, whereas here, the results reflect the entire continuum of auditory efficiency as would be found in an unselected normal population.

As in the SCAN results, the SSW results demonstrate that the L1 group performance is different from the test norming sample, and that norming of tests on local populations is of vital importance if they are to have true clinical utility. In addition, it is important to ascertain the test variables that are responsible for the differences,

or those that are particulary challenging for children in a multilingual environment: are they temporal aspects such as rate of presentation of test stimuli, and the time interval between test stimuli in which the child must respond, or is it the linguistic aspect? Again, the availability of information on the L1 and L2 group performances on the SSW made it possible to evaluate individual scores so that those children with severe deviations from their own group means were easily identified as were their educational distress situations. Used this way, the SSW was clinically useful for both the L1 and the L2 groups in this study.

In regard to CAPD subtypes (determined from response biases or error patterns on the SSW) the following are important to note. First, in this study, two useful innovations, inasmuch as they assisted in describing a significant number of children in this study, were added to the classifications proposed by Katz (1991). One was the 'Mixed' category consisting of children who showed more than one type of error response pattern, and the other was the 'Generalized' type that showed a high error rate without a specific response bias. The fact that there was no association between subtype and language group membership indicated that any response error pattern is a signature of individual differences due to the uniqueness of the CANS and unique language experience.

6.3 Educational Distress Variables

Oral language.

Discrete and integrated measures of language abilities were equally effective in discriminating between the two language groups. The discrete measure language test was more difficult for both groups but the difference between the discrete and integrated measures was greater for the L2 group. This is evidenced by the score distributions and differences in performance between the tests and the language groups. In the discrete measure, only 44% of the L2 sample performed within the normal range compared to 71% of the L1 group. In the integrated language measure, 65% of the L2 group's scores and 91% of the L1 group scores fell in this range. For the L1 group, the integrated measure seemed less well suited than the discrete measure for demonstrating within group differences in oral language abilities. In essence the integrated test's discriminating power proved much better suited for investigating the L2 group's language abilities than those of the L1 group, as noted by the wider range of scores in the L2 group.

The language group performance differences were visibly more dramatic on the discrete measure than on the integrated test. In the discrete measure, all subtests showed a large difference between the groups, but in the integrated measure, the differences between groups on all subtests were

much smaller, and in the reasoning subtest the performance was very similar.

The differences in performance between the two tests can be explained by examining the differences in the tasks involved. The discrete measure of language taxes language processing in a highly decontextualized situation, in tasks that may be unfamiliar or even novel to many children since they are not based on ordinary classroom uses of language. Ordinarily language manipulations in the classroom occur in *meaningful* contexts, be they reduced or enhanced, and very rarely are elementary school children asked to manipulate linguistic units without such contexts. According to Cummins' two dimensional model, cognitive demand is determined by both external and internal factors: Task complexity constitutes an external factor, whereas task familiarity and acceptability combined with the learner's language proficiency comprise the internal factors (in Cline & Frederickson, 1996). Consequently, the discrete tasks present a high cognitive demand on both groups but much higher on the L2 children.

In contrast, the integrated language test is composed of tasks with which all children are highly familiar since they are routinely used in the classroom from early on. Performance on these tasks is based on both successful receptive language processing and the ability to engage the verbal cognitive system to solve the linguistic 'problems'

presented by the various tasks. Because the linguistic and cognitive systems collaborate in this effort, the opportunity for success increases dramatically while the cognitive demand of these tasks for most of the L1 children is very much reduced, as it is for a significant portion (65%) of the L2 group. The result is a positive effect shown by the better performance in both groups.

Reading ability.

The performance of the two groups on the reading abilities test was much different from that on the oral language tests. The L2 group score distributions showed that 79% of the children performed within the normal range or better on the combined basic and comprehension skills, while in the L1 group 89% showed adequate reading abilities. The differences between the two groups on both the basic and the comprehension measures did not reach significance after the Bonferroni adjustment. This indicated that the groups' performances were more similar than was expected given their highly significant differences on the oral language measures.

It is recognized and accepted (ASHA, 1996) that central auditory processes are made up of neurocognitive mechanisms specifically dedicated to tasks of recognition and discrimination of acoustic signals, as well as nondedicated neurocognitive mechanisms such as attention, motivation,

memory, and language knowledge. The nondedicated mechanisms are deployed in the service of acoustic signal processing. Comprehension of spoken language depends on the accurate processing of the acoustic signal from the moment of detection to its progression through the various levels of the CANS, a system especially sensitive to temporal aspects of acoustic stimuli. Much of this processing occurs before the listener's conscious awareness.

Processing of the speech stream, a rapidly changing complex array of temporally ordered acoustic stimuli, exerts particular stress on the CANS. Unlike stable visual stimuli such as offered by stationary reading material, the transitory nature of the speech signal does not lend itself to review and repair. The nature of this auditory signal, an L2 status, and individual central auditory efficiency therefore interact to make oral-aural presentations of language more prone to 'misses' than would visual steady-state presentations which allow for more 'hits' because of availability for review and correction. In an L1 speaker with a more-or-less intact linguistic tool, the language factor acts as a facilitator in the processing of the speech stream. In this study, when the auditory factor was eliminated, as on the language tasks offered by the reading tests, better performance than on the oral language tests was noted. The differences between the two groups on the reading tasks may therefore be more representative of the L2

group's language knowledge than are the oral language test differences. As Collier (1989) notes, reading is a valid predictor of L2 thinking skills because it usually measures through vocabulary analysis and passage comprehension the ability to reason in that language.

Psychosocial-behavioural variables & academic standing.

The results on both the teacher and parent rating scales demonstrate that when linguistic factors are not at issue, the L2 and L1 group differences are non-significant. In fact, the differences seem to virtually disappear as is shown by both the means and the ranges in each group. The score distributions were more informative. For example, teachers tended to rate more L2 children as clinically 'anxious' whereas parents of both groups were aware of their children's anxiety symptoms. In general, parents tended to be more concerned with specific symptoms than were teachers. This may reflect the fact that the parents know their children more intimately and tend to judge them on individual longitudinal developmental patterns whereas teachers tend to judge the children in relation to the immediate group and school year so that patterns are not as obvious. It is also possible that children tend to show more compliance in an educational setting than they do at

home where they are generally more free and secure in showing their 'frailties'.

A difference was noted in the kind of concerns parents of each language group showed. The L2 parents, for example, were more concerned with 'learning problems' than were the L1 parents. This concern was justified given that many more L2 students were given a 'fail' rating by the teachers in virtually all areas of the class performance instrument. School Behaviour was the only area showing a very high percentage of pass scores for L2 students. The L1 students, on the other hand, were given the 'benefit of the doubt' as shown by a great number of marginal ratings in all areas but especially in Academics and Communication. The tendency of the teachers in this study was to be more strict in ratings of individual L2 children.

6.4 The Relationship Between CAP and The EDVs

The relationship between CAP efficiency and EDV performance was different for the two language groups, further emphasizing the uniqueness of each group. Weaknesses in auditory system efficiency in the L1 group was associated mainly with psychosocial effects and, to a much smaller extent, with oral language. In contrast, the oral language variable correlated moderately (negatively) with the SSW and accounted for 40% of the variance, and was the best predictor of central auditory efficiency in the L2

group. School performance, while also significantly correlated with the SSW, accounted for a mere 5% of the variance. This indicated that in L2 children, oral language performance problems (uncovered when the child is put through a full battery of language tests) may be accompanied by central auditory system efficiency problems.

It is important to note that these results represent correlational associations and cannot confirm cause-effect relationships. We can not ascertain whether central auditory inefficiency is a cause for low oral language abilities or further exacerbates an existing problem. To date, the exact nature of the interaction between the sensory/perceptual system and higher level mechanisms such as language representations is a basic science issue (ASHA, 1996). In L1 children some causal links between CAPD and language disorders have been uncovered (ASHA, 1996) but no such links have been established in L2 children.

Ellis (1996) argues that much of language acquisition is based on sound sequence learning: "The learner must acquire sound sequences in words ... word sequences in phrases. These sequences form the database for the abstraction of grammar" (p.92). He notes that in L1 and in L2 the representation of phonological strings is the first step in language acquisition. He emphasizes that learners' individual ability to remember simple verbal strings in sequence determines their language learning abilities.

Perfetti (as cited in Segalowitz & Hébert, 1990) argues that phonological codes are well-suited to working memory information storage for purposes of language processing. The importance of central auditory efficiency in allowing the learner easy access to phonological sequences is self-evident. Inability to detect and discriminate speech sounds accurately will interfere with establishing stable phonological strings or codes for auditory memory. In fact, because it is difficult to remember ambiguous acoustic stimuli, the effect will resemble attempts at writing messages on water. It follows then that the less efficient the system, the greater the delay in the acquisition of language, be it first or second, and consequently the greater the resulting delay, the less efficient the auditory system is in processing the speech stream in adverse or context reduced situations.

In contrast to the strong association noted between the severity of CAPD (as assessed by the SSW NOE) and performance on several EDVs, the CAPD subtypes were not correlated with the EDVs in the L2 group nor in the L1 group. This result may reflect the fact that in this study, the L2 and L1 children's response biases may represent behavioural correlates, not yet uncovered, that are different from that of the norming group of children. The establishment of whether subtypes can be uncovered in this group of children requires further study for clarification.

6.5 Cluster & Discriminant Analysis

L2 and L1 group EDV performance profiles.

Discriminant and classification analyses assisted in confirming and refining the EDV performance profiles identified within each language group during cluster analysis. These analyses showed interesting similarities and differences between the two language groups. In the L2 group the four resulting clusters represented the following student profiles. Children in cluster 1, (approximately 10% of the group) showed intact reading decoding skills but serious difficulties in oral language and reading comprehension. However, their class performance attested to adequate compensation abilities. They may achieve, at a cost, as suggested by their poor psychosocial results. These students were named the 'pretenders' since their oral reading is probably fluent and 'sounds good' but they derive little meaning from their reading. Cluster 4, comprising 16% of the group, showed superior oral language, reading, and class performance scores. However, their psychosocial score showed a lag. Teachers may consider them to be 'trouble makers' in class, but they are able to function academically in the upper range of the class. Cluster 2 containing 35% of the group portrayed strong well rounded students, with excellent scores on all the EDVs, the 'high achievers' in the group. In contrast, cluster 3 comprising 39% of the group were poor across all the EDVs. The

strength of this subgroup was on the psychosocial variable, which, although below average, represented their own best score. This profile is very typical of 'struggling' students with long standing educational distress.

In the L1 group six profiles of EDV performance were identified. Cluster 1, containing 9% of the students showed scores indicative of seemingly adequate reading decoding but difficulty extracting meaning from reading, probably due to their poor oral language abilities. They showed educational distress but with little effect on their psychosocial variable. This cluster, although similar to the L2 'pretenders' in their actual performance, were not able to compensate for their lags in reading and oral language as did the L2 cluster. These constituted the 'low achievers' as shown by their poor class performance scores.

L1 cluster 6 (9%), exhibited more than adequate abilities in reading and oral language but probably lacked motivation to learn as was shown by their poor class performance. Their profile was typical of 'underachievers'. Cluster 3 containing 9% of the group, showed a reading fluency problem: poor basic reading skills but adequate reading comprehension and oral language abilities. Serious problems in listening behaviour, and somewhat lesser difficulties in psychosocial and class performance were the signature for this cluster. This profile is typical of the 'frustrated' students whose slow and laboured reading drains

their motivation to perform academically, despite their ability to extract meaning from reading.

Cluster 4 (18% of the sample) resembled the 'struggling' L2 students. They exhibited serious academic distress most likely due to very poor oral language and reading abilities. Poor listening skills were shown as were serious psychosocial behavioural problems, indicated by their score which was the lowest of the entire L1 group on this variable. In this they differed from their L2 struggling peers whose best score was actually in the psychosocial variable. Cluster 5, constituting 20% of the group, can be characterized as the 'hard workers'. They showed a specific reading problem in both basic and comprehension skills. Adequate oral language skills, superior listening abilities with solid psychosocial behavioural traits, and probably consistent hard work were able to minimize the impact of their reading deficits so that class performance was not negatively affected.

Cluster 2 was the largest, containing 36% of the L1 students. These were the group's 'high achievers'. They were very similar to the L2 high achieving students. They exhibited the highest reading comprehension scores as well as the highest class performance of the entire group. Their psychosocial and listening scores, although above the group mean, were their own lowest scores. In all, they showed no difficulties in any of the EDVs.

When each of the language groups was examined according to class performance a bipolarity of performance was noted in both. In the L2 group 61%, including the 'pretenders', 'trouble makers', and the 'high achievers' showed class performance ranging from functional to high levels, whereas 39% were the 'strugglers', academically compromised, showing a serious lag in class performance. In the L1 group, 56%, the 'hard workers' and the 'high achievers', exhibited functional or high class performance levels. The remaining 44% were the 'low achievers', 'under achievers', 'frustrated' and 'struggling' students who exhibited notable academic distress.

Although in both groups a notable number were performing academically, their style, weaknesses, and strengths were quite unique. In the L2 group unlike the L1, the low performers showed a very uniform profile and constituted one large cluster. In the L1 group, low performance was due to a variety of difficulties constituting an interesting array of clusters. It appeared that in the L2 group, the combination of some strengths and ample motivation allowed academic compensation. However, when serious weaknesses were present in all areas, including CASE, compensation was not possible. In the L1 group, in contrast, the presence of even some weaknesses, undermined the children's compensation abilities, and motivation to

perform. In general, the L2 children appeared much more motivated academically.

Discriminant functions.

The discriminant functions uncovered during the discriminant analyses showed similarities as well as differences between the two language groups. In both groups class performance was the most powerful discriminator between the clusters accounting for 85% of the variance in the L2 group and 66% in the L1 group. Functions 2 & 3, corresponding to oral language, psychosocial and basic reading variables contributed to the remaining 15% of the variance in the L2 group, showing a minor discrimination role in this group. In the L1 group in contrast, the listening function contributed another 20% to the variance, while the remaining 15% was attributable to the psychosocial and basic reading variable with oral language playing a negligible role (<1%). In this study, it appears that the SIFTER, the instrument used to measure class performance was quite effective in uncovering the different performance profiles identified in each language group. The CHAPPS, the instrument used to assess classroom listening behaviour, was useful in the L1 group but not at all suitable for the L2 group as a profile discriminator. In this group, it is probably best used to uncovering individual listening distress signals.

In regard to the discriminant functions uncovered in this study it is important to note that according to Stevens (1996, p.265) unless the subject/variable ratio is quite large (≥20/1), the interpretation of the function-variable correlation or coefficient may not hold up in another sample from the same population. Accordingly, confidence that the variables selected in interpreting the discriminant functions in this study will emerge again in another study is guarded.

6.6 SSW NOE & EDV Performance Cluster Relationship CAP efficiency.

A significant difference in central auditory system efficiency (CASE) as defined by the SSW severity measure (as NOE increases CASE decreases) was found between the L2 performance clusters. The 'struggling' students cluster was significantly different from the 'trouble makers' and the 'high achievers' on CASE. Interestingly, no significant differences were found between the L1 clusters on CASE. It seemed that for the L1 students, low CASE is not necessarily associated with educational distress, and that compensatory mechanisms are operating, permitting students with low CASE to cope in adaptive ways to demanding classroom requirements. In the L2 group, a different story unfolds. Compensation for low CASE is more difficult and perhaps impossible as is shown by the educational distress displayed

in this group. These students do not seem to benefit from instruction via the auditory channel, the most frequently used route for learning in the classroom. Their low CASE, poor classroom listening conditions (ground noise and reverberations problems), and the added disadvantage of deficiencies in their L2 knowledge, prevent adequate bottom-up speech stream processing while increasing reliance on language knowledge or top-down analyses. These combine to make academic success extremely difficult. In addition, some of these students may have other neurocognitive mechanisms and systems problems that further contribute to their educational distress, for it is often the case that deficits in one neurological system has counterparts in proximal systems as well.

A modified SSW NOE.

A note regarding the calculations of SSW severity based on NOEs, as recommended by Katz (1994) is in order here. In this study, some students exhibited an error pattern called 'reversals' (See Appendix D for explanation) in excess of the permissible standards, in addition to the errors used for calculation of NOE. Some exhibited many reversals but no significant NOE. The reversals seemed to be indicative of a CASE problem but the NOE scoring did not allow for consideration of these errors in the final score. Standard deviations for reversal errors were calculated for each

student and the result added to the NOE score. The resulting score was named 'the complete NOE'. The analyses to determine the relationship between EDV clusters and CASE were rerun using the 'complete NOE'. The results showed again no significant differences between the L1 clusters on the SSW, but in the L2 group, cluster 1 containing the students named 'the pretenders' was found to be significantly different from cluster 4, whose students were named 'trouble makers', one of the high class performance groups. It seemed that the 'complete NOE' was a more powerful discriminator, identifying suspect CASE in a group that exhibited problems in oral language and reading comprehension, but with compensation capabilities as was indicated by their class performance score.

SSW subtypes & EDV performance clusters' relationship.

None of the clusters in either the L2 or the L1 groups was found to be associated with any specific subtype of auditory performance. Again this served to emphasize that in this study, auditory subtypes represent individual neuroauditory idiosyncracies and can neither be used to identify language groups nor performance profiles.

CHAPTER 7

CONCLUSION

7.1 Implications for Treatment, Educational Policy, and Future Research

This study was designed to investigate the usefulness of the CAPD construct in the assessment of L2 children's educational distress, to explore the ability of current diagnostic instruments to distinguish those with CAPD in both L2 and L1 children, and to determine the effect CAPD has on those who are clinically diagnosed. CAPD was offered as one explanation for educational distress in L2 children out of a myriad of factors that may exist. The results of this study show that CAPD or low CASE was clearly associated with low language levels and academic distress in the L2 group. These associations were demonstrated by the various quantitative analyses as well as the qualitative ones provided by the case study. The latter demonstrated the negative impact CAPD has on the academic lives of individual children in both language groups. The case study also succeeded in demonstrating the negative effects of CAPD from the very start of the academic process, at the Kindergarten level, especially for L2 children.

The fact that most of the educational curriculum is delivered in the classroom from the teacher to the students

via the auditory channel is well established. Many studies (Berg, Blair, & Benson, 1996) have confirmed that adverse classroom acoustics have a great negative impact on the ability of students to comprehend auditory information, and some (Crandell & Smaldino, 1996) have found that the impact is more severe in L2 children. Those L2 students with poor auditory efficiency may be further penalized by adverse physical circumstances in their classrooms. Indeed, these may play a major role in many of these children's continued educational distress. The importance of uncovering central auditory system deficiencies is therefore paramount if solutions to these children's problems are to be implemented. These solutions may either improve classroom listening conditions, or alter how children listen so that they are better able to process auditory information.

Interventions for CAPD comprise a combination of strategies reflecting the following approaches (ASHA, 1996). One approach is the enhancement of language knowledge and resources for improved 'top-down' processing. This approach has been found very useful in the processing of spoken discourse (ASHA, 1996). A bottom-up approach consists of the strategies that enhance the child's ability to cope with degraded auditory-linguistic stimuli through auditory training for improving phoneme and syllable discrimination, with added top-down or language intervention techniques (ASHA, 1996).

Recently, Tallal, et. al., (1995, 1996), and Merzenich, et. al., (1996) provided additional evidence that a neurological timing deficit in auditory processing underlies language-based learning disabilities. They found that deficits in discriminating rapidly changing speech sounds result in problems in oral and written language. These researchers believe that because this is a medical problem with a neurological basis, traditional remediation in the form of special-education programs are minimally effective in altering the course of academic failure for affected children.

In response to the needs of such children, Tallal and her associates applied technology from the domain of neuroscience to devise computer generated speech in a therapeutic program designed to alter cells in the primary auditory cortex that fail to detect rapid transition phonemes (in syllables). The program was found to be effective in improving speech and language comprehension in L1 children with temporal processing deficits (Tallal, et. al., 1996). Research to ascertain the effectiveness of such programs for L2 children is direly needed.

Another approach to intervention consists of strategies for improving the acoustic signal quality, and improving the listening environment. Some researchers (Berg, et.al., 1996, Crandell, 1996) advocate the use of sound-field FM amplification systems to improve the speech/noise ratio no

matter where the teacher is located in the classroom. It was found that the use of such systems in the classroom significantly improved speech-perception abilities of L2 children. Other researchers (Merzenich, 1994, cited in the Dana Foundation report; Wenndt, Burleigh, & Thompson, 1996) focus on devising instruments that can control the speed at which auditory signals enter the brain, or slow down real-time speech, as remediation strategies.

The choice of any intervention approach must be driven by the child's individual needs (uncovered by an assessment based on a holistic approach). An effective remediation program may be one that integrates Feuerstein's (1980) and Dollaghan's (1990) intervention approaches with those of the noted approaches that are most appropriate for each child, that is, those that respond to the child's unique problems. These approaches beg for further investigation so that the learning process can be facilitated in L2 children with noted CASE deficiencies. Perhaps early identification of these problems and the use of such systems as early as kindergarten would spare these children a stressful and often unsuccessful academic career.

The notion of L2 status as a possible etiology for learning problems still is found in the literature, even when the researchers' intentions are honourable (see Anderson & Johnson, 1996). A significant portion of L2 children in this study showed more than adequate L2

knowledge and literacy abilities. This finding strengthens the argument that L2 status is not a sufficient explanation for educational distress, and that when such distress occurs, individual abilities and weaknesses should be investigated. As well, the old research blaming poor academic performance on cognitive deficits "caused" by bilingualism, is further repudiated by the results in this study. Adequate and better cognitive abilities, equivalent to those of the L1 children, were noted in this L2 group. Further, it was clearly shown that as in the L1 group, L2 children can experience academic distress despite superior cognitive abilities.

The results in this study provide some evidence for the fallacy of the notion that non-immigrant status and adequate communicative fluency in the L2 is evidence that there are no differences between L1 children and those from minority groups. The acquisition of academic aspects of L2 in immigrant children may require five, seven or even nine years (Collier, 1989; Cummins, 1984), and it seems that this may be true for some native born L2 children even from mid-SES families and schools, especially when some specific learner characteristics are present. This study underlines the importance of meeting the L2 school child's individual needs if equal opportunity for success is to be a reality.

An important issue was raised with the discovery that identification of mother's mother tongue differentiated

between the two groups of children. One possible reason for this was a distinctive variety of English used by the L2 mother. Saville-Troike (1992), notes that while recognition and acceptance of varieties of English is now widespread around the world, within the United States, it is much less accepted. She states, "Sharing grammar and vocabulary does not ensure peoples' sharing the same language" (p.150). The relationship between language and culture is arbitrary, and the communicative uses of the language will be dictated by the cultural differences of the English speakers. She notes that for minority group students educated via English or any other 'majority' or 'national' language, the lack of recognition of these differences can cause serious mis-understanding of the children, and influence identity development, literacy, and achievement. Such misunderstandings were noted in this study (see case-study) where teachers either underestimated the child's language skills or overestimated them, as evidenced by prompts urging 'harder work' when the evidence that the child is already working to capacity was quite clear. These mis-understandings may explain the perceived elevated anxiety in the L2 group in this study. Indeed, data concerning the varieties of English developed in our 'ethnic mosaic' is to date largely a mystery. The diversity of English (or French for that matter) brought to school by children from minority

groups has not been acknowledged by our educational institutions.

The issue of home language (mother tongue) versus 'school language' needs to be addressed. Genesee (1994, p.1) voices many a researcher's view when he states, "We believe that maintenance and development of the home language and culture are pedagogically sound and essential components of any effective educational program." The reality for minority group children in most Canadian schools (be they English or French) reflects the opposite of this belief. Majority language and culture are intricately woven into the curriculum, and home languages are ignored, as is the reality of diverse varieties of English and French that reflect the cultural diversity of Canadian school children. The large number of minority group children dropping out of high school is testament to the need for a change in the context of education, a context largely devoid of socio-cultural elements that are essential in the construction of proud identities, academic achievement, and self-esteem in our students. Perhaps better understanding of the reality of varieties of one language-diverse cultures, and more appreciation of the importance of individual differences will better prepare educators in changing 'subtractive' curriculums to 'additive' ones, curriculums that humanely facilitate the acquisition of the academic language of instruction.

7.2 Epilogue

Recently I was asked to assess Max, a 5 year old prekindergarten child. His teacher said that he had difficulty pronouncing certain words, comprehending directions, and expressing himself in English. At the start of the school year he did not speak at all. According to his mother, he was very delayed in speech and barely spoke Portuguese, his mother tongue or home language. She noted a marked improvement in the latter part of the school year, when I first saw him. Max had been followed by an SLP at a hospital clinic because of pronunciation since age 4. Max's father, a stay-at-home dad, was interviewed. His wife was Portuguese born, but emigrated to Canada at a young age, and was educated in a submersion English educational setting. He had emigrated from a rural district in Portugal at the age of 20, and, as is the case for immigrants to Quebec, he attended government sponsored French language classes. At home he communicates with his wife and his 12 year old son (an excellent student attending the same school as Max) in Portuguese (roughly 50% of the time), in French (35% of the time), and in English (15% of the time). With Max, he uses mainly English, and tries to reduce Portuguese to the point that he hardly uses it at all with him. His wife communicates with Max in English only.

Max's father noted that when Max was three years old and still did not speak, he and his wife believed that

frequent and severe bouts of otitis media perhaps caused a problem with speech development. Max's pediatrician was consulted. He advised them to speak in English to the child and to enroll him into a daycare centre for English language stimulation. This advice was echoed by the SLP at the local hospital speech clinic: "stop speaking Portuguese and concentrate on English only." She explained that the child is confused, and expressed concern that he would not be ready for preschool when he turned four. The father continued, " so we start to speak English with him and his Portuguese was not there...because we were too afraid he goes to the English school he doesn't speak a word, not Portuguese not English, so we had to take a chance... we know it wasn't right!...but the thing I want you to tell me, what you think, if I have to speak Portuguese?...for me in my head, it's very complicated...I know it's for him it's complicated because it's so many languages."

The above is testament to the dilemma that L2 parents face when their young child exhibits speech and language difficulties. The fact that minority parents are 'afraid' to preserve and use their home language with their children is evidence for a widespread lack of information about the effects of bilingualism on developing children. When problems occur in majority language children educated in an immersion program, parents are not advised to discontinue using their mother tongue at home so that the school

language can take strong root without interference from the home language. Instead, they are often counselled to withdraw from the immersion program and concentrate on the home language, despite evidence that many can succeed in L2 programs (Bruck, 1982).

Twenty years have passed since I started working with children such as 'Max' and 'Tony', and was first made aware that minority group parents are advised to stop using their home language with their children who exhibit language-learning difficulties. This deplorable practice continues as I write these words. L1 children with the same problems are advised to strengthen their home language.

The L2 children in contrast may be denied opportunities to develop knowledge of their L1 because at a very young age the parents were advised that their home language would interfere with education later. Unlike the situation for L1 children, education via the mother tongue is unavailable in the public school sector.

The L2 child with a learning problem and his family are led down the garden path by well intentioned but often misinformed professionals from both the educational system and support personnel dealing with pediatric populations. The question of how best to treat these children in our school system requires intensive research. We owe these children and their families information and advice that is based on fact rather than fiction. Knowing a language or

several languages can not *harm* a neurological system. However, loss and devaluation of the home language can compromise the child. Mother tongue knowledge is basic and vital for development of the 'self' as a healthy member of a family, a cultural group, and consequently as a functional member of a larger society. As Cummins noted (1984) those bilingual children who have special learning needs will also show language needs because their general learning difficulties will also affect their acquisition of cognitive academic aspects of the language of instruction. When a child is seen as having a *language difficulty* because of an L2 status when in reality a neurological problem exists, then the child is deprived of appropriate educational support (Rogers & Pratten, 1996). Misdiagnoses may profoundly affect children and their families, seriously jeopardizing children's future learning progress and their self-esteem.

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APPENDIXES

APPENDIX A.

DEAR PARENT

Yvette Hus, the C.E.C.M. speech-language pathologist and Concordia University Doctoral (PhD) student, is currently gathering information that will greatly help in the identification of listening problems in children in grades 3, 4, 5 and 6. These problems are suspected to interfere with children's ability to perform in school to the best of their true ability. The detection of these problems is very important so that proper help can be given to the child and negative academic consequences may be avoided.

A complete audiological investigation by a highly respected pediatric audiologist (a hearing-listening specialist), as well as an investigation of your child's language-learning ability is offered to you, the parents of the C.E.C.M. English sector, completely free of charge. The audiological investigation will take place in an audiology clinic while all other assessments will be performed at your child's school.

The tasks your child will be asked to perform include listening, speaking, and reading. The tasks you and your child's teacher will be asked to perform include a short interview, and filling out a questionnaire. The speech-

language pathologist will be available to the parents and teachers to assist with the questionnaires.

The benefit of participation in this project is that the speech-language pathologist will provide you, the parent/s, with the assessment results, and in cases where a problem will be detected, appropriate recommendations that will help your child will be given, again, completely free of charge.

The following **guarantees** are given to you, the parent whose child will be accepted into the project:

1. Complete privacy:

- all personal information given by you, your child, or your child's teacher will remain strictly confidential.
- all results will be given directly to you the parent, and only you the parent will decide if you wish to share the results with the school.
- your child's name as well as you name will not be used in any publication or sharing of project data. Complete anonymity is therefore built into this guarantee.

2. A large body of research in the area of identification of listening problems in children allows for the guarantee that <u>No</u> known or expected discomfort or risk is involved from participation in this project.

3. All procedures in this project can be taken at face value and <u>Do Not</u> involve deception.

4. You may withdraw from this project at any time without penalty of any kind.

* **The speech-language pathologist reserves the right to select the parents and children from amongst those who may wish to participate.**

In the event that you may require additional information regarding the project you may contact Yvette Hus at the following telephone number: XXX-XXXX. In the event that you may wish further clarification during the project you may contact Dr. Patsy Lightbown at Concordia University.

Please **READ**, **SIGN**, and **RETURN** the lower portion: Informed Consent, to the school secretary if you wish to have your child participate in this project.

_____

School Principal

DECLARATION OF INFORMED CONSENT

I give my informed consent for my child/children to participate in this project that is aimed at identifying listening problems in children.

I have READ and UNDERSTOOD ALL the above information and guarantees provided by Yvette Hus, the speech-language pathologist who will be responsible for the gathering of all the information required in this project.

My Child/children's name:.....

My Child/Children's Date Of Birth:.....

My Child/ Children's School:.....

Home telephone number:.....

The language we use at home:.....

Mother's first language:.....

Father's first language:.....

Signed:.....DATE:.....

Parent or Guardian_____

APPENDIX B.

DEAR PARENT

Yvette Hus, the C.E.C.M. speech-language pathologist and Concordia University Doctoral (PhD) candidate, is currently gathering information that will greatly help in understanding how children's hearing and listening systems help them in learning in the classroom. This information will aid in identifying those with excellent listening systems, and those with listening problems. These problems are suspected to interfere with children's ability to perform in school to the best of their true ability.

A class language activity showed that **your child performed very well** relative to the others in the group. Your child is therefore an excellent candidate for the investigation of his/her listening system by both the audiologist (at her clinic) and speech-language pathologist (at your child's school). The information obtained from this investigation will help us understand better the factors involved in our children's learning process so that we can meet their needs better.

The assessment activities from both audiology and speech-language pathology include listening, speaking, and reading. You and your child's teacher will be asked to participate in a short interview, and fill out a questionnaire. The speech-language pathologist will be

available to the parents and teachers to assist with the questionnaires.

The benefits of participation in this project are: 1. you and your child will be instrumental in assisting others who have serious problems because of listening difficulties, 2. the speech-language pathologist will provide you, the parent/s, with the assessment results, and 3. in cases where a problem is detected, appropriate recommendations that will help you and your child will be given completely free of charge.

The following **guarantees** are given to you:

1. Complete privacy:

- all personal information given by you, your child, or your child's teacher will remain strictly confidential.
- all results will be given directly to you the parent, and only you the parent will decide if you wish to share the results with the school.
- your child's name as well as your name will not be used in any publication or sharing of project data. Complete anonymity is therefore built into this guarantee.

2. No known or expected discomfort or risk is involved from participation in this project.

3. All procedures in this project are designed to study factors involved in children's listening ability.

4. You may withdraw from this project at any time without penalty of any kind.

* **The speech-language pathologist reserves the right to select the parents and children from amongst those who may wish to participate.**

Your child's participation in this project is highly valued.

In the event that you may require additional information regarding the project you may contact **Yvette Hus** at the following telephone number: **XXX-XXXX**. In the event that you may wish further clarification during the project you may contact Dr. Patsy Lightbown at Concordia University.

Please **READ**, **SIGN**, and **RETURN** the lower portion: Declaration of Informed Consent, if you wish to have your child participate in this project.

DECLARATION OF INFORMED CONSENT

I give my informed consent for my child/children to participate in this project that is aimed at identifying listening problems in children.

I have **READ** and **UNDERSTOOD** ALL the above information and guarantees provided by Yvette Hus, the speech-language pathologist who will be responsible for the gathering of all the information required in this project.

My Child/children's name and Grade:.....

My Child/Children's Date Of Birth:.....

My Child/ Children's School:.....

Home Telephone Number:.....

The language we use at home:.....

Mother's first language:.....

Father's first language:.....

Signed:.....DATE:.....

Parent or Guardian_____

APPENDIX C.

The Test Of Nonverbal Intelligence

The TONI is described by its authors (Brown, Sherbenou, & Johnsen, 1982) as a language-free measure of cognitive ability. No listening, speaking, reading, or writing is required. Even the instructions to the students are non-verbal as well. The examiner pantomimes the directions and the student points to the chosen response. The test is un-timed, and uses problem-solving as the basis for all items. The student is required to solve problems by identifying rule governed relationships among abstract figures:

1. Simple Matching - All figures share the same number of attributes.

2. Analogies - The relationship among figures in one row or column is the same as in the other and they vary in the following way:

a. Matching - No difference exists among figures.

b. Addition - New attributes or new figures are added.

c. Subtraction - One or more attributes is subtracted.

d. Alteration - One or more attributes is changed.

e. Progressions - The same change continues between figures.

3. Classification - The figure in the stimulus is a member of one of the sets of figures in the response choices.

4. Intersections - By joining parts of figures in rows or columns, a new figure is formed.

5. Progressions -The same change continues between or among figures.

Administration instructions are provided in the test manual, and these were followed in this study. Testing is terminated when the student misses three out of five items. Test score consists of the calculation of the basal item (just below the first error), plus the number of correct responses between the basal item and the last error. The resulting raw score is then converted to an age appropriate TONI quotient and a percentile. Only students with quotients in the normal range, that is, with scores higher than 85 were selected for this study.

APPENDIX D.

Staggered Spondaic Words Test-SSW

The SSW test (Katz, 1962, 1968, cited in Brunt, 1972), p.334-356) requires the listener to repeat spondees or two syllable words (e.g. outlaw, sidewalk, etc.) presented in the following way (See Figure A.1 following Appendix D for testing format example). Each pair of spondees is presented with first syllable of the first word arriving to first ear only, second syllable and first syllable of the second spondee arriving to both ears simultaneously. This has the effect of presenting non-competing and competing signals, and it results in four listening conditions, two for each ear: right non competing (RnC), right competing (RC), left competing (LC), and left non competing (LnC).

The responses on this test yield information on various auditory processes, described by Tedeschi(1984):

a. Selective Listening: This is the ability to pay attention to or concentrate on a given auditory task. Auditory memory utilizes this skill. Errors of omission of the first or last word of an item, and displays of hyperactive behaviour (e.g. undue fidgeting) are clues to dysfunction in this area.

b. Binaural Separation: It describes the ability to attend to and integrate information presented to one ear and suppress the information which is presented simultaneously to the other ear.

c. Binaural Integration: This is the ability to combine different information presented to each ear simultaneously. Ear and order effects give clues to this process function.

d. Temporal Sequencing: This is the ability to recognize the correct sequential order of auditory signals. Errors of reversals give clues about this process.

e. Interhemispheric Interaction: This describes communication function between left and right hemispheres. The presence of an ear-effect can act as a clue to poor inter-hemispheric communication and therefore decreased ability to receive auditory information.

Errors on the verbal repetitions of the presented spondees include omissions, substitutions, and an inability to identify the presented word despite obvious reception of the signal as indicated by body language. The following response biases and patterns are also noted: ear effects or a comparison of total errors when presentation is in the right-ear-first and the left-ear-first; order effects, that is, observation of whether errors occurred mainly on the first spondee or the second (can be taken as a memory effect); reversals or a change in sequence of one or more words in an item; the presence of a high number of errors in one competing condition (Type A pattern).

Research indicates that the processes described above are developmental skills which reach maturity by approximately 12 years: adults with normal CAP exhibit no

ear effects, order effects, nor significant numbers of reversals. Children do exhibit response biases, that is, ear and order effects, and reversals, up till age 12. Beyond this age normal children respond as adults (Lukas and Genchur-Lukas, 1985).

Scoring of the SSW consists of calculating a raw SSW (R-SSW), that is, scores of percentage of error for each of the four listening conditions noted above. In order to avoid contamination of CAP results by poor speech discrimination results, a corrected SSW (C-SSW) is calculated. The calculation involves the deduction of the speech discrimination percentage of error from the R-SSW percentage of error for the involved ear. Response biases are also calculated, and these are used to determine CAPD subtype.

Katz (1994) reported two additions to the SSW that help simplify calculations. Instead of raw and corrected SSW (the latter invariably resulted in negative percentage scores which tended to mask a CAPD factor by making the child's performance look better than it actually was) he suggested scoring the number of errors (NOE). He noted that the established analyses of performance were based on site-of-lesion studies (used to locate lesions in the CNS) but that the new way of analyzing performance was more appropriate for evaluation of CAPD.

In the new analyses the NOE for each listening condition and ear are calculated and the resulting eight numbers are used to determine response biases and thus establish subtype. The use of NOE, notes Katz eliminates "the slight tilt of the SSW that is in favour of showing anterior response bias...". That is, the old calculations tended to show more of the Tolerance-Fading-Memory subtypes than Decoding ones. Using NOEs gives both subtypes statistically equal chance to be manifested.

The total NOE for each condition (but no longer considering each ear separately) is calculated to yield four cardinal numbers. The total NOE, obtained by adding the four cardinal numbers, suggests Katz, can be used to determine overall performance. In this study the total NOE was used to establish relative CAPD severity. NOE norms (means and standard deviations), and normal limits (set at +/- 1 SD) for scoring the cardinal numbers, totals, reversal errors, and ear and order effects, are provided for each age group. As well, Katz provides word discrimination scores (mean, SD, and normal limits set at 2 SD below mean) for each ear.

Katz (1991) noted that the differing error patterns on the SSW resulted in four CAPD subtypes. However, he cautions that these are not mutually exclusive as some subjects show several categories of dysfunction. In addition, some may show a generalized poor performance but

without a predominant subtype. In this study the Katz subtypes were used (1-4), but two additional categories were added (5 & 6):

1. Decoding: this is determined when significant errors on the RC and LNC conditions, and a low/high Order Effect or high/low Ear effect are present. The first is found when the NOE on the second spondees is significantly greater than the NOE on the first spondees. The second bias occurs when Right Ear First (REF) NOEs are greater than Left Ear First (LEF) NOEs. The Decoding subtype is associated with the following: phonemic discrimination problems, spelling and reading out loud difficulties, poor performance on receptive language tests, and articulation of the /L/ and /R/ phonemes.

2. Tolerance-Fading Memory (TFM): determined when high/low Order Effect (person has more difficulty remembering the first spondee than remembering the second spondee), and a low/high Ear effect is present. These point to problems in speech-in-noise or figure-ground and/or short term memory problems. This subtype is associated with reading comprehension problems, expressive language difficulties, poor handwriting, easy distractibility, and fearfulness.

3. Integration: there are two types identified in this category. Integration Type 1 implies difficulties in combining auditory and visual information. SSW scores show age-related significantly weaker performance on the

competing conditions. This pattern of errors, notes Katz, is frequently found in 'classic dyslexic cases'. It implies severe reading and spelling dysfunction, and extremely poor handwriting.

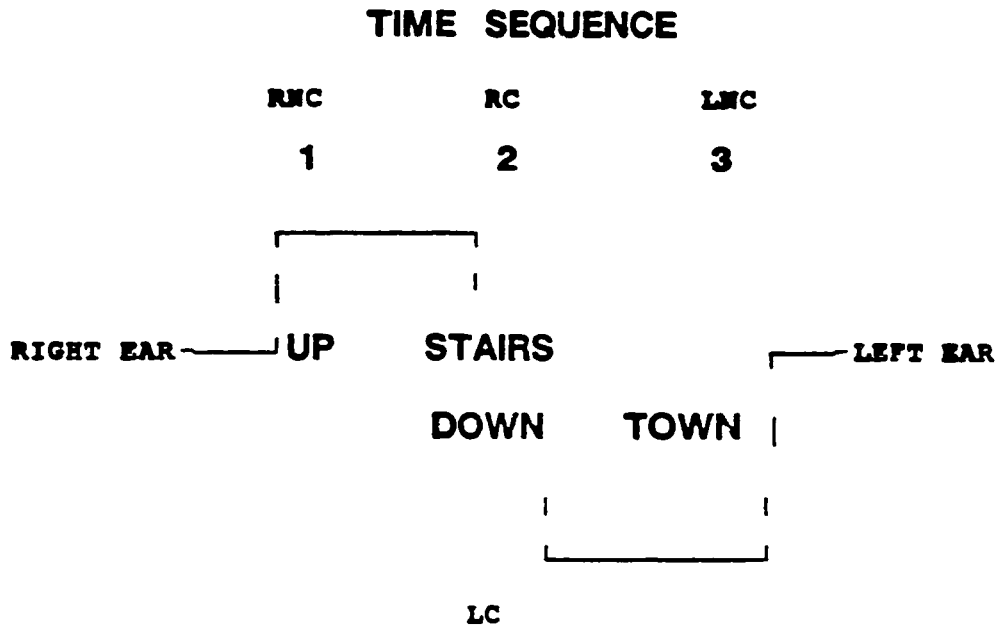
Integration Type 2 subtypes generally show less academic difficulty than Type 1. They perform poorly on speech-in-noise tests but do better on phonemic synthesis. They do not always display auditory-visual integration problems. However, they do exhibit poor motor planning skills that result in 'sloppy' writing. In this study no differentiation between the two types was made.

4. Organization category: Children in this subtype show a significant number of reversals on the SSW. It implies difficulties in maintaining sequence and organizing information. Behaviourally, these children seem very 'disorganized' both at home and school, show reversals in spelling and in reading, and have poor handwriting.

5. Generalized: In this study, children who were noted to exhibit a high total NOE but did not exhibit a specific response bias and could not therefore be classified into one of the major subgroups, were subtyped as exhibiting a 'generalized' CAPD, a fifth category.

6. Mixed: this subtype was coined in this study for children whose error biases showed a combination of subtypes (eg. Decoding & TFM).

A. RIGHT EAR FIRST



B. LEFT EAR FIRST

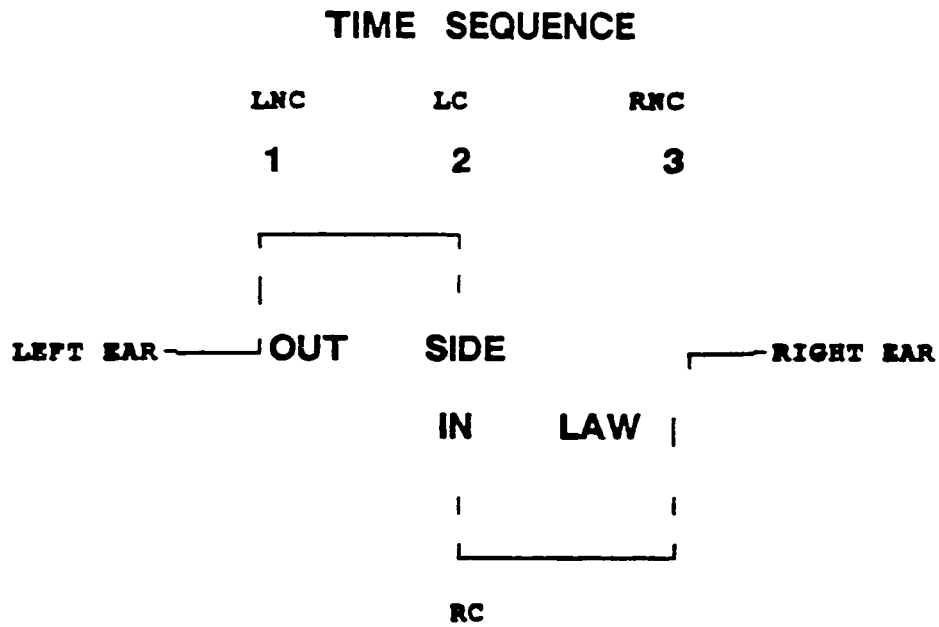


Figure A.1 SSW Testing Format

APPENDIX E.

Test Of Language Development-I

(TOLD-I. 2)

TOLD (Hammill & Newcomer, 1988) assesses both language systems (listening and speaking), and two language features (semantics and syntax). Subtests focus on either listening or speaking, however, both are involved in speaking tasks. The TOLD consists of the following subtests:

I. Sentence Combining (Speaking & Syntax): This task encourages the use of compound subjects, objects, verbs, and verb phrases. It also requires knowledge of adjectives, adverbs, and dependent clauses. The subject is given two or more simple sentences and is asked to form a compound or complex sentence. The target sentence must be as short as possible and at the same time must include all the key elements of the given sentences.

II. Vocabulary (Listening & Semantics): This requires the comprehension of specific words and the grasping of the relationships between word pairs. The student is given pairs of words and asked to decide if they have the same meaning, opposite meaning or are unrelated.

III. Word Ordering (Speaking & Syntax): In this subtest the student is given a string of words, ranging from three to seven words in length. She is asked to form a grammatical sentence by reordering the words.

IV. Generals (Speaking & Semantics): The student is given three words and is required to tell how they are similar. He must say what the relationship is or give the superordinate category to which they belong.

V. Grammatic Comprehension (Listening & Syntax): Sentences that contain errors in the use of subject-verb agreement, pronouns, comparative-superlative adjectives, negatives, plurals, and adverbs are given. The student must say whether the sentence is correct or incorrect.

VI. Malapropisms (Listening & Semantics): The student must recognize in sentences words that sound like the appropriate words but are absurd in that particular context. The student must provide the correct word in place of the malapropism.

Each of the subtest scores is converted to a standard score and entered according to the language system and feature it is meant to examine. The subtest standards are then calculated to yield listening, speaking, semantics, and syntax quotients. These yield a final overall spoken language quotient. Test administration instructions are provided for each subsection, and these were followed precisely in this study. In this study scoring was achieved by the Pro-Score computer system developed for the TOLD-2 I test (Hresko & Schlieve, 1986)

APPENDIX F.1

The Listening Test (TLT)

The TLT (Barrett, Huisingh, Zachman, Blagden, & Orman, 1992) was designed to assess the student's listening ability in situations that emulates actual classroom listening requirements. It does not assess discrete knowledge of language systems and features but rather uses an integrative approach, much like the one required in real classroom situations. This test emphasizes cognitive/listening processes such as attention/recognition, precision, reasoning, problem-solving, empathy, etc. It consists of the following subtests:

A. Main Idea: The student is required to identify the main idea in each of the short paragraphs presented by the tester.

B. Details: The student must use an analytical approach in listening to a given paragraph to determine details that are relevant from those that are not essential.

C. Concepts: The student is required to comprehend concepts of location, direction, quantity, and time, in order to follow a given direction or answer a question.

D. Reasoning: The student must infer answers from information presented in a short paragraph. This task requires critical listening, identifying relationships and similarities, drawing conclusions.

E. Story Comprehension: The student must answer questions following the presentation of a brief narrative. The student integrates information such as the main idea, concepts, reasoning, and details in order to comprehend stories.

Scoring of each subtest results in an age appropriate standard score as well as a percentile. An age equivalent can also be calculated. A total test standard score is also calculated. Test administration instructions are provided in the test manual. These were followed precisely in this study.

APPENDIX F.2

Classroom Listening Scale

This scale type questionnaire, completed by the teacher, provides information on the student's receptive integrative language skills that are tapped by the TLT test above. The teacher is asked to compare the student's abilities to her class peers rather than a normative sample. The scale consists of 10 questions. It uses a three category system, each given a numerical value: rarely= 0, sometimes=1, often=2. The teacher evaluates each item by answering the question: "compare to his classmates the student...". The maximum possible points is 20.

Norms consisting of age appropriate means and standard deviations for raw scores of 'normal'(those exhibiting no language problems) subjects are provided. The standard deviations noted for each student in the case study in this research was calculated by using the scale's norms.

APPENDIX G.

The Woodcock Reading Mastery Tests-Revised

(WRMT-R)

The subtests of the WRMT (Woodcock, 1987) probe basic skills, and reading comprehension. The tests provide standards, percentiles, grade equivalents, and age equivalents. While each area yields a cluster score, a total reading score is also calculated. The following comprise the subtests used in this study:

I. Basic Skills

1. Word Identification: This test contains words arranged in order of difficulty (frequent to infrequent) which the student is asked to read. A correct response is one that the student makes within five seconds and which sounds like a 'natural reading'. It is not necessary that the student know the meaning of the words.

2. Word Attack: The student is presented with nonsense words and some rare English words. This subtest measures the ability to apply phonic rules and analysis skills in order to pronounce the words.

II. Reading Comprehension

1. Word Comprehension: This test is composed of three subtests: Antonyms, synonyms, and analogies. Each measures the student's reading vocabulary in four areas: general reading, science-mathematics, social studies, and humanities:

Antonyms: The student reads a word and then gives orally a word opposite in meaning. This is considered the simplest cognitive processing skill (mainly word association).

Synonyms: The student is required to read a word and provide another one similar in meaning. A more difficult cognitive process than that assessed in the antonym subtest.

Analogies: The student is asked to read a pair of words, decide on their relationship, read another word from a second pair, and complete the analogy with a word from his own oral vocabulary. It is considered by the author as the hardest task cognitively.

2. Passage Comprehension: This subtest utilizes the Cloze procedure in testing both vocabulary and comprehension, by having the student read silently a short passage (two to three sentences) and to supply a missing word. The passages were selected from actual textbooks, newspapers, and household and business documents.

The basic skills cluster, comprehension cluster, and total reading Standard score is calculated for each student. Administration of this test followed the instructions provided in the test manual and in the test itself. In this study scoring was performed using ASSIST (Hauger, J., 1988), a computer software designed for the WRMT-R.

APPENDIX H.

Children's Auditory Processing Performance Scale

(CHAPPS)

This is a questionnaire type scale that permits the systematic collection and quantification of observed listening behaviours of children. It consists of 36 listening behaviour items in six listening conditions/functions: quiet, ideal, multiple inputs, noise, auditory memory/sequencing, and auditory attention span.

Items in each condition probe familiar listening demands such as responding to questions, following directions, and listening to someone read, as well as observations of behaviours when simple versus complex instruction is given. In addition, listening when paying attention versus not paying attention, and listening with versus without visual clues are evaluated.

The questionnaire respondents, the teachers, are asked to choose the degree of difficulty a child may have as compared to other children of similar age and background. The following quantified choices were developed: less (+1), same amount (0), slightly more (-1), more (-2), considerably more (-3), significantly more (-4), cannot function at all (-5). In this study, in order to eliminate most of the negative signs, the choices 0-5 were converted to positive values, while the choice of 'less' was given a negative value (-1). Therefore, high scores meant more problems, and

scores with minus signs showed the least problems, in any given listening condition.

The CHAPPS is scored by summing the raw score values of the subsections, and by dividing the sum by the number of questions. To obtain a score for a specific subsection, the total for that subsection is divided by the number of questions in that particular subsection. An explanation of the questionnaire completion is provided in each form. This was explained orally in cases where the teacher asked for help.

APPENDIX I.

The Screening Instrument For Targeting Educational Risk (SIFTER)

The SIFTER was designed to identify hearing impaired students having educational problems. Although this study is dealing with central rather than peripheral auditory problems, clinical experience with the CAPD group showed them to have great behavioural similarities to hearing impaired students. It was therefore felt that the SIFTER was a suitable instrument for this population. Also, the SIFTER validation information shows that the use of this instrument with controls who were not hearing impaired, produced an overall moderate reliability in identifying children with educational difficulty, making it a valid screening instrument for other than hearing impaired populations.

The SIFTER is a 15 question survey that is completed by the teacher. It was designed to screen the following areas: academics, attention, communication, class participation, and school behaviour. Three questions specific to each area are asked, and a 5-point rating scale is provided for each question. The sum of the ratings in each area provides the child's standing: Fail, Marginal, or Pass. Table I1. provides the scoring and interpretation for each of the screened areas.

Table I1.

SIFTER scoring and descriptor for each screened area.

Area	Fail	Marginal	Pass
Academics	3-7	8- 9	10-15
Attention	3-6	7- 8	9-15
Communication	3-7	8-10	11-15
Class Participation	3-6	7- 8	9-15
School Behaviour	3-7	8- 9	10-15

APPENDIX J.

J.1. The Conners' Teacher Rating Scales is an instrument that uses the teacher as informant to collect information that allows the evaluation of the child's behaviour patterns on the following seven scales:

a. Hyperactivity: This scale measures behaviours such as fidgeting, making odd noises, being easily frustrated, having poor coordination, being restless, exhibiting short attention span, day dreaming, disturbing others, demanding teacher's attention, and being uncooperative. Children scoring high on this scale are generally disruptive to the smooth running of a classroom.

b. Conduct Problem: Students scoring high on this scale tend to be quarrelsome, exhibit rapid mood swings, have temper outbursts, are defiant and oppositional.

c. Emotional Overindulgent: This measures the child's tendency to demand that needs be met immediately, to be over sensitive or sad, to exhibit unpredictable behaviour, and stubbornness.

d. Anxious-Passive: Children in this category tend to be followers, they act submissively, they tend to be fearful or shy, are overly anxious to please others.

e. Asocial: This scale refers to social-pragmatic functioning. It measures degree of acceptability by peers, interpersonal skills. Others often judge them as lacking

the sense of 'fair-play'. Children with this characteristic are often viewed as 'loners'.

f. Daydream-Attention Problem: Children in this category fail to finish tasks, show a short attention span, tend to daydream, and to prefer to be alone.

I. Hyperactivity Index: Those who score high on this subtest tend to be fidgety, restless, overactive, impulsive, excitable, disturb others, have rapid mood changes, and may also have 'temper-tantrums'. It is a general category often used to establish whether a child is exhibiting an Attention Deficit Hyperactivity Disorder (ADHD). This latter disorder is considered to be a psychiatric syndrome which is often treated with both medication and behavioural therapies.

The instrument consists of 39 items, and each is rated with one of four responses: not at all (0), just a little (1), pretty much (2), very much (3). The normative data was obtained from a sample of 9583 Canadian children (aged 4-12 years). T-scores are provided for each age group, for females and males separately.

J.2. The Conners' Parent Rating Scales (CPRS-48) was used in this study to allow insight into the child's behaviour at home. The questionnaire consists of 48 items divided into six scales, and as in the CTRS, each item is given a numerical rating (from 0-3 inclusive). The following scales are included in this instrument:

a. Conduct Disorder: This includes behaviours such as being defiant, destructive, quarrelsome, blaming others, bullying, and fighting.

b. Learning Problem: This category includes children who have a difficulty learning, fail to complete school assignments, tend to be distractible, and are easily frustrated.

c. Psychosomatic: This includes children whose somatic complaints are frequent and range from general aches and pains, to stomach aches, vomiting, nausea, and headaches.

d. Impulsive-Hyperactive: This scale measures excitability and impulsiveness, and the appearance of possessing excess or restless energy.

e. Anxiety: Problems in this area include being shy, anxious, having worries and fears about new people and situations, and general feelings of insecurity.

f. Hyperactivity Index: Children scoring high on this scale will tend to score high on other scales as well. It is a general category which includes restlessness, rapid mood changes, crying easily, low frustration threshold, disturbing others, and impulsivity. As in the CTRS above, this scale is often used by the medical community to make an ADHD diagnosis.

This instrument as well yields T-Scores for each age group, males, and females. The normal or Mean T-score for both the CTRS and the CPRS equals to 50 with a standard

deviation of 10. An abnormal score is one that is equal to or is greater than two standard deviations above the Mean, that is, 70 or greater. Therefore scores ranging from 0-50 are considered as low/average, 50-69 are seen as average/moderate, and 70 and over are considered high or clinically significant.

APPENDIX K.

Audiology Case History

The audiology case history, completed by the parent, has the following components:

1. Identifying information. Name, date of birth, address, parents' names, school, grade, siblings, and so on. As well, the name of the child's pediatrician and Otolaryngologist (ENT) is given. The parent is asked to note the child's health on the day of testing, hearing status, source of referral to the centre, and reason for testing request. All parents were asked to note participation in a study as the reason for testing.
2. Hearing and Speech Information. Hearing status and ear health history are requested in this section. All ear infections or problems are to be described by the parent, as well as age it occurred, frequency, duration, and how it was resolved.

Speech development history is also requested. The parent notes whether speech problems were observed in past or present and if so what type: articulation, language, stuttering, auditory perception, voice disorders, or aphasia. Again, the parent is asked to note at what age the problem occurred, who diagnosed it, what treatment was given, and for how long.

The parent is also asked to list all evaluations the child has had such as neurologic, psychologic, visual, and

so on. The names of the evaluators and centres, the age of the child, and test results are also requested. The final questions in this section are meant to collect information of family history of hearing and ear problems to determine familial tendencies.

3. Medical history - Prenatal, natal, and postnatal. In this section, mother's health during pregnancy is explored. The parent is to put a check mark beside each of the diseases listed, number of ultra sounds, medications, addictive habits such as smoking, drugs, alcoholism, and any other problems that occurred during pregnancy.

The natal history deals with the delivery and any of the possible complications, the child's weight at birth, noting of breathing problems, discolorations, jaundice, etc. The postnatal history includes questions on any deformations due to birth, and swallowing or feeding problems. All childhood diseases are listed and the parent is asked to note those that the child had. As well, questions about allergies, hospitalization, seizures, convulsions, and head traumas are included. The parent is also asked to name all medications the child takes, and whether there is a special diet involved.

This section also includes questions about handedness and age at which preference was established, listening abilities in various environments, bilinguality, distractibility, motivation and so on. The latter questions

were designed to investigate the possibility of attentional disorders because these may have a bearing on behaviour during testing.

4. Academic Information: these questions address the type of educational system the child attends, whether it is a French immersion situation, bilingual, English, or another type. The years of education at the present school and any other one attended by the child are also noted. Information on grade retention is also asked, and if the answer is positive, the parent is asked to note the reason for the repetition.

As well, the parent provides information on the kind of classroom the child is in, whether open (no walls, and sharing space with other classes) or closed, and subjects in school that present a problem. The questions encompass information about extra tutorial help outside of school, school behaviour, learning and reading problems, reliance on visual cues, and the family history of learning problems. The very last section also includes space for the parent to add any comments that she feels may be relevant.

APPENDIX L.

Cluster Analysis Agglomeration Schedule of L2 Group
(A computer print-out)

Agglomeration Schedule using Average Linkage (Between Groups)

Stage	Clusters Cluster 1	Combined Cluster 2	Coefficient	Stage Cluster 1st Appears Cluster 1	Cluster 2	Next Stage
1	31	50	.983833	0	0	48
2	16	52	.976164	0	0	26
3	46	53	.975466	0	0	6
4	13	29	.973486	0	0	18
5	4	23	.973145	0	0	21
6	40	46	.972909	0	3	13
7	22	51	.968074	0	0	20
8	44	64	.966366	0	0	27
9	11	37	.959908	0	0	16
10	56	70	.959638	0	0	14
11	38	69	.958851	0	0	19
12	8	30	.949740	0	0	34
13	40	41	.949515	6	0	21
14	39	56	.943907	0	10	23
15	2	6	.941758	0	0	37
16	5	11	.932710	0	9	17
17	5	60	.927959	16	0	29
18	13	65	.921961	4	0	25
19	25	38	.921116	0	11	24
20	22	71	.919425	7	0	43
21	4	40	.916301	5	13	33
22	14	63	.911864	0	0	26
23	9	39	.897782	0	14	35
24	25	35	.894304	19	0	36
25	13	66	.890225	18	0	34
26	14	16	.887834	22	2	44
27	17	44	.887245	0	8	38
28	24	49	.880391	0	0	48
29	5	58	.877011	17	0	50
30	26	54	.868093	0	0	42
31	7	15	.864676	0	0	46
32	10	12	.849672	0	0	54
33	4	32	.843154	21	0	36
34	8	13	.837315	12	25	38
35	9	62	.835429	23	0	42
36	4	25	.824851	33	24	39
37	2	48	.813700	15	0	63
38	8	17	.810742	34	27	51
39	3	4	.808014	0	36	54
40	1	43	.807916	0	0	64
41	33	34	.800519	0	0	58
42	9	26	.798211	35	30	52
43	22	42	.791310	20	0	46
44	14	55	.790561	26	0	52
45	28	59	.785406	0	0	61

APPENDIX L. L2 Cluster Analysis Agglomeration Schedule (Continued)

Agglomeration Schedule using Average Linkage (Between Groups) (CONT.)

	Clusters Combined			Stage Cluster 1st Appears		Next
Stage	Cluster 1	Cluster 2	Coefficient	Cluster 1	Cluster 2	Stage
46	7	22	.763036	31	43	49
47	20	61	.756192	0	0	59
48	24	31	.740921	28	1	51
49	7	68	.734521	46	0	60
50	5	47	.724597	29	0	53
51	8	24	.687466	38	48	60
52	9	14	.683055	42	44	56
53	5	57	.680737	50	0	57
54	3	10	.668890	39	32	56
55	36	45	.641319	0	0	66
56	3	9	.622622	54	52	67
57	5	21	.619421	53	0	61
58	19	33	.594925	0	41	68
59	18	20	.562843	0	47	64
60	7	8	.562685	49	51	63
61	5	28	.507573	57	45	65
62	27	67	.505809	0	0	66
63	2	7	.466725	37	60	65
64	1	18	.397312	40	59	67
65	2	5	.337696	63	61	68
66	27	36	.229591	62	55	69
67	1	3	.141907	64	56	70
68	2	19	.113070	65	58	69
69	2	27	-.024121	68	66	70
70	1	2	-.421123	67	69	0

APPENDIX M.

Cluster Analysis Agglomeration Schedule for L1 Group
(A computer print-out)

Agglomeration Schedule using Average Linkage (Between Groups)

Stage	Clusters Cluster 1	Combined Cluster 2	Coefficient	Stage Cluster 1st Appears Cluster 1	Cluster 2	Next Stage
1	7	38	.969586	0	0	12
2	26	32	.965107	0	0	7
3	10	11	.963453	0	0	7
4	8	41	.957853	0	0	17
5	4	39	.944198	0	0	9
6	30	42	.938390	0	0	11
7	10	26	.936847	3	2	11
8	16	44	.931427	0	0	13
9	4	9	.925632	5	0	16
10	12	15	.924552	0	0	32
11	10	30	.921450	7	6	21
12	7	24	.900655	1	0	25
13	6	16	.896087	0	8	24
14	34	37	.893137	0	0	30
15	20	33	.880686	0	0	25
16	3	4	.854738	0	9	27
17	8	40	.854307	4	0	33
18	28	35	.853041	0	0	28
19	21	31	.850528	0	0	26
20	19	22	.846287	0	0	37
21	2	10	.845564	0	11	24
22	5	13	.827832	0	0	33
23	14	25	.823791	0	0	31
24	2	6	.817852	21	13	27
25	7	20	.760986	12	15	37
26	21	23	.748586	19	0	35
27	2	3	.747814	24	16	30
28	1	28	.702995	0	18	34
29	17	45	.690904	0	0	36
30	2	34	.662368	27	14	31
31	2	14	.651097	30	23	40
32	12	36	.607773	10	0	42
33	5	8	.602646	22	17	39
34	1	27	.597356	28	0	41
35	21	29	.584889	26	0	40
36	17	43	.559169	29	0	38
37	7	19	.470302	25	20	39
38	17	18	.447024	36	0	42
39	5	7	.374198	33	37	41
40	2	21	.298562	31	35	43
41	1	5	.270620	34	39	44
42	12	17	.177422	32	38	43
43	2	12	-.145456	40	42	44
44	1	2	-.303964	41	43	0

GLOSSARY

(of acronyms)

ADD: Attention deficit disorder.

ADHD: Attention deficit & Hyperactivity disorder

ANSI: American National Standards Institute: sets standards and specifications for audiometric equipment and measurement.

ASHA: American Speech-Language Hearing Association: pertains to the professional and administrative activities of speech-language pathology, audiology, speech, language, and hearing science and the Association.

CANS: Central Auditory Nervous System: those areas and mechanisms of the nervous system involved in hearing and listening, and comprehension of auditory information.

CAP: Central Auditory Processing: processing that occurs beyond the auditory nerve. It is distinguished from peripheral hearing which is considered to end at the point where the auditory nerve enters the brain stem.

CAPD: Central Auditory Processing Disorders

CASE: Central Auditory System Efficiency

CECM: La Commission des Écoles Catholiques de Montréal, English sector, formerly the Montreal Catholic School Commission.

CHAPPS: Children's Auditory Processing Performance Scale. This scale was used to determine listening behaviour in the classroom.

CPRS: Conners' Parent Rating Scales. These were used to determine psychosocial-behavioural variables at home.

CTRS: Conners' Teacher Rating Scales. These were used to determine psychosocial-behavioural variables at school.

CV: Consonant-Vowel syllable.

dB: Decibel: a unit of sound pressure level or intensity where the base of the logarithm is the tenth root of ten, and the quantities concerned are proportional to power.

DDT: Dichotic digits test.

DSM-III: Diagnostic and Statistical Manual of Mental Disorders, 3rd edition and 3rd edition revised: an American psychiatric association publication.

EDV: Educational Distress Variables. These comprise oral language, basic reading, reading comprehension, listening, psychosocial-behavioural, and class performance variables.

ESL: English as a second language.

FLA: First Language Acquisition.

HTL: Hearing Threshold Level: The intensity at which a sound is heard.

Hz: Hertz: a unit of sound frequency measured as cycles per second.

L1: English is the child's mother tongue if mother reports English as her mother tongue, and the use of her mother tongue at home and with extended family including mixing of mother tongue and any other language.

L2: English is the child's second language if mother reports Italian as her mother tongue (includes any variety of Italian), and the use of her mother tongue at home and with extended family including mixing of mother tongue and any other language.

NOE: Number Of Errors: The score used to determine severity level of CAPD as measured by the SSW.

SCAN: A Screening Test for Auditory Processing Disorders.

SES: Socio Economic Status.

SIFTER: Screening Instrument For Targeting Educational Risk: an instrument used to measure the class performance variable.

SL: Sensation Level: sound intensity which is 40 or 50dB above the speech reception threshold (the lowest intensity level at which spondaic or two syllable words are correctly identified with 50% accuracy by the listener).

SLA: Second language acquisition.

SLI: Specific language impairment

SLP: Speech Language Pathologist: the official title of professionals trained in human communication science and disorders in Canada and the United States.

SSW: Staggered Spondaic Words Test: a dichotic listening insturment for measuring CAPD in adults and children.

TLT: The Listening Test: an instrument used to measure integrative language performance.

TOLD: Test Of Language Development: a discrete measure of oral language.

TONI: Test Of Nonverbal Intellignece: a cognitive measure used to screen participants for this study.

WDS: Word Discrimination Tests: used in the battery to investigate the status of central auditory processing disorders.

WRMT-R: Woodcock Reading Mastery Tests Revised: the test use to evaluate basic reading and reading comprehension.