IMPLICIT LINGUISTIC PROCESSING

IN

BILINGUALS WITH MENTAL RETARDATION

(WITH AND WITHOUT DOWN SYNDROME)

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Register Number: O9SLP024

A

Dissertation

submitted in part fulfillment of the

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University of Mysore

Mysore

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JUNE - 2011

CERTIFICATE

This is to certify that the dissertation entitled "***Implicit Linguistic Processing in Bilinguals with Mental Retardation (with and without Down Syndrome)***" is a bonafide work submitted in part fulfilment for the degree of ***Master of Science (Speech-Language Pathology)*** of the student Registration No. 09SLP024. This has been carried out under the guidance of a faculty of the institute and has not been submitted earlier to any other university for the award of any other Diploma or Degree.

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This is to certify that the dissertation entitled "***Implicit Linguistic Processing in Bilinguals with Mental Retardation (with and without Down Syndrome)***" has been prepared under my supervision and guidance. It is also certified that it has not been submitted earlier to any other university for the award of any Diploma or Degree.

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DECLARATION

This dissertation entitled "***Implicit Linguistic Processing in Bilinguals with Mental Retardation (with and without Down Syndrome)***" is the result of my own study under the guidance of Dr. K. C. Shyamala, Professor in Language Pathology, Department of Speech-Language Pathology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other university for the award of any Diploma or Degree.

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I thank almighty for being there at each step of my life and enriching my life with wonderful people around me...without them I would have been so lonely.....Thank God, you are there...

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CHAPTER I

INTRODUCTION

Linguistic processing refers to the entire process that is involved in stages ranging from the reception of the linguistic input to the explicit manifestation of linguistic output. There have been several perspectives regarding the exploration and description of language processing such as the neurolinguistic, psycholinguistic, cognitive linguistic etc. All of these domains attempt to unwind the intricacies of language processing through the use of a systematic ensemble of tasks. These tasks could largely be divided into those that only measure covert aspects of language processing and those that measure the overt responses obtained. The former would be a result of an implicit task and the latter would be the outcome of an explicit task. Implicit linguistic processing has been keenly studied over the years to explore beyond the obvious in various clinical populations.

Implicit linguistic processing, the focus of this research has been studied through methods such as priming, lexical gating, syllable similarity etc. Priming, one of the most widely used methods for tapping implicit linguistic processing, involves presenting a material before a stimulus to which a response has to be made. The most commonly used paradigms involve presenting one word prior to the target word to which a response (naming or lexical decision) has to be made. In the naming task, a participant is visually presented a word which has to be named, and the naming latency is measured. Naming latency is the time taken to produce the word from the presentation of the target. This reaction time is found to be in the order of 500 ms from the onset of the presentation of the word (Harley, 2008).

In a primed picture naming task, the first word is called the prime, and the picture presented subsequently is called the target. The participant is instructed to name the target picture as soon as it is presented (Alario, Segui, & Ferrand, 2000). The time between the first presentation of the prime (its onset) and the start of the target is called 'stimulus onset asynchrony' or SOA. The effect of the prime on subsequent processing is then observed. In priming paradigm parameters like the relation between the prime and the target, stimulus onset synchrony, and type of prime (picture, written/spoken word, written/spoken sentences etc.) can be manipulated to study the effect of a prime on a target and in turn implicit language processing (Glaser & Dungelhoff, 1984; Harley, 2008).

The current investigation supposed that using certain variations between the 'prime' and 'target', one could explore the numerous manifestations of linguistic processing deficits of implicit nature in two disorders of general cognitive impairment. Thus, the study is aimed at investigating the implicit linguistic processing abilities using a custom made stimulus designed on a 'priming' paradigm across bilinguals with Mental Retardation with unknown etiology (refer to MR henceforth) and individuals with Down Syndrome and typically developing bilingual children (TD).

The individuals with Down Syndrome and Mental Retardation have been found to exhibit deficits in terms of gross linguistic skills such as listening, speaking, reading, writing and thinking using language. It may not be wrong to speculate that implicit processes underlying these gross skills may be compromised in these individuals. Carlesimo, Marotta and Vicari (1997) studied the long term memory functioning in Down Syndrome (DS) subjects, individuals with Mental Retardation (MR) of different etiologies and Mental Age (MA) matched normal children. They

reported comparable performances of the three groups on repetition verbal priming. In the explicit memory tasks typically developing Mental Age matched children scored the best followed by Individuals with Mental Retardation and Down Syndrome. Compared to the other two groups, individuals with Down Syndrome performed poorest on the explicit memory task. The results revealed that individuals with MR with different underlying etiologies may present with varying neuropsychological deficits.

In a study by Wyatt and Conners (1997) implicit and explicit memory was investigated in Individuals with and without Mental Retardation across the three age groups. The three age groups taken, ranged from 6 to 8 years, 10 to 12 years and 15 to 17 years. Results revealed that typically developing individuals performed better than individuals with Mental Retardation on explicit memory tasks. On implicit memory tasks, no significant difference was noticed between the groups. Implicit and explicit memory was found to improve from age 6 to 8 and age 10 to 12. However, no significant increase was noticed between 15 to 17 yrs. These authors reported implicit memory as the area of relative strength for individual with Mental Retardation and suggested the further exploration in the area of implicit processes.

The studies in literature do provide us some insight on implicit cognitive processing in individuals with Mental Retardation and Down Syndrome but they do not sufficiently describe the nature of implicit linguistic processing in these individuals.

In order to examine the exact nature of these implicit deficits and strengths in a circular fashion, the 'priming' paradigm requires itself to be applied on a task that is representative of the linguistic output of individuals with Down Syndrome and Mental

Retardation and is also sufficiently simple to allow for finer analyses. ‘Naming’ to the presentation of a picture is a task that comes closest to the requirements.

The process of ‘Naming’ a picture involves at least, the perception of the picture, selection of the target lexeme and execution of the phonological representation through a motor act. Johnson, Carla, Paivio, Allan, Clark and James (1996) proposed three stages involved in naming the pictured object. They are ‘Object Identification’, ‘Name Activation’ and Response generation. This process can be influenced by various factors. It was these factors that had been considered in designing the ‘prime-target’ pairs. However, to systematically select the types of prime, a comprehensive conceptual model that represented single-word naming along with its influencing conditions was required. The representation of the language processing model for single words (Whitworth, Webster & Howard, 2005) (Figure 1) based on the ‘Logogen Model of Word Processing’ (Patterson & Shewell, 1987) was selected for the purpose. This model depicts the various components and processes involved in language processing. The boxes contain the component processes and arrows show how these process components are related to each other.

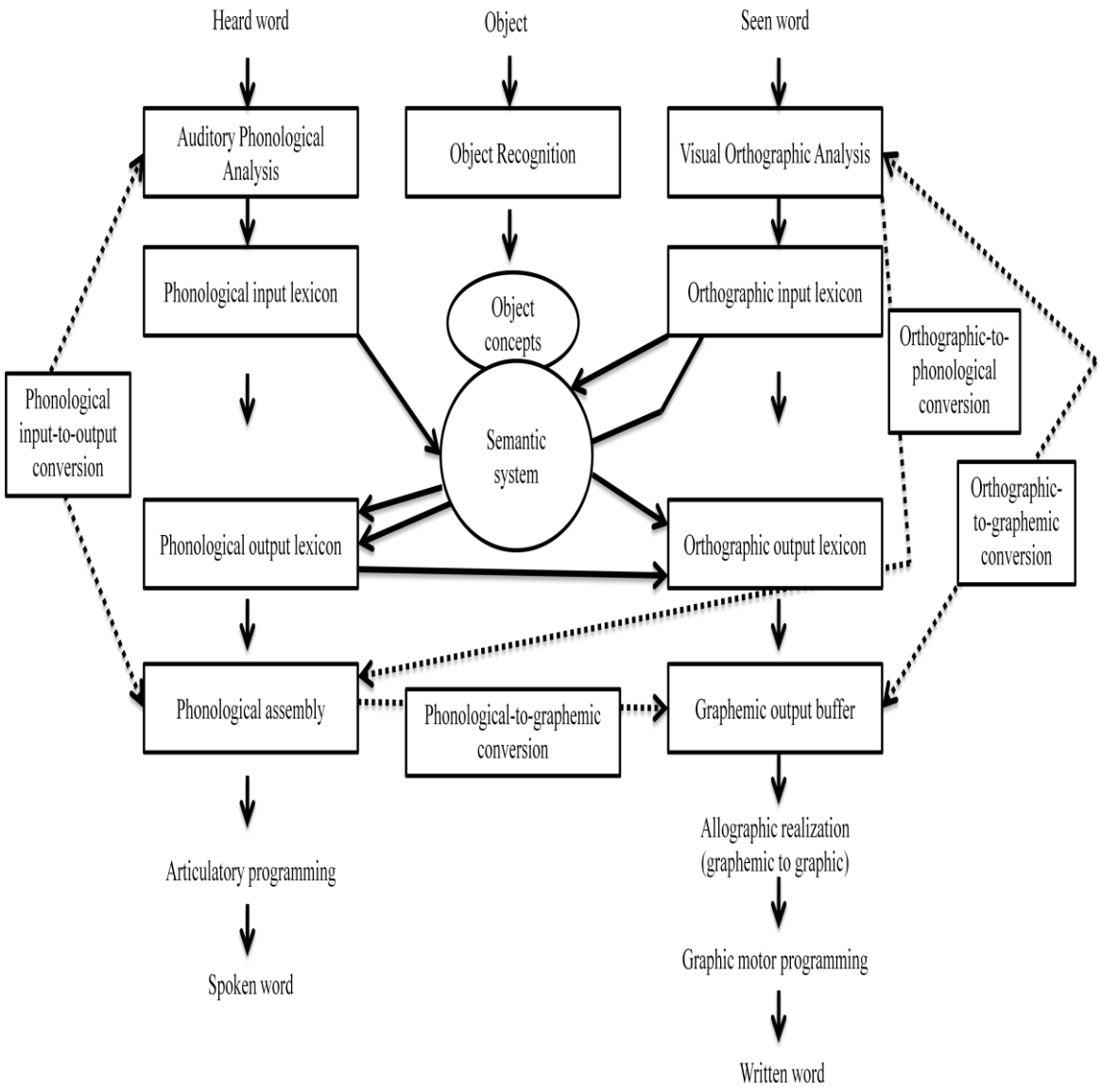

Figure 1.1. Modified Representation of the Logogen Model of 'Word Processing' (Patterson & Shewell, 1987).

The semantic system is represented at the centre of this model and it is the access to and from this system that influences the 'Naming' response in a 'prime-target' pair. The access to this system is possible through three routes namely, auditory-phonological, visual-pictorial and visual-orthographic. On this basis, the 'primes' were grouped in the current study in to three modalities of presentation namely, 'phonological', 'pictorial' and 'orthographic' respectively. In addition to these modalities, 'prime-target' pairs were grouped based on the relationship the

primes had with the targets. Four possible relations were considered in the present study. They were 'repetition' (prime was same as the target), 'semantic' (prime and target belonged to the same lexical category), 'phonological/orthographic' (prime had one initial phoneme and its corresponding initial grapheme in common with the target) and 'unrelated' (prime and target were not related either semantically or phonological/orthographically). In addition to these, there was a 'No Prime' condition where no prime was presented. Thus, 13 types of 'prime-target' pairs were designed for the purpose of the study. The 'target' item would always be presented through the pictorial modality.

A 'Stimulus Onset Asynchrony' (SOA) of - 400 milliseconds was used in the current investigation owing to support from the findings of a study by Glaser and Dungelhoff (1984). They found significant facilitating effects of priming when related primes were used at long negative SOAs (- 400 ms) compared to when the primes were unrelated. The authors also discovered that short negative SOAs and very short negative SOAs were not as facilitating as the long negative SOAs. Instead the short negative SOAs showed no difference between the related and unrelated primes and the very short negative SOAs showed faster responses for unrelated primes than related primes. The facilitating effects however have not been conclusively established at different SOAs for 'prime-target' pairs other than those with semantic relatedness. Hence, the present study conveniently chose to keep the SOA constant at – 400 milliseconds for all types of priming except the 'phonological' type where the duration of word was the duration of the prime.

The study measured reaction times of the naming responses and this measure was considered to interpret the nature of implicit linguistic processing in three groups namely, Kannada-English bilinguals with Mental Retardation, Kannada-English

bilinguals with Down Syndrome and Kannada-English bilingual typically developing children.

Mental Retardation is a disability characterised by significant limitations both in intellectual functioning and in adaptive behaviour as expressed in conceptual, social, and practical adaptive skills. The disability originates before the age of 18 (American Association on Mental Retardation, 2005). The name 'American Association on Mental Retardation' (AAMR) was changed to 'American Association on Intellectual and Developmental Disabilities' (AAIDD) in 2007. The American Association on Intellectual and Developmental Disability uses the term 'Intellectual Disability' in place of 'Mental Retardation'. According to AAIDD term Mental Retardation and Intellectual Disability are two names of the same condition (online). In India, the term 'Mental Retardation' continues to be used in official documents e.g., The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995 (online). The PWD Act is under revision and no updates regarding the changes in terminology are currently available. Some Non Governmental Organizations use the term 'Intellectually Challenged' but the usage is not uniform across the country. Hence in the current study the term 'Individuals with Mental Retardation' is being used.

Mental Retardation can have many causes ranging from genetic, prenatal-, natal-, post natal-factors, endocrine disorders, metabolic disorders, cranial abnormalities etc. Over hundreds of genetic factors are responsible for Mental Retardation (Hegde & Maul, 2006). One such genetic condition is Down Syndrome.

Down Syndrome is a common syndrome found in Individuals with Mental Retardation. It results from an extra chromosome 21, being present in the affected

individual. This abnormal gene dosage leads to various structural and functional abnormalities of the central nervous system. These structural and functional abnormalities result in varying degrees of cognitive, linguistic and other neurological dysfunction in children and adults with Down Syndrome (Rondal, Perera, Nadel, & Comblain, 1996).

Though Down Syndrome is one of the conditions seen in individuals with Mental Retardation, researchers suggest that some difference may exist in the performance of individuals with Mental Retardation across various etiological conditions (Mattson & Riley, 1999; Vicari, 2001; Mc Hale, Kittler, Brown, Jenkins & Devenny, 2005; Carlesimo, Marotta & Vicari (1997).

The implicit processes mainly studied in these individuals using repetition priming (verbal & non verbal) and procedural tasks (non verbal). Carlesimo, Marotta and Vicari (1997) studied the long term memory functioning in Down Syndrome (DS) subjects and compared them with the Individuals with Mental Retardation (MR) of different etiology and Mental Age (MA) matched normal children. They took 15 children in all the three groups and administered tests of verbal and visuo-perceptual explicit memory and a verbal repetition priming task. The results indicated comparable performances on repetition verbal priming but their performance was reported to be poor on explicit memory tasks.

Wyatt and Conners (1997 investigated) implicit and explicit memory in individuals with and without Mental Retardation across three age groups. Results were reported to be in consonance with previous studies on intelligence related differences in controlled and automatic processes. The individuals without Mental Retardation performed better than those individuals with Mental Retardation.

However on Implicit Memory task, no difference was found between the groups. Similar findings were reported by Vicari, Bellucci, and Carlesimo, 2000; Vicari, 2001; Brown, Devenny, Jenkins, Kittler and McHale, 2005. They suggested a functional dissociation between implicit and explicit memory abilities in individuals with Down Syndrome.

In a recent study by Carlesimo, Verucci and Vicari (2007) concluded that implicit memory is independent of Intelligence Quotient but differs across the etiologies of Mental Retardation. Hence their results supported the 'etiology specificity' hypothesis. According to the etiology 'specificity hypothesis' various domains of development in individual with Mental Retardation are dependent on the etiology rather than the intelligence quotient.

The above mentioned studies do give us an insight into implicit processing and the factors affecting the same such as Intelligence Quotient and various etiologies but they certain limitation due to the following reasons:

1) The tasks used to study implicit linguistic processing were mainly limited to repetition priming
2) The procedural learning tasks used, mainly focused on motor learning
3) None of the studies focussed on implicit linguistic processes exclusively.

Thus, the effect of linguistic priming in individuals with Mental Retardation and Down Syndrome remains largely unexplored. Moreover, in a multilingual country like India where majority of the population is comprised of bilinguals and multilinguals, there is a dearth of research in this area. Therefore the study focussed exclusively on implicit linguistic processing using the custom made priming task and is a first of its kind in the country.

1.1 Need of the study

The nature of cognitive deficits in children with Down syndrome have not been clearly understood with reference to implicit linguistic processing as most studies have focused on the effect repetition priming alone. This lacuna could be filled to a large extent by the findings of the present study. It is essential to understand the cognitive deficits of bilinguals with Mental Retardation, with and without Down syndrome for purposes of assessment and rehabilitation. The present study may offer findings that could very well differentiate the two conditions, and in turn identify the specific deficit areas to be worked upon. Also, the evaluation of language processes in bilingual (Kannada-English) children could provide very specific details regarding the nature of linguistic processing in the second language. Also, this study would reveal as to which modality would be most effective and which relations facilitate the responses most in bilinguals with Mental Retardation. Keeping the multilingual culture of the country in mind it became essential to choose bilingual participants for the study.

Considering the above issues the study aimed at investigating implicit linguistic processing from a holistic perspective in three populations namely, bilingual individuals with Mental Retardation, bilingual individuals with Down Syndrome and Developmental Age (DA) matched typically developing bilingual children using a 'Priming' paradigm applied to a 'Naming' task.

1.2 Objectives of the study

1. To compare and contrast the implicit linguistic processing abilities of Kannada-English bilinguals with Mental Retardation, Kannada-English

bilinguals with Down Syndrome and typically developing Kannada-English bilingual children.

2. To compare and contrast the effects of the 13 'prime-target' conditions on picture naming in Kannada-English bilinguals with Mental Retardation
3. To compare and contrast the effects of the 13 'prime-target' conditions on picture naming in Kannada-English bilinguals with Down Syndrome
4. To compare and contrast the effects of the 13 'prime-target' conditions on picture naming in typically developing Kannada-English bilingual children.
5. To compare and contrast the effects of phonological, orthographic and pictorial priming (modality of presentation of the prime) on picture naming in Kannada-English bilinguals with Mental Retardation
6. To compare and contrast the effects of phonological, orthographic and pictorial priming (modality of presentation of the prime) on picture naming in Kannada-English bilinguals with Down Syndrome
7. To compare and contrast the effects of phonological, orthographic and pictorial priming (modality of presentation of the prime) on picture naming in typically developing Kannada-English bilingual children
8. To compare and contrast the effects of repetition, semantic, phonological/orthographic and unrelated priming (relation between the 'prime' and 'target') on picture naming in Kannada-English bilinguals with Mental Retardation
9. To compare and contrast the effects of repetition, semantic, phonological/orthographic and unrelated priming (relation between the

'prime' and 'target') on picture naming in Kannada-English bilinguals with Down Syndrome

10. To compare and contrast the effects of repetition, semantic, phonological/orthographic and unrelated priming (relation between the 'prime' and 'target') on picture naming in typically developing Kannada-English bilingual children

CHAPTER II

REVIEW OF LITERATURE

The present investigation was an attempt to understand the implicit linguistic processing abilities of bilinguals with Mental Retardation, Down Syndrome and typically developing bilingual children using a custom made stimulus for the priming experiment applied on a picture naming task. The decisions regarding the design of the present study were made on the basis of literature evidences on the paradigms for measurement of implicit linguistic processing, the nature of linguistic processing deficits in individuals with 'Mental Retardation' and 'Down Syndrome', and the effectiveness of various tasks in explicitly demonstrating the implicit linguistic processes. Some of these evidences were compiled for the purpose of arriving at decisions regarding the dynamics of the study.

The compilation of the review of literature is done under the following sections.

1) Linguistic processing: An overview
2) Priming: An overview
3) Naming task
4) Factors affecting naming task
5) Priming studies in typically developing children and typical adults
6) Priming studies in individuals with Mental Retardation and Down Syndrome

2.1 Linguistic Processing: An Overview

Linguistic processing involves both implicit and explicit processes. Implicit linguistic processing is the unconscious knowledge which an individual may have but cannot describe. It mainly comprises of explicit processes which turn automatic over a

period of time due to repeated practice, and also the procedural tasks. On the other hand it is easy to retrieve and describe explicit linguistic knowledge. Both explicit and implicit linguistic processing underlies different parts of the brain, representations, mechanisms and memory systems. The implicit and explicit processing of language had been studied in various sciences such as language education, applied linguistics, psychology and cognitive neuroscience (Robinson & Ellis, 2008). The explicit processes had been understood in greater detail than the implicit, particularly in individuals with 'Mental Retardation' and 'Down Syndrome'. The present study thus focused on exploring the implicit connectivity through linguistic measures. Of the measures available such as priming, gating, syllable similarity task etc., 'priming' was chosen for the present study considering the nature of the task and the existing body of work.

2.2 Priming: An Overview

Priming involves presenting a word to which a response has to be made. The first word is called the 'prime', and the word to which a response has to be made is called the 'target'. The two major responses that have been studied with priming are the lexical decision task and the naming task. In a lexical decision task, the participant has to decide whether the presented string of letters is a word or a non word. In the naming task, a subject is visually presented a word which they have to name, and the naming latency is measured. Naming latency is the time taken to produce the word from the presentation of the target. This reaction time was found to be of the order of 500 ms from the onset of the presentation of the word (Harley, 2008). The target word to be named has been presented either as a written word or as a picture, and the processes in each of the two types have been reported to be substantially different.

2.3 Naming Task

Ferrand, Grainger and Segui (1994) compared 'picture naming' with 'word naming' using orthographic or phonological primes for repetition and pseudohomophone primes. The findings revealed that the participants were primed to a greater extent through the phonological primes on 'picture naming' while the priming was greater through orthographic primes on 'word naming'. This was explained on the basis of access of the respective primes to the phonological and/or orthographic lexicons and the relationship between these lexicons and the types of naming. It was speculated that on word naming the orthographic lexicon for the target was activated and on picture naming the whole word phonological representation of the target was activated; and since the primes were also routed through these lexicons, with the orthographic prime first accessing the orthographic lexicon followed by activation of the phonological lexicon and the phonological prime activating vice-versa, the findings were such. The present study opted for the 'picture naming' task as the word reading skills of the target population of this study was expected to be highly variable due to factors related to educational exposure.

Johnson, Paivio and Clark (1996) in their review article proposed three generally accepted stages of naming a pictured object. The three stages involved in picture naming were as follows:

1) The first step involved the identification of the object as a member of a particular class of objects (Object Identification)
2) In the second step, the name of the object was activated from the words known by user (Name Activation)

3) The third step involved giving articulatory commands for the execution of the response (Response Generation)

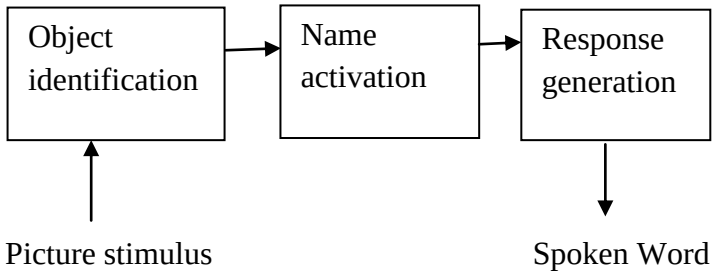

Fig 2.1. Processes involved in picture naming (Johnson, Paivio & Clark, 1996).

2.4 Factors affecting Picture Naming

The factors affecting the reaction time to name the presented pictorial target include the modality of presentation of the prime, the time course of the events (e.g., the stimulus-onset asynchrony - SOA, or the duration of the prime) and the relation between prime and the target (Glasger & Dungelhoff, 1984).

In a recent study, D'Amico, Devescovi and Bates (2001) studied the factors affecting picture naming using a reaction time task. The naming reaction times were compared between 50 Italian speaking adults and 34 children (aged 5 to 6 years). The participants were instructed to name a set of 250 line drawings. The dependent measures included were overall naming ability, percentage agreement on the most frequent name (target), number of alternative names provided, overall reaction time and latency to produce the target name. The independent measures (characteristics of target words and pictures that might affect naming) included frequency, age of acquisition, animacy, semantic category, various word structure, length, various word structure and grammatical category measures specific to Italian and picture complexity. Their results indicated that children took more time to name the pictures

than adults. The performance of the children and adults was found to be correlating. In addition, similar factors were found to be affecting the naming times of both adults and children. However, there were a few differences between the groups. The differences were observed in word complexity (more correlated for adults than children), age of acquisition (affected the children more than adults) and semantic categories (different semantic categories were easier for children and adults).

2.5 Priming studies in typically developing children and typical adults

Grainger and Ferrand (1996) compared masked orthographic priming with phonological priming on three tasks namely, word naming, lexical decision and visual word recognition. Non-words were used as primes and they were presented for 29, 43 or 57 milliseconds. The results showed that phonological primes did not have any facilitatory effect for any duration of the prime. The orthographic primes however, were effective when presented for 29 milliseconds. This indicated that short duration primes were facilitative if visual words were presented.

Ferrand, Humphreys and Segui (1998) studied the effect of repetition priming and phonological priming on picture naming in normal adults. They found that repetition priming facilitated the naming of pictured targets over an unrelated prime. Homophones that were orthographically dissimilar also facilitated picture naming compared to an unrelated prime. High frequency primes facilitated picture naming better than the related (overlapping semantic and phonological) primes.

Semantic and associative priming in picture naming were studied in four priming experiments by Alario, Segui and Ferrand (2000). Two types of prime were presented at stimulus onset asynchronies (SOAs) of 114 ms and 234 ms that formed the four experimental conditions. At the SOA of 114 ms, the semantic (coordinate

pairs) relation showed interference, while there were no differences between the associative and unrelated prime conditions. At the SOA of 234 ms, there was no effect of semantic prime in either direction, but a significant facilitatory effect of associative prime was evidenced. The findings were thus, not uniform either between relations of the prime and target or between the SOAs. The authors confirmed that atleast two types of meaning relatedness existed and that they were evident on an implicit measure.

Carlesimo, Vicari, Albertoni, Turriziani and Caltagirone (2000) reported that visual and auditory repetition priming develop at different rates. In their study, they used visual and auditory stem completion tasks to study implicit processing in first graders, third graders and fifth graders. The findings revealed that auditory repetition priming showed a more stable pattern compared to visual repetition priming. The effects of visual repetition priming were found to increase with age. The results supported the hypothesis that repetition prime helps in activating the stored memory representation. The study clearly demonstrated that the modality of presentation of a prime was an influencing variable, particularly in children.

Gonnerman, Seidenberg and Anderson (2007) conducted a series of experiments with cross modal lexical decision tasks in typical individuals. They varied the relationship between the prime and target in a graded manner. They found that the magnitude of priming was higher when the similarity between the ‘prime’ and ‘target’ in terms of semantic and phonological overlap was more.

Bi, Xu and Caramazza (2009) attempted to evaluate the effects of phonological and orthographic primes (using the logographic script of Mandarin-Chinese) on a picture naming task. The selection of Mandarin-Chinese ensured that

orthographic primes would largely elicit only orthographic priming, and would not be mediated through phonology. The results revealed that both phonologically and orthographically related primes were facilitatory. The study also found that the orthographic priming effects were more than the phonological effects.

Perraudin and Mounoud (2003, 2009) investigated the effects of different types of semantic primes on picture naming in typically developing children between 5 and 9 years and typical adults. They used four types of priming: categorical, functional, unrelated and neutral. They found that only with increasing age (after 7 years), categorical primes exhibited facilitative effects, where as functional primes (associative) exhibited facilitative effects even at age 5. The findings pointed towards the existence of changing preferences to different prime types during development.

Ganesh and Subba Rao (2009) explored the effect of semantic priming on the reaction time of picture-naming responses. Participants were 5 to 6 yrs old school going children. DMDX software was used to program the priming paradigm. They used 25 line drawings stimuli. The results indicated that there was a significant difference in the reaction times in the semantic prime and no prime conditions. When a semantic prime preceded the target the reaction time was faster (890.93) compared to no prime condition (1048.86 ms). These studies indicated that typically developing children and typical adults do exhibit variations in their responses to stimuli with and without primes.

The patterns of responses were not absolutely similar across studies although, repetition, phonological and semantic primes (of various types) were found to be facilitative.

2.6 Priming Studies in Individuals with Mental Retardation and Down Syndrome

The studies on implicit processing in individuals with Mental Retardation and Down Syndrome have indicated dissociation between explicit and implicit processing. Most studies have supported the idea that implicit learning is better facilitated in individuals with Mental Retardation and Down Syndrome compared to explicit learning. Some of the studies are compiled as follows:

Carlesimo, Marotta and Vicari (1997) studied the long term memory functioning in Down Syndrome (DS) subjects and compared them with individuals with Mental Retardation (MR) of a different etiology and Mental Age (MA) matched typically developing children. They took 15 children in all the three groups and administered tests of verbal and visuo-perceptual explicit memory and a verbal repetition priming task. The results indicated comparable performances across the three groups on verbal repetition priming. On explicit memory tasks the normal children scored the best followed by individuals with Mental Retardation who were followed by individuals with Down Syndrome. The results substantiated the claim that individuals with Mental Retardation of different underlying etiologies differ across neuropsychological domains.

In a study by Wyatt and Conners (1997) implicit and explicit memory was investigated in individuals with and without Mental Retardation across three age groups. The age groups taken were 6 to 8 years, 10 to 12 years and 15 to 17 years. The results were reported to be in consonance with previous studies on intelligence related differences in controlled and automatic processes. The individuals without Mental Retardation performed better than those with Mental Retardation. However on an implicit memory task, no difference was found between the groups. Implicit

memory was thus reported as an area of relative strength for individuals with Mental Retardation. These authors emphasized the need for further exploration in the area of implicit processes, so as to aid in the assessment and management of individuals with Mental Retardation.

Carlesimo, Bellucci and Vicari (2000) studied 14 individuals with Down Syndrome and 20 Mental Age matched typically developing children using explicit memory (tests of verbal & visuospatial memory) and implicit memory (verbal repetition priming, visual repetition priming & procedural learning) tasks. The results revealed comparable implicit abilities in the two groups. However, on explicit memory tasks typically developing children performed better than individuals with Down Syndrome. This again was suggestive of a functional dissociation between implicit and explicit memory abilities in individuals with Down Syndrome.

Vicari (2001) compared children with Down Syndrome, William Syndrome and Mental Age matched typically developing children on implicit and explicit memory tasks. He took 12 participants with William Syndrome, 14 with Down Syndrome and 32 typically developing children. To check the explicit memory, visuo perceptual and verbal memory tests were administered, whereas for implicit memory procedural learning tasks, verbal and visual repetition priming tasks were used. Typically developing children performed better than Children with Down and William Syndrome on explicit memory tasks. On repetition priming task (verbal & visual) the performance of children with William Syndrome and Down Syndrome was comparable to typically developing children. Children with William Syndrome performed poorer than Down Syndrome in procedural learning. The children with Down Syndrome performed comparable to typically developing children on

procedural learning. The study threw light on the qualitative differences between children with Mental Retardation of different etiologies.

Brown, Devenny, Jenkins, Kittler and McHale (2005) reported age and intelligence related dissociation between implicit and explicit memory in individuals with Down and William Syndrome but such dissociation was not observed in children with unspecified Mental Retardation. They found that performance on repetition priming (implicit memory task) did not change with age but the scores on free recall tests (explicit memory task) deteriorated with age. From the similar performances of the two groups (William & Down Syndrome) on implicit and explicit memory tasks, the authors concluded that William Syndrome could also be related to precocious aging like Down Syndrome that could lead to the loss of some cognitive abilities with aging.

Ypsilanti, Grouios, Zikouli, and Hatzinikikolaou (2006) investigated speed of naming in children with William Syndrome and Down Syndrome using the timed naming task with pictures, colours, letters and words. The results revealed that children with William Syndrome and Down Syndrome did not differed significantly from typically developing children in terms of reaction time but exhibited qualitative differences (on error analysis in naming words and pictures).

Carlesimo, Vicari and Verucci (2007) studied implicit processing using the modified version of Nissen and Bullemer's (1987) Serial Reaction Time task. They took thirty-two individuals with William Syndrome (18 males and 14 females), twenty-six individuals with Down Syndrome (14 males and 12 females) and forty nine typically developing children. All the subjects were matched on Mental Age. Individuals with William Syndrome followed a different trend in procedural learning and reaction time measures. Individuals with Down Syndrome and typically

developing children followed a parallel trend on the reaction time measure. These researchers concluded that implicit memory could be independent of Intelligence Quotient but differed across the etiologies of Mental Retardation. Hence their results supported the 'etiology specificity' hypothesis. According to the 'etiology specificity' hypothesis, the development in various domains in individuals with Mental Retardation is dependent on the etiology rather than on intelligence.

The above mentioned studies do throw light on implicit processing as to how intelligence quotient and various etiologies could have an effect on implicit processing, but they have limitations in helping us understand implicit linguistic processing due to the following reasons:

1) The tasks were mainly limited to repetition priming
2) The procedural learning tasks mainly included motor learning
3) They did not focus on implicit linguistic processes exclusively.

These issues remain a major cause of concern due to the difficulties in comparing across studies. In order to bridge the gap between the findings of the studies discussed in literature on individuals with Mental Retardation and individuals with Down Syndrome, it was necessary to design an investigation that could tap the varied processing abilities of implicit nature using linguistic stimuli. Consequently, the present study was conceptualized. The study incorporated the central idea of the Logogen Model (Patterson & Shewell, 1987) to evenly distribute the examination of implicit linguistic processes across the different input modalities in addition to considering the salient features of linguistic entities (phonological, orthographic and semantic). On this basis, a priming based experiment using a picture naming response was considered to investigate the similarities and differences in implicit linguistic

processing between bilinguals with Mental Retardation, bilinguals with Down Syndrome and Developmental Age matched typically developing children.

CHAPTER III

METHOD

The current study aimed at investigating the implicit linguistic processing abilities using a custom made stimulus based on the priming paradigm across bilingual individuals with Down Syndrome, bilinguals individuals with Mental Retardation and typically developing bilingual children. The implicit linguistic processing was studied within a group and across the groups using the naming task.

3.1 Participants

18 participants participated in the study. Participants were divided into three groups. The first group comprised 6 individuals with Down syndrome aged between 9 to 26 years. The second group comprised individuals with Mild to Moderate Mental Retardation without Down syndrome aged between 9 to 27 years. Third Group comprised of 6 typically developing children aged 6 to 13 years. The typically developing children were selected for the pair wise comparison with respect to the Developmental age.

3.1.1 Participant selection criteria:

3.1.1.1 Criteria common to all subjects

- Their Developmental Age had to be between 6 to 13 years
- They had to be Kannada- English Bilinguals, with Kannada as their mother tongue and English as the medium of instruction.

3.1.1.2 Criteria specific to the individual groups

- Group I: Participants had to be diagnosed as having Down syndrome with by a qualified Paediatrician / Psychologist / Speech-Language Pathologist.

- Group II: Participants had to be diagnosed as having Mild to Moderate Mental Retardation by a qualified Psychologist.
- Group III: Typically developing children devoid of any history of Speech, Language, Hearing and Neurological problems.

3.1.2 Details of the Participants

Table 3.1

Details of bilinguals with Down syndrome (Group I)

Participant code	Gender	Chronological Age	Developmental Age
DS 1	Female	20 years	6 years
DS 2	Female	9 years	6 years
DS 3	Female	14 years	8 years
DS 4	Male	26 years	9 years
DS 5	Male	22 years	12 years
DS 6	Female	19 years	13 years

Table 3.2

Details of bilinguals with Mental Retardation (Group II)

Participant code	Gender	Chronological Age	Developmental Age
MR 1	Male	22 years	6 years
MR 2	Female	9 years	6 years
MR 3	Male	18 years	6 years
MR 4	Male	18 years	7 years
MR 5	Male	20 years	7 years
MR 6	Male	27 years	9 years

Table 3.3

Details of Typically Developing bilingual Children (Group III)

Participant code	Gender	Chronological Age	Developmental Age
TD 1	Female	6 years	6 years
TD 2	Female	7 years	7 years
TD 3	Male	8 years	8 years
TD 4	Female	9 years	9 years
TD 5	Male	12 years	12 years
TD 6	Female	13 years	13 years

3.2 Materials

The set of standardized / non standardized tests was used at various stages of the study. The tests and the purpose for which they were used are given in the following table:

Table 3.4

List of tools used in the study

S No.	Tools	Author	Year	Purpose
1.	Developmental Screening Test	J. Bharat Raj	1983	To assess the Developmental Age (DA)of group I and II To select Developmentally Age (DA) matched typically developing children
2.	International Second Language Proficiency Rating Scale (ISLPR)	Ingram and Wylie	1999	To evaluate the proficiency in English of all the participants across 4 domains: Speaking, listening, writing and reading. The performance on ISLPR was also used to interpret the final data.

In addition to these, 130 prime-target pairs were designed by the investigator based on the priming paradigm to form 13 (10 pairs in each set) sets of stimuli. The 13 sets were used to study the implicit linguistic processing in the three groups.

3.3 Steps in the preparation of test stimulus

3.3.1 Step I

A list of 60 words that could be pictorially represented was selected from Kinder Garten books. The words were taken from 10 lexical categories such as animals, clothing, fruits, food items, vegetables, stationery, common objects, nature, grooming items and vehicles.

3.3.2 Step II

Two Post graduate students of Speech-Language Pathology were asked to rate the appropriateness on a 3-point rating scale (highly appropriate, appropriate and inappropriate) of the 60 words, in terms of the ease of naming those words in English for typically developing children below 6 yrs of age. Only words those were rated by both the judges as very appropriate were shortlisted. Out of the 43 words that were rated 'highly appropriate' by both the judges, 30 words were pseudo randomly selected for the final list of 30 target items.

3.3.3 Step III

These 30 words were divided into three sets of 10 words each such that no more than two items of a lexical category were repeated in each set of 10 words. Three more lists of 30 words (3 sets of 10 words each) were extracted using pseudo random sampling from the original list of 30 words. Also 10 words from the original list of 30 were selected pseudo randomly. Thus the total number of target items was equal to 130 (4 lists of 30 words each and one list of 10 words).

3.3.4 Step IV

The first 4 lists of 30 words each were grouped under 4 heads namely Repetition, Semantic, Phonological/Orthographic and Unrelated respectively. Each of the lists that were further into 10 items each was grouped under the following three sub heads namely Pictorial, Orthographic and Phonological respectively. The fifth list of 10 words formed the 'No Prime' group.

Step V: Words that were suitable as semantic, phonological/orthographic and unrelated primes for the target stimuli were chosen from the same books as target. None of the priming words were repeated. Semantic primes were selected such that they belonged to the same lexical category as the target word and that they had no phonological/orthographic relationship in terms of the similarity of the initial

phoneme/grapheme. Phonological/Orthographic primes were chosen such that their initial phoneme/grapheme was same as that of the target word in that they were not semantically related. Unrelated primes were chosen such that they bore no semantic relationship or phonological/orthographic similarity with the target words. Thus a set of 130 'prime-target' pairs were finalised.

The list of 130 'prime-target' pairs is provided in the 'Appendix I'.

3.4 Stimulus characteristics

Coloured pictures of the all the words selected as targets were taken in 'bmp' format and resized within a range of 5 inches X 5 inches and 6 inches X 6 inches. Similarly pictures for all pictorial primes were selected. Orthographic primes were presented in block letters in the 'Times New Roman' format sized, 100. Phonological prime were recorded by proficient English speaking Kannada-English bilingual adult male using PRAAT software.

3.5 Instrumentation

The prime target pairs were programmed using DMDX software. The pictures and graphemes were presented on the '17 inches' screen of a Compaq Presario CQ 60 laptop and the phonological primes were presented through Zippo headphone at fixed volume level. The check vocal software was used for the analysis of the recoded naming responses.

3.6 Procedure

The participants of the three groups were tested through a set of tools as follows:

- The participants were made to sit on a comfortable position in a well lit room, free of any noise and distractions.

- Developmental Screening Test was administered by the investigator and the developmental age was estimated on the bases of information obtained from parental interview, participant interview, teacher interview and observation wherever possible.
- The International Second Language Proficiency Scale was administered and 4 domains (speaking, listening, writing & reading) were rated based on observation of the participant's discourse, informal reading (ranging from letter identification to reading comprehension) and writing (ranging from single letter writing to story writing) tasks, along with information from their caregivers or teachers.
- The 130 prime-target pairs' stimulus was presented on a Compaq Presario CQ 60 17" laptop screen and Zippo headphones; each participant was made to comfortably such that the stimuli were for clearly audible and visible. The stimuli were grouped under four separate programs: No Prime, Pictorial Priming, Orthographic Priming and Phonological Priming. The schemes of the presentation of each prime-target pair in the four programs were as depicted in *Figures 3.1 to 3.4*

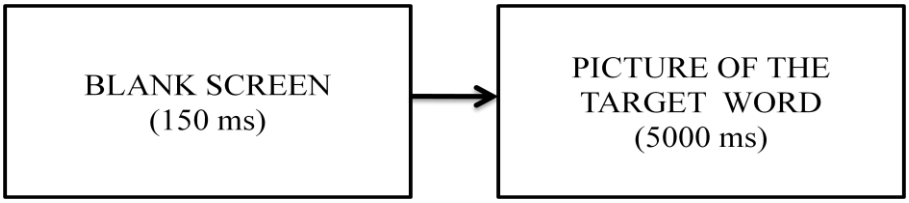

Figure 3.1. Pattern of stimulus presentation for the 'No Prime' condition.

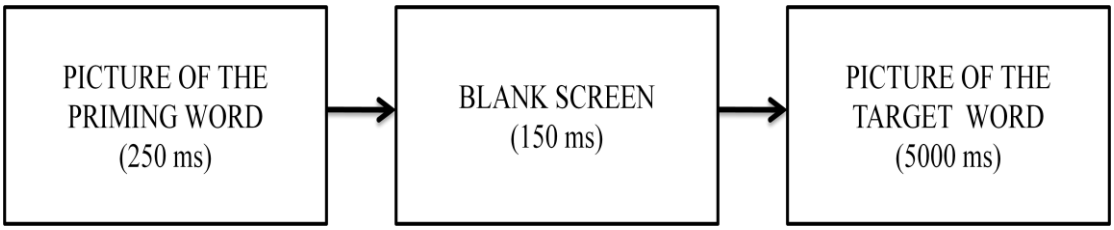

Figure 3.2. Pattern of 'prime-target' pair presentation in the Pictorial modality.

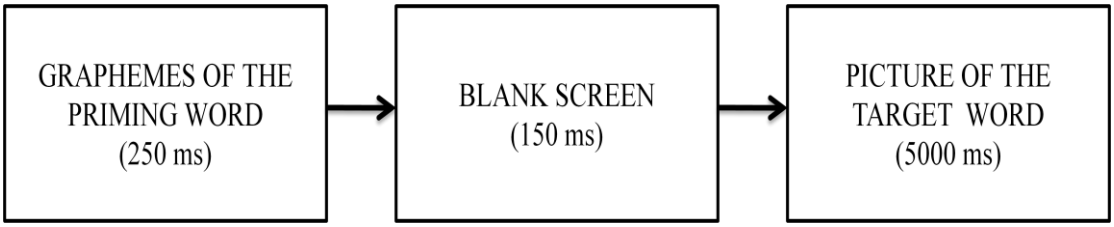

Figure 3.3. Pattern of 'prime-target' pair presentation in the Orthographic modality.

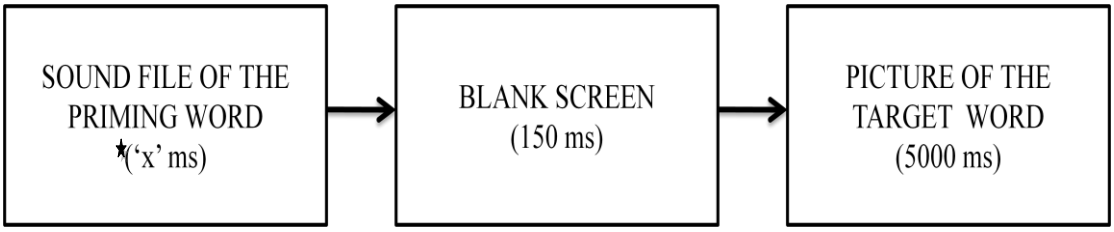

Figure 3.4. Pattern of 'prime-target' pair presentation in the Pictorial modality.
**Note* 'x' – duration of the sound file (minimum: 157 ms for /cup/ to maximum: 764 ms for /bench/)

Apart from the 'No Prime' program, the priming words were presented on the screen for a duration of 250 ms (barring Phonological Priming), followed by a gap of 150 ms (Stimulus Onset Asynchrony = 250 + 150 = 400 ms) before the presentation

of the picture of the target word. The picture of the target word was displayed for duration of 5000 ms.

The order of presentation of these four programs was pseudo-randomized across the participants. In addition, the order of presentation of the items within each of the programs was randomized by the DMDX software. The rate of presentation of each prime-target pair was controlled by the investigator, to ensure that the items were presented only when the participants were ready to respond.

The participants were instructed to name the picture of the target words as quickly as possible in English. A sufficient number of practice trials resembling the four types of priming sets (No Prime, Pictorial Priming, Orthographic Priming and Phonological Priming) were given to each participant using another set of prime-target practice which was not repeated in the actual test, till they performed according to the requirements of the task. This was followed by the presentation of 130 prime-target stimulus.

3.7 Analysis

The responses on the naming task obtained from all the participants through the DMDX software were analysed using the Check Vocal software. The software provided the option of recording the responses in a time window of 5000 ms, starting from the onset of presentation of the picture of the target word. The onset of each of the named responses was marked (correct or wrong) through visual inspection of the wave form and/or spectrogram, which was noted as the reaction time. The marking was followed by judgement regarding the correctness of the responses. The responses were judged as correct, wrong or no response.

The responses were considered correct if it fulfilled any of the three conditions:

- ✓ The picture was named accurately
- ✓ The picture was named correctly but with articulatory error
- ✓ The picture was named correctly after an incorrect response

The responses were considered as wrong when it did not satisfy the criteria for the correct response. The responses were judged no response when participant did not say anything or some unrelated vocal expressions were recorded.

The measured reaction times of all the items for each participant were noted and grouped according to the 13 conditions (No Prime (NP), Pictorial Repetition (PIREP), Pictorial Semantic (PISEM), Pictorial Phonological/Orthographic (PIPHOR), Pictorial Unrelated (PIUR), Orthographic Repetition (ORREP), Orthographic Semantic (ORSEM), Orthographic Phonological/Orthographic (ORPHOR), Orthographic Unrelated (ORUR), Phonological Repetition (PHREP), Phonological Semantic (PHSEM), Phonological Phonological/Orthographic (PHPHOR) and Phonological Unrelated PHUR)* inherent in the 'prime-target pairs'. The reaction times of the correct responses within each of the 13 conditions were averaged and Mean values were obtained. The Mean values across the 13 conditions for all the participants were entered in the SPSS software for statistical analyses.

{*Note: Pictorial, Orthographic and Phonological referred to the modality of presentation of the 'prime'; Repetition, Semantic, Phonological/Orthographic and Unrelated referred to the nature of the relationship of the 'prime' with the 'target'}

The Mean values were used to obtain descriptive statistical information (group Mean, group Median and group Standard Deviation) across the three groups (participants with Down Syndrome, participants with Mental Retardation and typically developing participants) in all the 13 conditions. The Kruskal Wallis test was used to compare the scores across the three groups. The Friedman test was used

to compare the differences across the modalities of presentation and across the different relationships of the prime with the target, within each of the groups. If differences were discovered on the Friedman test, the Wilcoxon Signed Ranks test was used for pair-wise comparisons.

In addition to the above statistical procedures, the following analyses were done:

1. Pair-wise comparison of each participant with Down Syndrome/Mental Retardation and a developmental age-matched typically developing participant.
2. Comparisons of the results obtained on International Second Language Proficiency Rating Scale and the 130 'prime-target' stimulus.
3. Qualitative errors made by the participants (while naming the target picture) were profiled descriptively.

CHAPTER IV

RESULTS

The study aimed at investigating the implicit linguistic processing in bilinguals with Mental Retardation (with and without Down Syndrome) using a naming task. Their performance was compared both across and within the groups. Comparison was also done across the modalities and different types of prime in each of the groups independently.

4.1 Summary of the statistical analysis carried out for group I, group II and group III

1) Descriptive statistics of the 13 'prime-target' conditions
2) Comparison of the three groups using Kruskal-Wallis test
3) Pair wise comparison using Mann-Whitney test
4) Comparison of the 'No Prime' condition with the 12 'prime-target' conditions
5) Comparison with in the 3 modalities of presentation using Friedman test
6) Pair wise comparison between the modalities of presentation using Wilcoxon Signed Rank Test
7) Comparison with in 12 'Prime-Target' Relations using Friedman test
8) Pair wise comparison between the 'Prime-Target' Relations of presentation using Wilcoxon Signed Rank Test
9) Descriptive Statistics of the Combined Conditions
10) Comparisons of groups in combined conditions using Kruskal Wallis test
11) Comparison within the combined conditions using the Friedman test
12) Pair wise comparison between the modalities in combined conditions using the Wilcoxon Signed Rank test

4.2 International Second Language Proficiency Rating Scale

The International Second Language Proficiency Rating Scale (Ingram & Wylie, 1999) was administered on all the participants. The performance of the participants of the three groups (Individuals with Down syndrome, Individuals with Mental Retardation and Typically Developing Children) on the same is tabulated as follows.

Table 4.1

The performance of Individuals in group I, group II and group III on different domains of the International Second Language Proficiency Rating Scale

Participant Code	Speaking level	Listening level	Writing level	Reading level
DS 1	S:1 elementary proficiency	L:1 elementary proficiency	W:0+ initial proficiency	R:0+ initial proficiency
DS 2	S:1 minimum survival proficiency	L:2 minimum social proficiency	W:0+ initial proficiency	R:0+ initial proficiency
DS 3	S:0+ initial proficiency	L: 0+ initial proficiency	W:0+ initial proficiency	R:0+ initial proficiency
DS 4	S:1 elementary proficiency	L:1 elementary proficiency	W:0+ initial proficiency	R:0+ initial proficiency
DS 5	S:1 minimum survival proficiency	L:1 minimum survival proficiency	W:1 minimum survival proficiency	R:1 minimum survival proficiency
DS 6	S:3 minimum vocational proficiency	L:3 minimum vocational proficiency	W1: minimum survival proficiency	R:2 minimum social proficiency
MR 1	S:1 elementary proficiency	L:1 elementary proficiency	W:0+ initial proficiency	R:0+ initial proficiency
MR 2	S:1 elementary proficiency	L:1 elementary proficiency	W:0+ initial proficiency	R:0+ initial proficiency
MR 3	S:0+ initial proficiency	L: 0+ initial proficiency	W:0 zero proficiency	R:0+ initial proficiency
MR 4	S:2 minimum social proficiency	L:2 minimum social proficiency	W:1 elementary proficiency	R:1 elementary proficiency
MR 5	S:1 elementary proficiency	L:1 elementary proficiency	W:0+ initial proficiency	R:0+ initial proficiency
MR 6	S:1 elementary proficiency	L:1 elementary proficiency	W:0+ initial proficiency	R:0+ initial proficiency

Table 4.1 (contd.)

The performance of Individuals in group I, group II and group III on different domains of the International Second Language Proficiency Rating Scale

Participant Code	Speaking level	Listening level	Writing level	Reading level
TD 1	S:1 elementary proficiency	L:1 elementary proficiency	W:0+ initial proficiency	R:0+ initial proficiency
TD 2	S:2 minimum social proficiency	L:2 minimum social proficiency	W:2 minimum social proficiency	R:2 minimum social proficiency
TD 3	S:3 minimum vocational proficiency	L:3 minimum vocational proficiency	W:3 minimum vocational proficiency	R:3 minimum vocational proficiency
TD 4	S:1 minimum survival proficiency	L:1 minimum survival proficiency	W:1 minimum survival proficiency	R:1 minimum survival proficiency
TD 5	S:4 vocational proficiency	L:4 vocational proficiency	W:4 vocational proficiency	R:4 vocational proficiency
TD 6	S:4 vocational proficiency	L:4 vocational proficiency	W:4 vocational proficiency	R:4 vocational proficiency

4.3 Descriptive statistics of the 13 'prime-target' conditions

All the participants named the 'target' words in the 130 'prime-target' pairs' stimulus, yielding raw data in terms of 'reaction time'. The values of the same were averaged for each of the participants of the three groups under the 13 'prime-target' conditions separately. These values were analyzed using SPSS software to obtain descriptive statistical information namely, Mean, Median and Standard Deviation. The descriptive statistics for the three groups (Individuals with Down Syndrome, Individuals with Mental Retardation & Typically Developing Children) is tabulated in Table 4.2.

Table 4.2

Mean, Median and Standard Deviation for Group I Group II and Group III for all the 13 conditions

*C	Group I			Group II			Group III		
	Mean	**Median**	**SD**	**Mean**	**Median**	**SD**	**Mean**	**Median**	**SD**
*1	1486	1378	449	1706	1546	529	975	898	217
2	1145	1131	432	1050	1078	295	884	745	354
3	1298	1307	339	1463	1354	616	1060	1104	220
4	1368	1402	92	1490	1532	537	1256	1193	430
5	1538	1480	315	1181	1158	289	1104	1106	314
6	1266	1095	415	1353	1310	249	991	945	370
7	1446	1247	547	1644	1830	568	1179	1134	320
8	1314	1374	430	1413	1378	301	1164	1041	219
9	1416	1281	581	1615	1637	205	1259	1384	268
10	1134	1059	275	1128	1008	609	967	706	736
11	1785	1613	659	1514	1506	450	1091	1012	296
12	1422	1319	443	1724	1857	408	1040	935	325
13	1480	1518	379	1532	1600	335	1032	974	204

*C – Conditions, 1 - No Prime (NP); 2 - Pictorial Repetition (PIREP); 3 - Pictorial Semantic (PISEM); 4 - Pictorial Phonological/Orthographic (PIPHOR); 5 - Pictorial Unrelated (PIUR), 6 - Orthographic Repetition (ORREP), 7 - Orthographic Semantic (ORSEM); 8 - Orthographic Phonological/Orthographic (ORPHOR); 9 - Orthographic Unrelated (ORUR); 10 - Phonological Repetition (PHREP), 11 - Phonological Semantic (PHSEM); 12 - Phonological Phonological/Orthographic (PHPHOR); 13 - Phonological Unrelated (PHUR); Group I: Bilinguals with Down Syndrome; Group II: Bilinguals with Mental Retardation; Group III: Typically Developing bilingual children

4.4 Comparison of Groups I, II & III

The Kruskal-Wallis Test was done to compare the three groups in all the 13 conditions. Significant differences were found in the No Prime ($p \leq 0.05$) and Phonological Phonological/Orthographic conditions ($p \leq 0.05$).

Table 4.3

Comparison of groups I, II & III for the 13 'prime-target' conditions

Conditions	Chi-Square	df	Asymp. Sig.
NP	9.088	2	0.011
PIREP	1.205	2	0.548
PISEM	1.766	2	0.414
PIPHOR	2.012	2	0.366
PIUR	3.801	2	0.149
ORREP	4.082	2	0.130
ORSEM	1.825	2	0.402
ORPHOR	2.468	2	0.291
ORUR	4.105	2	0.128
PHREP	3.135	2	0.209
PHSEM	5.345	2	0.069
PHPHOR	7.240	2	0.027
PHUR	5.942	2	0.051

Pair-wise comparison was done to identify the groups which were significantly different from each other using the Mann-Whitney Test. Group I and Group II were not found to be significantly different in either the No prime or the Phonological Phonological/Orthographic condition. Group I and Group III were significantly different ($p \leq 0.05$) from each other in the No Prime condition. However, there was no significant difference in the Phonological Phonological/Orthographic condition between Group I and III. Group II and Group III were significantly different ($p > 0.05$) in both the No Prime and Phonological Phonological/Orthographic conditions. This is indicated in the following table.

Table 4.4

Pair wise comparison across groups in the No Prime and Phonological Phonological/Orthographic conditions

Groups	No Prime		Phonological Phonological/Orthographic	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
I – II	1.961	0.337	1.121	0.262
I – III	2.242	0.025	1.922	0.055
II – III	2.722	0.006	2.402	0.016

4.5 Comparison of the 'No Prime' condition with the 12 'prime-target' conditions

The Wilcoxon Signed Ranks Test was used to compare the No prime condition with 12 'prime-target conditions in each of the group.

4.5.1 Group I

Only 'No Prime' and Phonological Repetition were found to be significantly different from each other. Other 11 conditions (Pictorial Repetition, Pictorial Semantic, Pictorial Phonological/Orthographic, Pictorial Unrelated, Orthographic Repetition, Orthographic Semantic, Orthographic Phonological/Orthographic, Orthographic Unrelated, Phonological Semantic, Phonological Phonological/Orthographic, Phonological Unrelated) did not differ significantly from the 'No Prime' condition.

4.5.2 Group II

Pictorial Repetition, Pictorial Unrelated, Orthographic Repetition and Phonological Repetition were found to be significantly different from 'No Prime' condition. Remaining 8 conditions did not differ significantly from 'No Prime' condition.

4.5.3 Group III

Orthographic Phonological/Orthographic and Orthographic Unrelated conditions were found to be significantly different from 'No Prime' condition. Other 10 'prime-target' conditions (Pictorial Repetition, Pictorial Semantic, Pictorial Phonological/Orthographic, Pictorial Unrelated, Orthographic Repetition, Orthographic Semantic, Phonological Repetition, Phonological Semantic, Phonological Phonological/Orthographic, and Phonological Unrelated did not differ significantly from the 'No Prime' condition. The results of Wilcoxon Signed Rank test for groups I, II and III are tabulated as follows:

Table 4.5

Comparison of 'No Prime' condition with 13 'prime-target pairs for group I, group II and group III

Pairs	Group I		Group II		Group III	
	/Z/	Asym. Sig. (2-tailed)	/Z/	Asym. Sig. (2-tailed)	/Z/	Asym. Sig. (2-tailed)
PIREP-NP	1.572	0.116	2.201	0.028	0.943	0.345
PISEM-NP	0.734	0.463	1.572	0.116	0.734	0.463
PIPHOR-NP	0.105	0.917	1.782	0.075	1.572	0.116
PIUR-NP	0.524	0.600	2.201	0.028	0.105	0.917
ORREP-NP	0.734	0.463	2.201	0.028	0.314	0.753
ORSEM-NP	0.314	0.753	0.314	0.753	1.153	0.249
ORPHOR-NP	0.734	0.463	1.572	0.116	2.201	0.028
ORUR-NP	0.314	.753	0.105	0.917	1.992	0.046
PHREP-NP	1.992	0.046	2.201	0.028	0.943	0.345
PHSEM-NP	0.734	0.463	0.943	0.345	0.943	0.345
PHPHOR-NP	0.314	0.753	0.105	0.917	0.314	0.753
PHUR-NP	0.105	0.917	0.524	0.600	0.943	0.345

4.6 Comparison with in Modalities of Presentation

The Friedman Test was used to study the effect of the relationship between the 'prime-target' pairs (Repetition/Semantic/Phonological-Orthographic/Unrelated) with in each modality of presentation (Pictorial/Orthographic/Phonological) for all the three groups independently.

4.6.1 Group I: Effect of 'Prime-Target' Relations

There was no significant difference found across the four types of 'prime-target' relations (Repetition, Semantic, Phonological/Orthographic and Unrelated) in the Pictorial and Orthographic modalities for Group I. However there was a statistically significant difference in the phonological mode ($p \leq 0.05$). This is depicted in the following table as follows.

Table 4.6

Comparison of different 'prime-target' relations within each modality for Group I

Modality	Chi-Square	Df	Asymp. Sig.
Picture	4.200	3	0.241
Orthographic	1.800	3	0.615
Phonological	9.000	3	0.029

To study which of the 'prime-target' relations led to the difference in the Phonological modality in Group I, the Wilcoxon Signed Ranks Test was administered. Statistically significant differences ($p \leq 0.05$) were found between the following pairs: Semantic - Repetition, Unrelated – Repetition and Phonological/Orthographic – Semantic. Table (4.7) depicts the same.

Table 4.7

Pair wise comparison across the 'prime-target' relations in the Phonological Modality for Group I

Prime-Target Relations	Modality – Phonological	
	/Z/	Asymp. Sig. (2-tailed)
Semantic – Repetition	1.992	0.046
Phonological/Orthographic – Repetition	1.153	0.249
Unrelated – Repetition	2.201	0.028
Phonological/Orthographic – Semantic	2.201	0.028
Unrelated – Semantic	1.782	0.075
Unrelated – Phonological/Orthographic	0.314	0.753

4.6.2 Group II: Effect of 'Prime-Target' Relations

For Group II, significant differences ($p \leq 0.05$) were found in the Pictorial and Phonological modalities on the Friedman Test. In the Orthographic modality, there was no significant difference across the various 'prime-target' relations. The same is represented in Table 4.8.

Table 4.8

Comparison of different 'prime-target' relations within each modality for Group II

Modality	Chi-Square	Df	Asymp. Sig.
Picture	9.800	3	0.020
Orthographic	3.000	3	0.392
Phonological	8.600	3	0.035

The Wilcoxon Signed Ranks Test was administered to find the 'prime-target' relations that led to significant differences in the Pictorial and Phonological modalities in Group II. The results showed significant differences ($p \leq 0.05$) between Semantic - Repetition and Phonological/Orthographic – Repetition in the Pictorial modality. In the Phonological modality, significant differences ($p \leq 0.05$) were found between Phonological/Orthographic - Semantic and Unrelated - Phonological/Orthographic relations. The same is represented in the following table.

Table 4.9

Pair wise comparison across the 'prime-target' relation in Picture and Phonological Modality for Group II

Prime-Target Relation	Modality – Pictorial		Modality – Phonological	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Semantic – Repetition	1.992	0.046	1.782	0.075
Phonological/Orthographic – Repetition	2.201	0.028	1.992	0.046
Unrelated – Repetition	1.572	0.116	1.572	0.116
Phonological/Orthographic – Semantic	0.943	0.345	2.201	0.028
Unrelated – Semantic	1.572	0.116	0.105	0.917
Unrelated – Phonological/Orthographic	1.782	0.075	1.992	0.046

4.6.3 Group III: Effect of 'Prime-Target' Relations

On the Friedman Test, Group III showed significant difference ($p \leq 0.05$) in the Pictorial modality, but no significant differences in the Orthographic and Phonological modalities. Table 4.10 indicates the same.

Table 4.10

Comparison of different 'prime-target' relations within each modality for Group III

Modality	**Chi-Square**	**Df**	**Asymp. Sig.**
Picture	9.800	3	0.020
Orthographic	6.600	3	0.086
Phonological	5.400	3	0.145

On pair-wise comparison using the Wilcoxon Signed Ranks Test, Group III was found to be significantly different ($p \leq 0.05$) between the Phonological/Orthographic – Repetition and Unrelated – Repetition relations in the Pictorial modality. The following table depicts the same.

Table 4.11

Pair wise comparison across the 'prime-target' relations in the Pictorial Modality for Group III

Prime-Target Relation	**Modality – Pictorial**	
	/Z/	**Asymp. Sig. (2-tailed)**
Semantic – Repetition	0.943	0.345
Phonological/Orthographic – Repetition	2.201	0.028
Unrelated – Repetition	2.201	0.028
Phonological/Orthographic – Semantic	1.153	0.249
Unrelated – Semantic	0.314	0.753
Unrelated – Phonological/Orthographic	0.943	0.345

4.7 Comparison with in 'Prime-Target' Relations

The Friedman Test was used to study the effect of the modality of presentation (Pictorial/Orthographic/Phonological) with in each of the 'prime-target' relations (Repetition/Semantic/Phonological-Orthographic/Unrelated) for all the three groups independently.

4.7.1 Group I: Effect of Modality of Presentation

In Group I, no significant difference ($p > 0.05$) was found across the three modalities (Picture, Orthographic and Phonological) when the 'prime-target' relations were Repetition, Semantic, Phonological/Orthographic and Unrelated. Table (4.12) depicts the same.

Table 4.12

Comparison of different modalities within each 'prime-target' relation for Group I

'Prime-Target' Relation	**Chi-Square**	**Df**	**Asymp. Sig.**
Repetition	2.333	2	0.311
Semantic	4.000	2	0.135
Phonological/Orthographic	0.333	2	0.846
Unrelated	0.000	2	1.000

4.7.2 Group II: Effect of Modality of Presentation

In Group II, no significant difference was found in the Semantic and Phonological/Orthographic Prime-Target relations across the three modalities. However, a significant difference ($p \leq 0.05$) was found in the Repetition and Unrelated 'prime-target' relations across the various modalities. Table 4.13 depicts the same.

Table 4.13

Comparison of different modalities within each 'prime-target' relation for Group II

'Prime-Target' Relation	**Chi-Square**	**Df**	**Asymp. Sig.**
Repetition	6.333	2	0.042
Semantic	1.000	2	0.607
Phonological/Orthographic	1.333	2	0.513
Unrelated	6.333	2	0.042

To find, which of the modalities differed significantly from each other, pair wise comparison was done using Wilcoxon Signed Ranks Test. Significant difference ($p \leq 0.05$) was found between the Orthographic and Pictorial modalities for Repetition relation. Significant differences ($p \leq 0.05$) were found between the Orthographic and Pictorial and the Phonological and Pictorial modalities for the Unrelated 'prime-target' relation. The same is represented in the following table.

Table 4.14

Pair wise comparison across the modalities of presentation in the Repetition and Unrelated relations for Group II

Modality	**Repetition Relation**		**Unrelated Relation**	
	/Z/	**Asymp. Sig. (2-tailed)**	**/Z/**	**Asymp. Sig. (2-tailed)**
Orthographic – Pictorial	2.201	0.028	2.201	0.028
Phonological - Pictorial	3.140	0.753	1.992	0.046
Phonological - Orthographic	9.430	0.345	0.105	0.917

4.7.3 Group III: Effect of Modality of Presentation

Group III was also studied for the effect of modality of presentation in all the 'prime-target' relations using the Friedman Test. There was no significant difference between the modalities (Pictorial, Orthographic and Phonological) for Repetition, Semantic and Unrelated 'prime-target' pairs. There was a significant difference ($p \leq 0.05$) across modalities for the Phonological/Orthographic 'prime-target' relation. The same is represented in the following table.

Table 4.15

Comparison of different modalities within each 'prime-target' relation for Group III

'Prime-Target' Relation	**Chi-Square**	**Df**	**Asymp. Sig.**
Repetition	1.333	2	0.513
Semantic	1.333	2	0.513
Phonological/Orthographic	7.000	2	0.030
Unrelated	4.000	2	0.135

Pair-wise comparison was done using the Wilcoxon Singed Ranks test, to check which of modalities differed significantly from each other. The Pictorial and Phonological modalities were found to be significantly different ($p \leq 0.05$) from each other in the Phonological/Orthographic 'prime-target' relation. Table () indicates the same.

Table 4.16

Pair wise comparison across the modalities of presentation in the Phonological/Orthographic relation for Group III

Modality	**Phonological/Orthographic Relation**	
	/Z/	**Asymp. Sig. (2-tailed)**
Orthographic – Pictorial	0.314	0.753
Phonological - Pictorial	2.201	0.028
Phonological – Orthographic	0.943	0.345

4.8 Descriptive Statistics of the Combined Conditions

The variations in the three modalities and four types of 'prime-target' relations were considered collectively and compared across and within the three groups. The descriptive statistics were obtained and tabulated in Table 4.17.

Table 4.17

Mean, Median and Standard Deviation (SD) for the No Prime, three Modalities and four Prime Target relations in Groups I, II and III

*C C	Group I			Group II			Group III		
	Mean	*M	SD	Mean	M	SD	Mean	M	SD
*NP	1486	1378	449	1706	1546	529	975	898	217
PI	1337	1326	264	1296	1288	409	1076	1071	284
ORTHO	1360	1207	444	1506	1552	276	1148	1108	237
PHO	1455	1459	357	1475	1464	404	1033	921	372
REP	1181	1193	269	1177	1131	354	947	765	467
SEM	1510	1420	485	1541	1570	462	1110	1133	231
PH/OR	1368	1410	295	1542	1541	362	1153	1095	267
UR	1478	1460	319	1443	1500	214	1132	1095	193

(*C C – Combined Conditions, M – Median, NP - No Prime, PI - Picture, ORTHO - Orthographic, PHO - Phonological, REP - Repetition, SEM - Semantic, PHO/OR - Phonological/Orthographic, UR - Unrelated)

4.9 Comparison of Groups I, II & III: Combined Conditions

The three groups were compared using the Kruskal-Wallis Test across the No Prime condition, three modalities and four 'prime-target' relations. A significant difference was found only in the No Prime condition ($p \leq 0.05$) across the three groups. The following table depicts the same.

Table 4.18

Comparison of Group I, II and III for 3 'combined modalities', 4 'combined relations' and the 'no prime' condition

Combined Conditions	Chi-Square	Df	Asymp. Sig.
*NP	9.088	2	0.011
PI	2.000	2	0.368
ORTHO	3.591	2	0.166
PHO	4.257	2	0.119
REP	2.257	2	0.323
SEM	4.643	2	0.098
PH/OR	4.456	2	0.108
UR	5.509	2	0.064

Note: *Refer Table 4.3

4.10 Comparison with in the Combined Conditions

The Friedman Test was then administered to study the differences across the modalities of presentation and 'prime-target' relations (i.e. combined conditions) respectively, within each group.

4.10.1 Group I

Group I had no significant difference across the modalities or 'prime-target' relations. The following table depicts the same.

Table 4.19

Comparison of combined modalities and 'prime-target' relations for Group I

Combined Conditions	Chi-Square	df	Asymp. Sig.
Combined modalities (& N P)	0.200	3	0.978
Combined 'prime-target' relations (& NP)	7.200	4	0.126

4.10.2 Group II

Group II had significant difference across the modalities ($p \leq 0.05$) and 'prime-target' relations ($p \leq 0.05$). Table 4.20 shows the same.

Table 4.20

Comparison of combined modalities and 'prime-target' relations for Group II

Combined Conditions	Chi-Square	df	Asymp. Sig.
Combined modalities (& N P)	10.000	3	0.019
Combined 'prime-target' relations (& NP)	12.000	4	0.017

To decipher as to which of the combined modalities or combined 'prime-target' relations led to the significant differences, pair-wise comparisons were done using the Wilcoxon Signed Ranks Test. In terms of modality, there were significant

differences in the Pictorial and No prime ($p \leq 0.05$) and Orthographic and Pictorial ($p \leq 0.05$) conditions. Table 4.21 depicts the same.

Table 4.21

Pair wise comparison across the combined modalities for Group II

Combined Modalities	**/Z/**	**Asymp. Sig. (2-tailed)**
PI – NP	2.201	0.028
OR – NP	1.363	0.173
PH – NP	1.572	0.116
OR – PI	1.992	0.046
PH – PI	1.153	0.249
PH – OR	0.314	0.753

Group II also differed significantly between Repetition and No Prime ($p \leq 0.05$), Semantic and Repetition ($p \leq 0.05$), Phonological/Orthographic and Repetition ($p \leq 0.05$) and Unrelated and Repetition ($p \leq 0.05$) relations. Table 4.22 shows the same.

Table 4.22

Pair wise comparison across the combined relations for Group II

Combined Relations	**/Z/**	**Asymp. Sig. (2-tailed)**
REP – NP	2.201	0.028
SEM – NP	1.363	0.173
PH/OR – NP	1.153	0.249
UR – NP	1.572	0.116
SEM – REP	2.201	0.028
PH/OR – REP	2.201	0.028
UR – REP	1.992	0.046
PH/OR – SEM	0.314	0.753
UR – SEM	0.943	0.345
PH/OR – UR	1.363	0.173

4.10.3 Group III

Group III had no significant difference across the No Prime condition, the three modalities and the four ‘prime-target’ relations. The values of the statistical test were tabulated as follows.

Table 4.23

Comparison of combined modalities and 'prime-target' relations for Group I

Combined Conditions	Chi-Square	df	Asymp. Sig.
Combined modalities (& N P)	3.400	3	0.334
Combined 'prime-target' relations (& NP)	8.400	4	0.078

4.11 Pair wise Comparison of each Participant in Group I and II with a Developmental Age-matched Typically Developing Individual from Group III

Individuals with Down Syndrome and Individuals with Mental Retardation were compared pair wise with Developmental age matched Typically Developing children.

The pair wise comparison for each Group I participant (Individual with Down Syndrome) with a Developmental age matched Group III participant (Typically Developing child) is depicted diagrammatically (*Figure 4.1 – 4.6*) as follows:

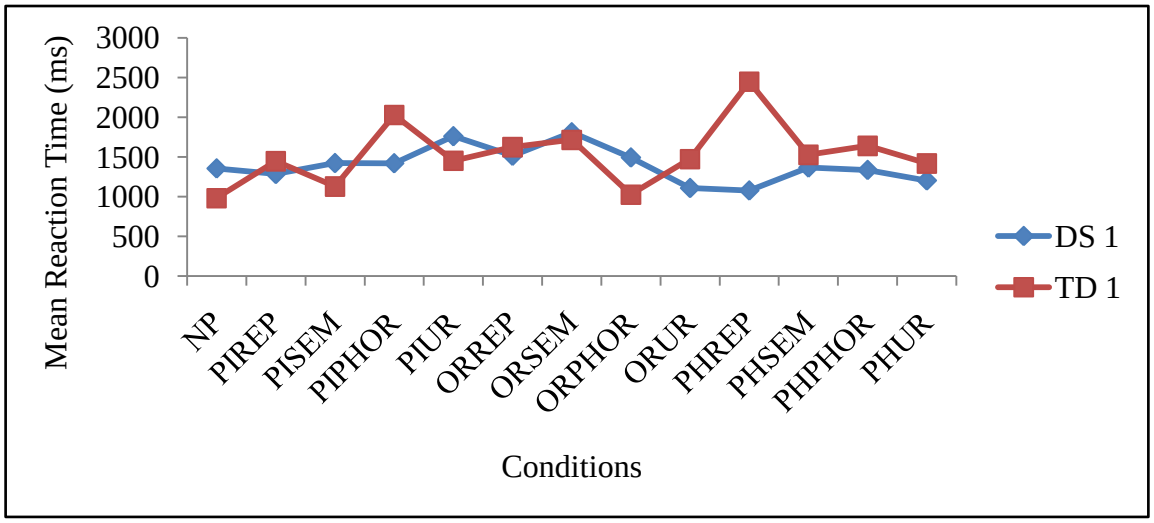

Figure 4.1. Comparison of DS 1 with TD 1.
*Note: DS: Bilingual with Down Syndrome; TD: Typically Developing Bilingual Child; Legend as in Table 4.2.

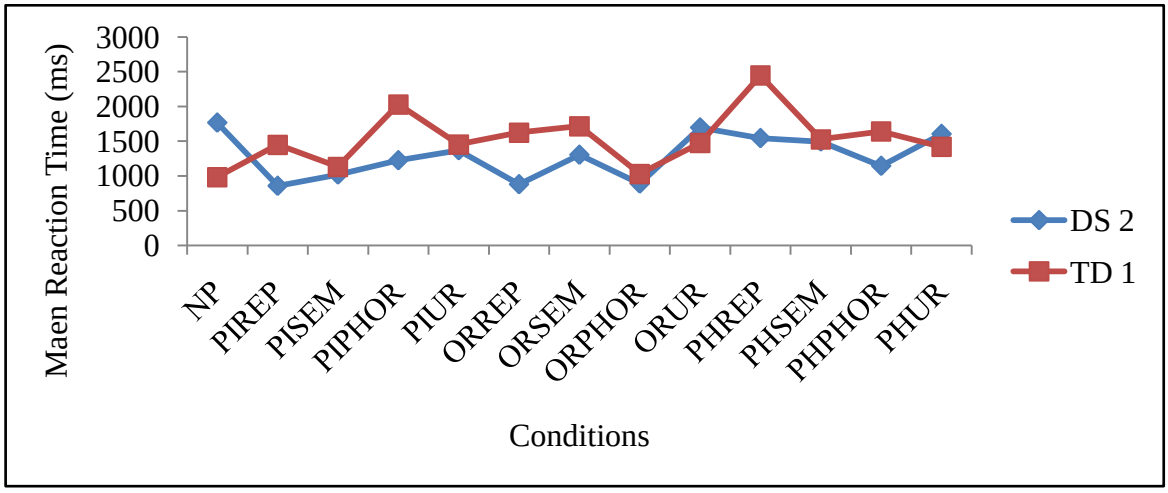

Figure 4.2. Comparison of DS 2 with TD 1.

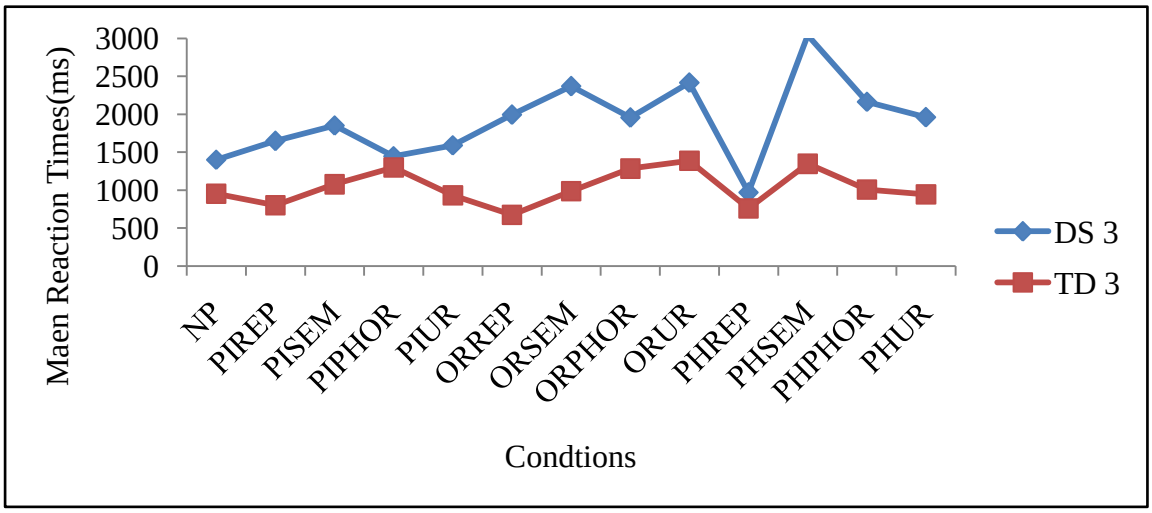

Figure 4.3. Comparison of DS 3 with TD 3.

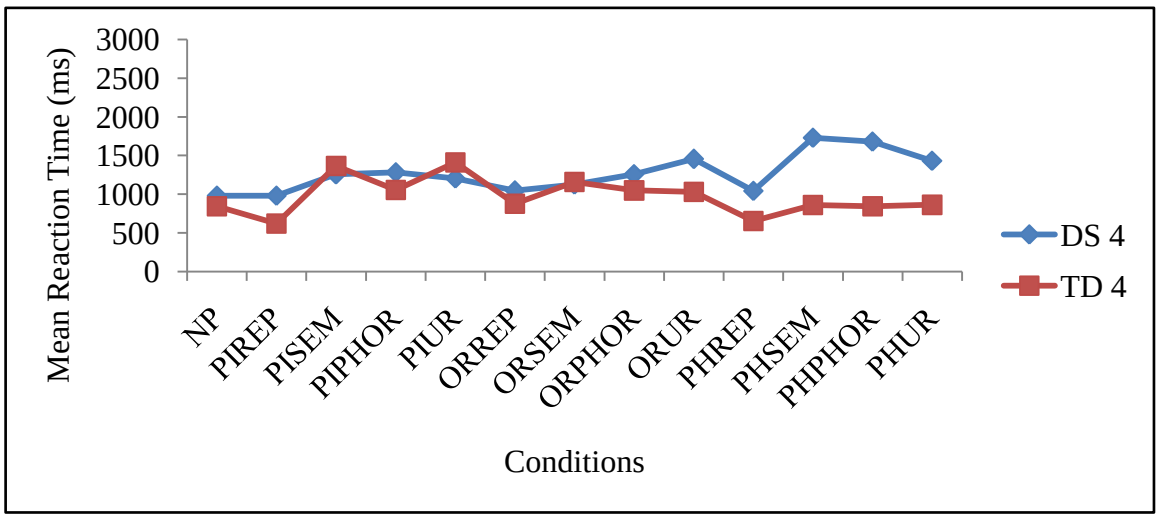

Figure 4.4. Comparison of DS 4 with TD 4.

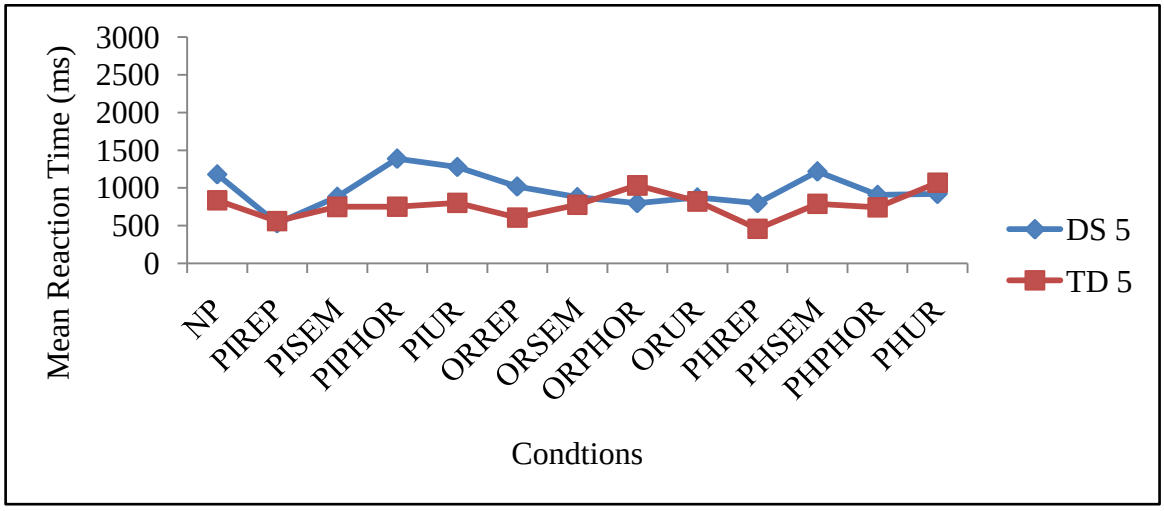

Figure 4.5: Comparison of DS 5 with TD 5.

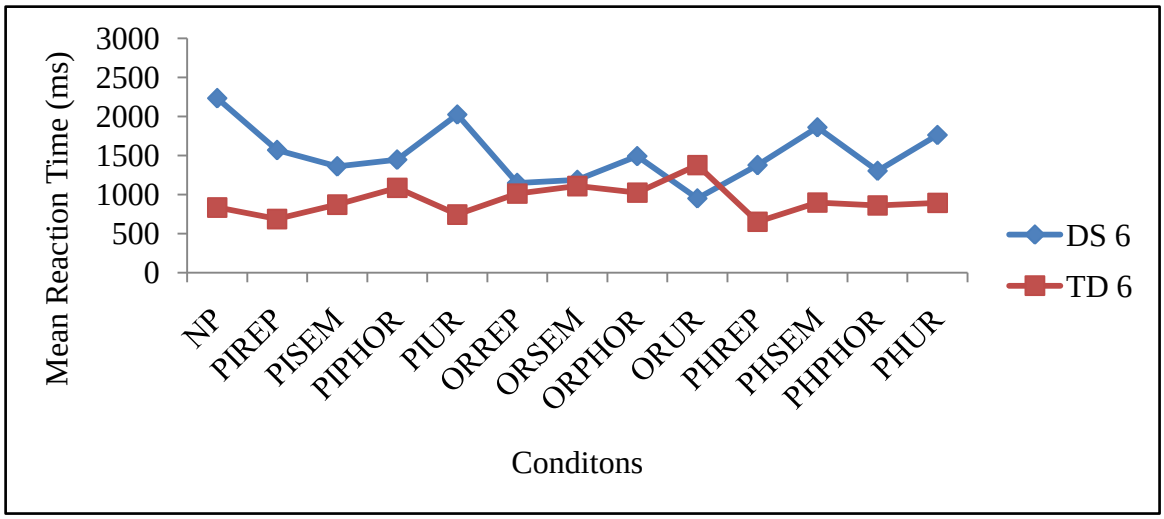

Figure 4.6: Comparison of DS 6 with TD 6.

The pair-wise comparison for each of the Group II participants (Individual with Mental Retardation) with a Developmental age matched Group III participant (Typically Developing child) is depicted diagrammatically (*Figure 4.7 – 4.12*) as follows:

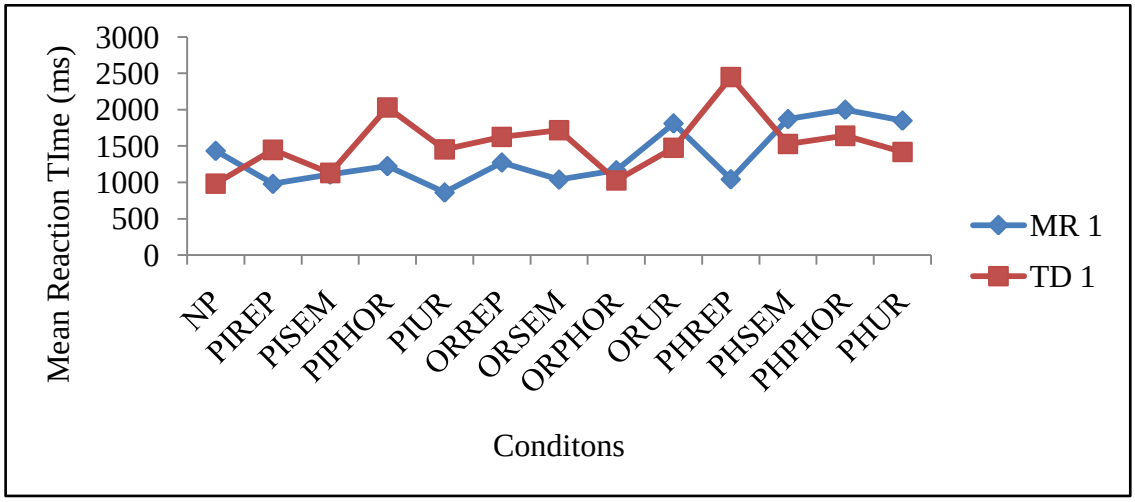

Figure 4.7. Comparison of MR1 with TD 1.

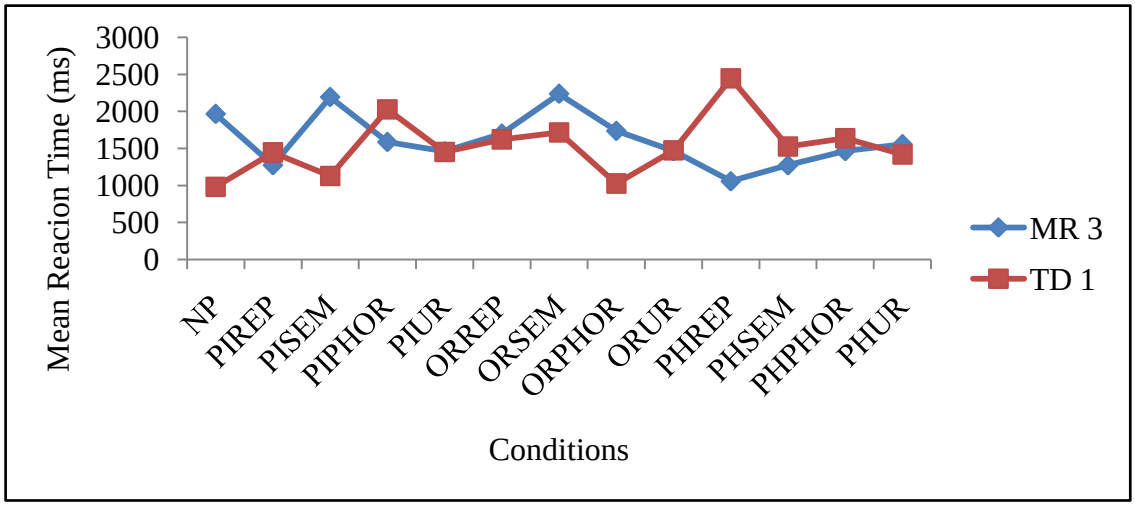

Figure 4.8. Comparison of MR 3 with TD 1.

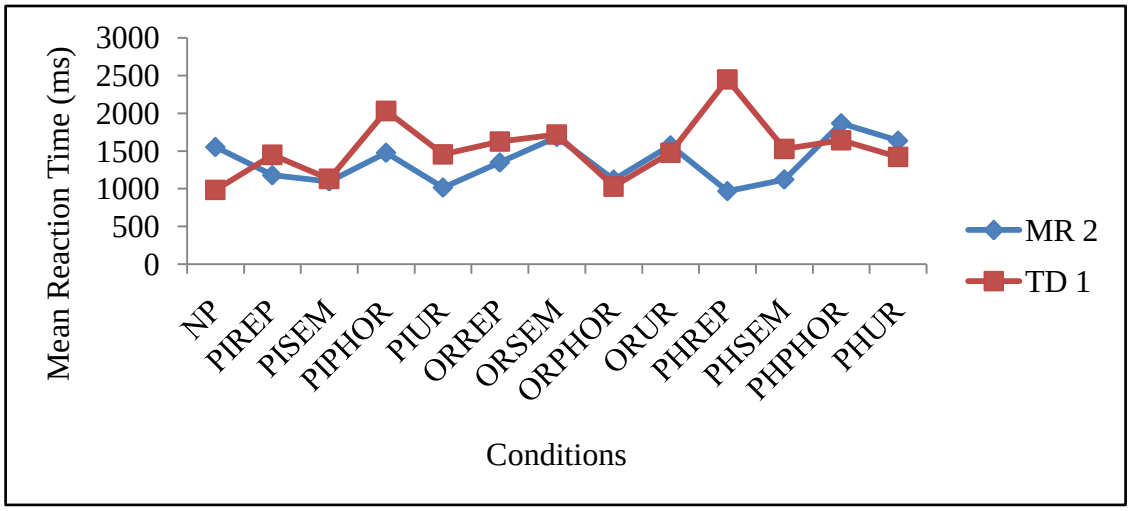

Figure 4.9 Comparison of MR 2 with TD1.

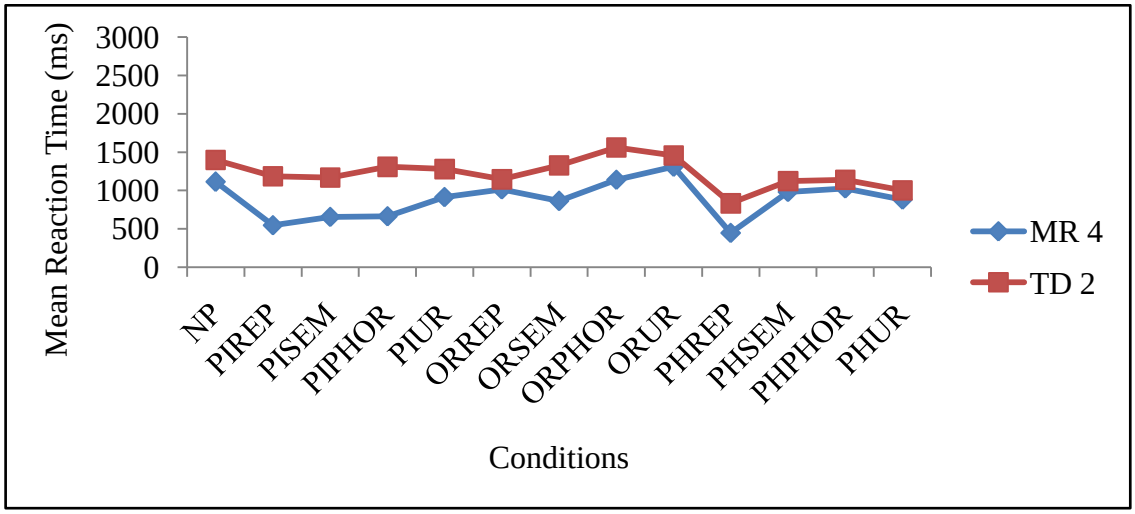

Figure 4.10. Comparison of MR 4 with TD 2.

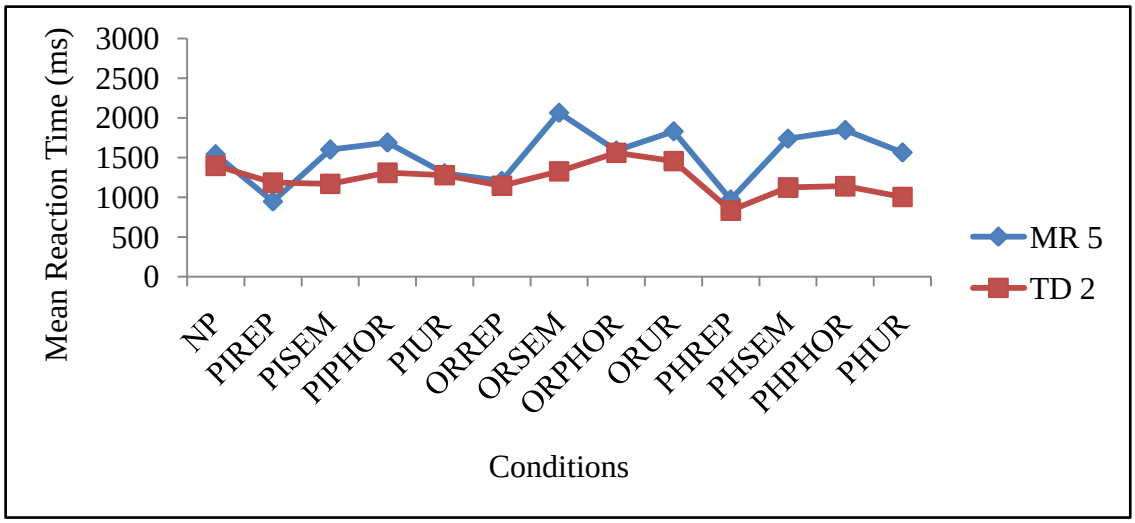

Figure 4.11. Comparison of MR 5 with TD 2.

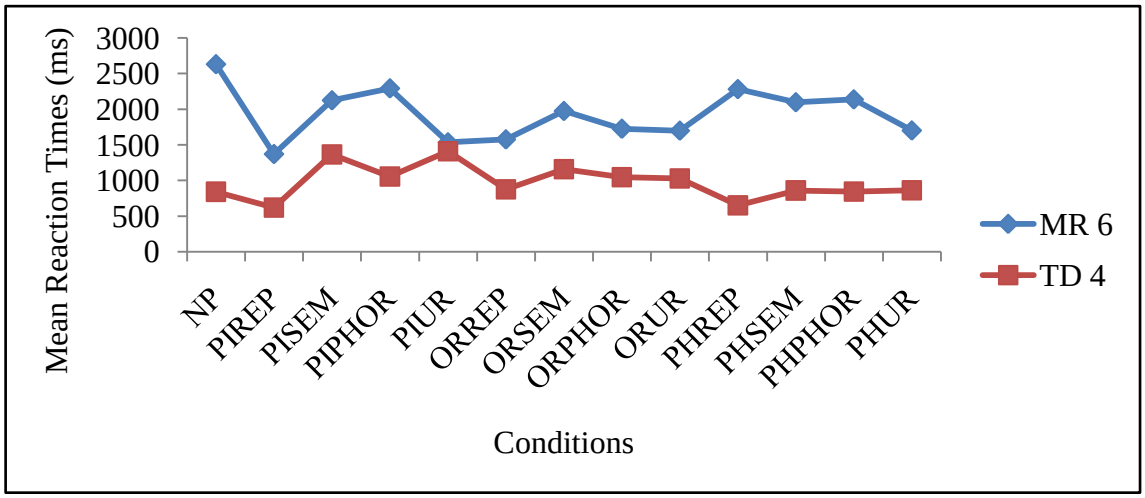

Figure 4.12. Comparison of MR 6 with TD 4.

Table 4.11

Summary of comparisons and the results of the statistical analysis

Comparisons	**Results showing differences**
Group I, II and III in the 13 prime target conditions	Groups I and III differed significantly in the 'No Prime' condition. Group II and III exhibited significant difference in the 'No Prime' and Phonological Phonological/Orthographic conditions. No significant difference was found between Groups I and II,
No Prime condition with 12 'prime-target' conditions for Groups I, II and III	Group I: significant difference between 'No Prime' and Phonological Repetition Group II: Pictorial Repetition, Orthographic Repetition, Phonological Repetition and Pictorial Unrelated conditions were found to be significantly different from 'No Prime' condition Group III: Orthographic Phonological/Orthographic and Orthographic Unrelated were found to be significantly different from No Prime condition
Within the modalities for different 'prime-target' relations	Group I: differed significantly on Phonological modality Group II: differed significantly on Pictorial and Phonological modalities Group III: Pictorial
Within prime-target relations for different modalities	Group I: No difference within 'prime target' relations for all the modalities Group II: differed significantly on Repetition and Unrelated relations Group III: differed significantly only on Phonological/Orthographic relation
Groups I, II and III: combined conditions	Significant difference in the 'No Prime' condition for all the three groups
Within combined conditions	Group I: no significant difference between the combined conditions Group II: significant differences between Pictorial-No Prime; Orthographic-Pictorial; Repetition-No Prime; Semantic-Repetition; Phonological/Orthographic-Repetition and Unrelated-Repetition conditions Group III: no difference between the combined conditions

CHAPTER V

DISCUSSION

The study aimed at investigating the implicit linguistic processing in bilinguals with Mental Retardation and Down Syndrome using a naming task. Their performance was compared both across and within the groups. Comparison was also done across the modalities and different types of primes in each of the groups independently. In addition, the International Second Language Proficiency Scale was administered to obtain the level of second language. The results are discussed under the following headings.

5.1 Comparison of groups I, II and III the on the 13 'prime-target' conditions

The results of the differences between bilinguals with Mental Retardation, Down Syndrome and Developmental Age matched Typically Developing children in the thirteen prime-target conditions did not reveal statistically significant difference in all the conditions. Although their mean reaction time scores indicate better performance of the TD group in comparison with the other two groups. Schweitzer (2001) reported that individuals with low intelligence have slower and more variable reaction times on elementary cognitive tasks. He reported a tendency for more intelligent people to have faster reaction times. The study by Schweitzer partly explains the slower reaction times in individuals with MR and DS but it cannot be considered as direct evidence because of the differences in the nature of tasks used in the two studies. Contradicting evidences also come from a study by Nettelbeck and Kirby (1983), where he had reported that individuals with same intelligence can also have variable reaction times. Therefore, intelligence alone cannot explain the performance on the reaction time measure.

Among the thirteen ‘prime-target’ conditions, only the ‘No Prime’ condition was found to be significantly different between TD children and individuals with DS. Bilinguals with Down Syndrome were found to be slower than TD children in terms of the reaction time for the ‘No Prime’ condition. As, in the ‘No Prime’ condition, the participant has to name the pictures without the prime preceding them, this condition can be compared to a picture naming task. A study by Ypsilanti Grouios, Hatzinikalaou, Zikouli, and Hatzinikalaou (2006) on the speed of picture naming in Down Syndrome reported that the speed of naming response in individuals with Down Syndrome is not significantly different from the mental age matched controls. However, they are qualitative differences in the naming response of the two groups. This finding is not in consonance with the present study in quantitative terms, if the ‘No Prime’ condition is assumed to be similar to the picture naming task. But this finding might just have become a quantitative support for their qualitative remark.

Individuals with MR however, differed from the TD children in the ‘No Prime’ and ‘Phonological Phonological/Orthographic’ conditions. In both the target-prime conditions, they were found to be slower than TD children. If the ‘No Prime’ condition is assumed to be similar to a simple picture naming task, the individuals with MR may be slower on the same considering their deficits in visual perception and word access attributed to a generally reduced speed of information processing (Kail, 2000). The poor performance on the ‘Phonological Phonological/Orthographic’ condition may be attributed to their inability to extract the single letter overlap of the prime with the target as the defining similarity is not highlighted nor are the participants guided to attend to the commonality. This explanation appears feasible as individuals with MR have been found to perform well on selective attention tasks only when guided or when the item they would have to select is highlighted (Carlin,

Soraci, Dennis, Strawbridge & Chechile, 2002). Also, the reduction in the speed of processing any information in individuals with MR may be influencing this analytical extraction of information where the phonological or orthographic overlap would have to be deciphered after processing the auditory phonological input (phonological processing), due to which a 'Phonological/Orthographic' prime presented through the auditory modality may not facilitate the picture naming responses in bilinguals with Mental Retardation as it does in Typically Developing children.

If only the performance for the verbal repetition prime is considered, then the present finding that the three groups (I, II & III) are not significantly different are partly in consonance with the study done by Carlesimo, Marotta and Vicari (1997) where they found that typically developing children, individuals with Mental Retardation and individuals with Down Syndrome performed equally for verbal repetition primes. Also, the findings on the effects of semantic primes are in consonance with Davies, Sperber and McCauley (1981) who found no significant differences between individuals with Mental retardation and neurotypical individuals using semantic primes with an object naming task, but found differences on using a category decision task.

5.2 Comparison of the 'No Prime' condition with the 12 'prime-target' conditions for all the three groups

No Prime condition was compared with the 12 'prime-target' conditions for all the three groups.

5.2.1 Bilinguals with Down Syndrome

In bilinguals with Down syndrome, significant difference was only found in the Phonological Repetition and 'No Prime' condition. It was observed on the mean scores that reaction time for the Phonological Repetition condition was faster compared to the 'No Prime' condition. This is to imply that Phonological Repetition condition may be facilitating than the other 'prime-target' conditions.

5.2.2 Bilinguals with Mental Retardation

In bilinguals with Mental Retardation, significant difference was found between the Pictorial Repetition-No Prime; Pictorial Unrelated-No Prime condition; Orthographic Repetition-No Prime and Phonological Repetition-No Prime. In Pictorial Repetition, Orthographic Repetition and Phonological Repetition, the mean reaction time scores were better than the No Prime condition. This implies that Pictorial Repetition, Orthographic Repetition and Phonological Repetition are facilitating the naming response. On the contrary the mean reaction time scores were slower in the Pictorial Unrelated condition. This implies that the Pictorial Unrelated prime may be interfering with the naming response.

5.2.3 Typically developing bilingual children

Typically developing bilingual children exhibited significant differences in Orthographic Phonological/Orthographic-No Prime and Orthographic Unrelated-No Prime conditions. The mean reaction time scores for both Orthographic Phonological/Orthographic and Orthographic Unrelated conditions were faster than the 'No prime' condition. This implies that both the conditions were facilitating the naming response.

5.3 Comparison of the effect of 'prime-target' relations in each modality of presentation for all the three groups

Each of the groups was compared across the different prime-target relations in each modality of presentation exclusively.

5.3.1 Bilinguals with Down Syndrome

In bilinguals with Down Syndrome, significant differences were found only in the Phonological modality across the prime-target relations. The prime-target relations which differed significantly from each other were Semantic-Repetition, Unrelated - Repetition and Phonologic/Orthographic-Semantic. It was observed on the mean scores that reaction times for the Repetition relation were faster compared to the Semantic and Unrelated relations. This may be due to a higher number of overlapping features in the Repetition relation when compared to the other two. Gonnerman, Seidenberg and Anderson (2007) found that the magnitude of priming is directly related to the degree of similarity in terms of either semantics or phonology between a prime and target. Studies have also reported that individuals with DS perform similar to TD children on verbal repetition priming (Carlesimo, Marotta & Vicari 1997; Vicari, Bellucci & Carlesimo, 2000; Vicari, 2001). This can be extended to speculate that the Phonological/Orthographic relation is not found be significantly different from Repetition as the similarity between the two are greater than any of the other relations. Between the Phonologic/Orthographic and Semantic relations, the reaction times were faster for the former. This could be due to the ease of extracting the overlapping features of phonology in comparison to the extraction of features from a semantically related prime when presented through the auditory phonological channel (on the basis of the modified Logogen Model of Word Processing).

5.3.2 Bilinguals with Mental Retardation

Bilinguals with mental retardation exhibit differences in the effects of the 'prime-target' relations in two modalities of presentation (Pictorial & Phonological). In general, it only implies that the activation of a target item is enhanced if the same item is presented as a prime either in the form of a spoken word or a visual picture. In the pictorial modality, the prime-target relations which are significantly different from each other are Semantic-Repetition and Phonological/Orthographic-Repetition. Repetition primes again were found to have faster reaction times than Semantic and Phonological/Orthographic relations. The findings are partly supported in literature. Carlesimo, Marotta and Vicari (1997) reported that individuals with MR perform similar to individuals with DS and TD children on the verbal repetition prime. However this study cannot be taken as direct evidence to support the current findings because the priming modality used in the study by Carlesimo, Marotta and Vicari (1997) was verbal and the modality in the current study is pictorial. The prime-target relations, which are found to be significantly different in the Phonological modality, are Phonological/Orthographic-Semantic, Phonological/Orthographic-Repetition and Phonological/Orthographic-Unrelated. The participants with MR were found to have the slowest reaction time on the Phonological/Orthographic relation in the Phonological modality. There is a distinct possibility that the auditory phonological presentation of phonologically (phonological/orthographic) related primes interfere with the phonemic plan of the target, on observation of the mean scores. The mean scores also point towards possibility of the presence of facilitation with reference to repetition, while the semantic and unrelated condition appear to neither interfere nor facilitate (on the basis of the modified Logogen Model of Word Processing).

The groups (I & II) depict different patterns in terms of the effects of 'prime target' relations in each of the modalities of presentation. This finding may be supportive of the 'etiology specificity' hypothesis, according to which, individuals with different etiologies leading to MR perform differently on various neuropsychological tasks (Vicari, Verucci, & Carlesimo, 2007).

5.3.3 Typically developing bilingual children

Typically developing children exhibited differences across 'prime-target' relations only in the Pictorial modality. The prime-target relations that are found to be significantly different are Phonological/Orthographic-Repetition and Unrelated-Repetition. On the observation of mean scores repetition priming is found to be more facilitating compared to the Unrelated and Phonological/Orthographic relations. Although the Repetition relation is significantly different from the other relations, it does not hold the same difference with the Semantic relation. These variations may be explained on the basis of the modified Logogen Model. As all the primes are pictorially presented, the input information first reaches the semantic system. At this point, only the Repetition and Semantic relations should yield priming effects. Among the two, the Semantic relation would take longer to prime the target due to an additional layer of category extraction. The Phonological/Orthographic relation, on the other hand would have be further analysed with inputs from the phonological or orthographic lexicons for priming to be facilitative. The decision on the lack of overlap between the prime and target for an Unrelated prime, would require it to cross all these levels of analyses. Thus, the extent of processing required determines the 'reaction time'.

5.4 Comparison of the effect of modalities of presentation on each 'prime-target' relation for all the three groups

Each group was compared across the different modalities in each of the 'prime-target' relations.

5.4.1 Bilinguals with Down Syndrome

In all of the prime-target relations (Repetition, Semantic, Phonological/Orthographic & Unrelated), individuals with DS do not differ significantly across the three modalities (Pictorial, Orthographic & Phonological). Therefore, comparing with the findings across the 'prime-target' relations in each modality (previous section), it may be safely concluded that individuals with DS may exhibit differences in reaction times only with respect to the relationship between the prime and the target, and that the priming effects of each of the 'prime-target' relations are independent of mode of presentation of the stimuli.

5.4.2 Bilinguals with Mental Retardation

In individuals with MR, no significant difference is found between the Semantic and Phonological/Orthographic 'prime-target' relations across the three modalities (Pictorial, Orthographic & Phonological). However, a significant difference is found in the Repetition between the Orthographic and Pictorial modalities of presentation. On observation of the mean scores, the effect of the Pictorial modality is found to be better than that of the Orthographic modality. This can be explained using the modified Logogen Model where a picture with a repetition relation activates the semantic system directly and aids in facilitating the selection of the target response whereas, a visual word gains has to cross the level of orthographic

analysis to influence the target. In the Unrelated relation, the differences are found between the Orthographic and Pictorial, and Phonological and Pictorial modalities. On observing the mean scores for the three modalities, the reaction times for Orthographic and Phonological modality were found to be faster than the Pictorial modality. A Pictorial prime may be more interfering when compared to primes presented in the Phonological or Orthographic modalities. The finding can be explained in terms of the temporal difference between the analysis of a prime and the initiation of the target. In this case, the pictorially presented stimulus possibly reaches the semantic system at a faster rate compared to the others, and since the relation of the prime with target is Unrelated, this might interfere with the initiation of the target; while the Orthographic or Phonological modalities may not allow the analysed prime to interact with the initiation of the target. This can accounted for on the basis of a study by Cherry, Applegate, & Reese (2002) who discussed a phenomenon called 'picture superiority effect' in individuals with MR for both recognition and free recall.

5.4.3 Typically developing bilingual children

In Typically Developing children, difference is found to be significant only in the Phonological/Orthographic relation between the Pictorial and Phonological modalities. The reaction time of the responses to targets for primes presented through the phonological route is found to be faster compared to the primes presented through the pictorial route. It may again be a case closer correspondence between the phonological/orthographic relation and phonological modality compared to pictorial modality (based on the Modified Logogen Model of Word Processing)**.** Carlesimo, Vicari, Albertoni, Turriziani and Caltagirone (2000) studied 40 reading beginners (first-graders), 40 third-graders and 20 fifth-graders using visual and auditory implicit stem completion. They found that responses for the auditory modality were more

stable across the age groups. On the contrary, visual priming showed an improvement in performance with increasing age. They concluded that auditory and visual priming mature at different ages; and of the two, auditory priming matures faster. The tasks taken in the present study are different from the study by Carlesimo, Vicari, Albertoni, Turriziani and Caltagirone (2000). Hence, this study may not directly support the differences observed currently, but it does hint towards the possibility of a visually based analysis being slower than an auditory analysis.

5.5 Comparison of Groups I, II & III: Combined Conditions

The information regarding the combined conditions was obtained by grouping the 'prime-target' pairs under specific 'prime-target' relations and specific modalities of presentation. The three groups were then compared across the 'No Prime' condition, 3 combined modalities and 4 combined 'prime-target' relations. The differences were significant only in 'No Prime condition'. The differences related to the 'No Prime' condition across the groups are already discussed (5.1).

The 7 combined conditions and the 'No Prime' condition are compared in each of the groups independently. Bilinguals with Down Syndrome showed no significant differences in the combined modalities, the combined 'prime-target' relations and the 'No prime' condition. This implies that bilinguals with Down Syndrome may not exhibit deficits in implicit linguistic processing when the modalities of presentation of an input or the relations between two closely occurring items ('prime-target' pairs) are taken as a whole. This necessitates the need to take a closer look at the intricacies in terms of implicit linguistic processing.

Bilinguals with Mental Retardation show differences in reaction times for primes presented through the Pictorial modality and the 'No prime' condition and for

the primes presented through the 'Pictorial' and 'Orthographic' modalities. The Pictorial modality of presentation appears to be facilitative (based on the mean scores) in individuals with MR which may imply that pictorial mediation is a significant entity in eliciting verbal responses. When the relations are compared across themselves and with the 'No Prime' condition, the Repetition facilitates the responses in comparison to all the other conditions (No Prime, Unrelated, Semantic and Phonological/Orthographic). It may imply that the presentation of a prime that is the same as the target, particularly through a pictorial representation is the best facilitator of lexical access. On the basis of the modified Logogen Model, it can be said that children with MR prefer a direct access to the semantic system as the amount of analysis required to extract the semantic information is minimal compared to the other modes; and that repetition leads faster lexical access due to the minimal load placed on the cognitive system for activation of the target.

Typically developing children showed no significant differences in the combined modalities, the combined 'prime-target' relations and the 'No prime' condition. Thus, it may be speculated that bilinguals with Down Syndrome are closely related to typically developing bilingual children in terms of implicit linguistic processing considered as a whole, while bilinguals with Mental Retardation exhibit wide differences with the other two groups.

5.6 Pair wise Comparison of each bilingual with Down Syndrome and Mental Retardation with a Developmental Age-matched Typically Developing Child

Bilinguals with Down Syndrome and Bilinguals with Mental Retardation were compared pair wise with the Developing Age matched Typically Developing bilingual children across the 13 'prime-target' conditions.

5.6.1 Pair wise comparison of each bilingual with Down Syndrome with a Developmental Age matched typically developing child

Mean reaction time scores of bilinguals with Down Syndrome are compared pair wise with the Developmental Age matched bilingual Typically Developing children. The mean reaction time scores of bilinguals with DS and bilingual TD children on the 13 prime-target conditions are depicted using the *Figures 4.1 to 4.6*. ISLPR scores were carefully examined for presence or absence of any relations.

Figures 4.1 and 4.2 depict the reaction time scores for DS 1 and DS 2 compared with DA age matched TD 1 respectively. On visual inspection, the data reveals more overlaps in the reaction times than differences. However some differences were observed on the Pictorial Phonological/Orthographic and Phonological Repetition conditions in both the Figures where bilingual with DS (DA: 6 yrs) is compared with DA matched bilingual TD child.

ISLPR reveals similar second language proficiency for DS 1 and TD 1 and different for DS2 and TD 1 (TD 1 was less proficient than DS 2)

The data in Figure 4.3 depicts the comparison of mean reaction times of a bilingual with DS (DA: 8yrs) with a DA matched bilingual TD child. The visual inspection of the graph reveals clearly better performance of DA age matched TD children. However the difference was less on the Phonological/Orthographic and Phonological Repetition conditions. These are the areas where DA matched 6 year old bilingual TD performs poorer when compared to bilingual with DS.

ISLPR reveals different levels of second language proficiency for DS 3 and TD 3 (TD 4 was more proficient than the DS 3).

The data on Figure 4.4 depicts the comparison of mean reaction time scores of a bilingual with DS (DA: 9 yrs) with a DA matched bilingual TD child. The gap

between the performances on all the 13 prime-target condition decreased. However, the amount of decrement was less for Phonological Repetition, Phonological Semantic, Phonological Phonological/Orthographic and Phonological Unrelated conditions.

ISLPR reveals different levels of second language proficiency for DS 4 and TD 4 (TD 4 was more proficient than the DS 4).

The data in Figure 4.5 depicts the comparison of mean reaction time scores of a bilingual with DS (DA: 12 yrs) with a DA matched bilingual TD child. The data reveals overlaps only in Pictorial Repetition, Orthographic Semantic and Orthographic Unrelated condition. For others, gap persists and it is more for Pictorial Phonological/orthographic, Pictorial Unrelated, Orthographic Repetition, Phonological Repetition and Phonological Phonological/Orthographic.

ISLPR reveals different levels of second language proficiency for DS 5 and TD 5 (TD 5 was more proficient than the DS 5).

The data in Figure 4.6 depicts the comparison of mean reaction time scores of a bilingual with DS (DA: 13 yrs) with a DA matched bilingual TD child. The visual inspection of the Figure reveals increase in gap between the performances of bilingual TD child and bilingual with DS except in Orthographic Repetition, Orthographic Semantic (the reaction time scores are more or less overlapping in the two conditions).

ISLPR reveals different levels of second language proficiency for DS 6 and TD 6 (TD 6 was more proficient than the DS 6).

At a lower DA, bilinguals with Down Syndrome perform similar to the DA matched TD children. In fact they sometimes show better performance on some ‘prime-target’ pairs e.g., Pictorial Phonological/Orthographic and Phonological

Repetition. But with the increase in age, TD children not only bridged the gap but appear to outperform bilinguals with DS on several 'prime-target' relations e.g., No Prime, Pictorial Repetition, Pictorial Semantic, Pictorial Phonological/Orthographic, Pictorial Unrelated, Phonological Repetition, Phonological Semantic, Phonological Phonological/Orthographic and Phonological Unrelated. However, these increases in performances do not follow a linear pattern. Second language proficiency scores may be used to explain the better performances of the DA matched older TD bilingual children. As overall the second language proficiency of DA matched older TD bilingual children was higher than Bilinguals with Down Syndrome.

5.6.2 Pair wise comparison of each bilingual with Mental Retardation with a Developmental Age matched typically developing child

Bilinguals with MR were compared pair wise with DA age matched TD children. The mean reaction time scores of bilinguals with MR and bilingual TD children on 13 prime-target conditions are depicted using the Figures 4.6 to 4.12. ISLPR scores were carefully examined for presence or absence of any relations.

Figures 4.7, 4.8 and 4.9 depict the reaction time scores for MR 1, MR 2 and MR 3 compared with a DA age matched 6yrs old TD 1 respectively. No specific pattern is located in the three Figures except the persistent large gap in the Phonological Repetition conditions, where the DA age matched TD child performed poorer compared to all three bilinguals with MR.

ISLPR reveals similar second language proficiency for MR 1, MR 2 and TD 1 and different for MR 3 and TD 1.

Figures 4.10 and 4.11 depict the reaction time scores for MR 4 and MR 5 compared with DA age matched TD 2 respectively. A conspicuous difference is noted

in the Phonological Repetition condition, where the gap between the DA matched TD child and bilinguals with MR reduced to a large extent (almost overlapping).

ISLPR reveals different levels of second language proficiency for MR 4 and MR 5 when compared with TD 2 (TD 2 was more proficient than MR 4 in the reading and writing domains compared to MR 5 TD 2 was more proficient on all the domains).

The data in Figure 4.12 depicts the comparison of mean reaction time scores of a bilingual with MR (DA: 9 yrs) with a DA matched bilingual TD child. The visual inspection of the Figure reveals differences in the performances of MR 6 and TD 4 (TD 4 performed better than the MR 6) on all prime target conditions except the Pictorial Unrelated condition. In Pictorial Unrelated condition, both the individuals (MR 6 & TD 4) performed similarly.

ISLPR reveals different levels of second language proficiency for DS 6 and TD 6 (TD 6 was more proficient than the DS 6).

The mean reaction time scores of bilinguals with MR do not follow a conspicuous pattern. The variations in the mean reaction time scores are more for the bilinguals with MR even when their DA is same (e.g., MR 1 & MR 3). Visual inspection reveals poorer performance of younger DA matched bilingual TD children in the Phonological Repetition condition. This gap reduces with increase in age in TD children and these children appear to outperform the bilinguals with MR on all the 'prime- target' conditions except the Pictorial Unrelated condition.

These findings can be partly explained in terms of better second language proficiency in DA matched older typically developing bilingual children. However, in some participants (e.g., MR 1 & MR 2) the performance in implicit linguistic processing did not match even when the DA and second language proficiency were

similar. This indicates that, there may be some other factors also that influence implicit linguistic processing.

5.7 Descriptive account of the errors and corrections during the responses to 'prime-target' pairs in the naming task in the three groups

The absolute responses obtained during the picture naming task is analysed qualitatively for each participant. The patterns of errors evidenced are interestingly similar across the participants of a particular group. A brief representation of the same is made in the following Table.

Table 5.1

Naming errors and corrections in Groups I, II and III.

Error/Correction	Example	I	II	III
Semantic Substitution	'tomato' for potato	+	-	+
Self correction after semantic substitution	'tomato - potato' for potato	+	+	+
Double correction after semantic substitution	'cat - dog - cow' for cow	-	+	-
Self correction after language error and semantic substitutions	'/hasu/ - dog - cow' for cow	-	+	-
Visuo-perceptual error	'apple' for 'tomato'	+	-	-
Language switch	'/hasu/' for cow	+	-	-
Self correction after language switch	'/hasu/ - cow' for cow	+	+	+
Distant verbal substitutions	'sun' for bulb	+	+	-
Incomplete response	'sun' for sunflower	-	+	+
Phonemic confusion with incomplete response	'/s/ - /te:/' for table	+	-	-
Phonotactic error after Language switch	'/a:lugadde/ - /potokaeto/' for potato	-	+	-
Collocative adjunct	'watch TV' for TV	+	+	-
Parenthetical remark	'no flower' for flower	-	+	-
Part-word repetition (PWR)	'/pəpəpotaeto/' for potato	+	-	+
PWR after prolongation	'/ɔ----ɔrɛndz/' for orange	-	+	-
Partial spelling before target	'/e:pipi - aepəl/' for apple	-	+	-
Audible fillers	'/ə----potaeto/' for potato	-	+	+
Misarticulation	'/bab/' for bulb	+	+	-

The responses clearly indicate that typically developing children do not make as many errors in naming with a prime preceding the target as do bilinguals with DS and bilinguals with MR. Errors reflecting the influence of the native language are also observed in all the three groups. However, only bilinguals with DS do not appear to make attempts at correcting these incorrect activations. On keen observation a difference in the error patterns of bilinguals with DS and bilinguals with MR could be observed. Bilinguals with DS appear to make simpler errors, lesser corrections and fewer speech fluency errors compared to bilinguals with MR who make more complex errors, attempt many corrections and produce disfluent responses. As these error patterns are noted during the administration of the task for assessing implicit linguistic processing, these errors may be considered as a reflection of those processes that are implicitly functioning at the time.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Implicit linguistic processing refers to the covert processes that are operational during a language-based task. Individuals with cognitive impairments have been found to exhibit deficits in implicit linguistic processing owing to factors such as slower speed of information processing, attention and perception deficits and poor lexical organization. Profiling the implicit linguistic characteristics of individuals with cognitive deficits to aid in clinical decision making had not been done extensively in India, a country where bi/multilingualism has been the norm. Therefore, the present study aimed at exploring the implicit linguistic processing abilities in Kannada-English bilinguals with Mental Retardation (with & without Down syndrome).

The study investigated the implicit linguistic processing abilities in three groups. The first group comprised 6 individuals with Down syndrome aged between 9 to 26 years. The second group comprised individuals with Mild to Moderate Mental Retardation (without Down syndrome) aged between 9 to 27 years. The Developmental Screening Test was used to estimate the Developmental Age (DA) of the participants and those with a developmental age anywhere between 6 to 13 years were included in the study. The third Group comprised 6 typically developing DA matched children aged between 6 to 13 years.

The International Second Language Proficiency Rating scale (ISLPR) was administered to estimate the second language proficiency in speaking, listening, reading and writing domains. This was followed by the administration of the 130 ‘prime-target’ pairs’ stimulus for a picture naming task, which was designed by the investigator based on the Logogen Model (Patterson & Shewell, 1987). These 130 prime-target pairs were classified in to 13 (10 pairs in each) ‘prime-target’ conditions

that comprised three modalities of presentation (Pictorial, Orthographic, Phonological) and 4 'prime-target' relations (Repetition, Semantic, Phonological, Unrelated).

The reaction times that were obtained using the Check Vocal software for picture naming (administered in the DMDX software) were then averaged and subjected to descriptive and inferential statistical analysis using the Kruskal-Wallis, Mann-Whitney, Friedman and Wilcoxon Signed Rank tests for comparisons across and within groups. The effects of the modalities of presentation and the 'prime-target' relations on reaction time were investigated. In addition to this, pair-wise comparison of each participant (on mean reaction time scores and second language proficiency) in group I and II with a Development Age matched typically developing individual from group III was done. Qualitative errors noticed during the naming task were also profiled. The findings were discussed with reference to the existing research and on the basis of the modified 'Logogen Model of Word Processing" (Patterson & Shewell, 1987).

6.1 Conclusions

The following conclusions are drawn from the results of the current study.

1. Bilinguals with Down Syndrome and bilinguals with Mental Retardation do not differ from each other in the 13 'prime target' relations indicating that, at a gross level, Mental Retardation due to unknown etiology may not differ from individuals with Down Syndrome on implicit linguistic processing.
2. In the 'No Prime' condition, both bilinguals with Down syndrome and Mental Retardation perform slower than Typically Developing bilingual children.

3. In the Phonological Phonological/Orthographic condition, only bilinguals with Mental Retardation perform slower than Typically Developing bilingual children.
4. Phonological Repetition condition is facilitating for bilinguals with Down syndrome
5. Repetition relation in all the modalities facilitates naming for bilinguals with Mental Retardation.
6. The Unrelated Pictorial condition interferes in the naming response for bilinguals with Mental Retardation.
7. The Orthographic Phonological/Orthographic condition facilitates naming response in typically developing bilingual children.
8. Response to Phonological Repetition is faster than the response to Phonological Semantic and Phonological Unrelated conditions in bilinguals with Down syndrome.
9. Bilinguals with Down syndrome perform better in the Phonological Phonological/Orthographic condition than the Phonological Semantic condition.
10. In the Pictorial modality, bilinguals with Mental Retardation perform better for the Repetition relation compared to the Semantic and Phonological/Orthographic relations.
11. Bilinguals with Mental Retardation perform better in the Phonological Semantic condition than Phonological Phonological/Orthographic condition.
12. In the Pictorial modality, typically developing bilingual children perform better for the Repetition relation compared to the Unrelated and Phonological/Orthographic conditions.

13. Bilinguals with Down Syndrome perform similarly across the three modalities when the 'prime-target' relations are Repetition, Semantic, Phonological/Orthographic and Unrelated.
14. Bilinguals with Mental retardation show a preference for being primed with repetition through the pictorial modality over the orthographic modality.
15. At lower Developmental Ages, the performance of typically developing bilingual children and bilinguals with Down Syndrome can not be easily separated.
16. Older Developmental Age matched Typically Developing bilingual children perform considerably better than bilinguals with Down Syndrome in the Phonological and Pictorial modalities
17. The variability in the performance of individuals with Mental Retardation is more at lower Developmental Ages.
18. The Developmental Age matched typically developing children appear to perform considerably better than the bilinguals with Mental Retardation only at 9 years of age.
19. Better second language proficiency facilitates faster response in all the three groups.
20. Bilinguals with Mental Retardation and bilinguals with Down Syndrome produced a larger number of qualitative errors compared to typically developing bilingual children.
21. However, it may be said that individuals with Mental Retardation of unknown etiology may show subtle differences in specific aspects of implicit linguistic processing when compared to individuals with Down Syndrome.

6.2 Limitations of the study

1. Small sample size: Data from a larger number of participants for a Developmental Age would have aided in increasing the validity of the findings in addition to facilitating the observations regarding the developmental trends.
2. Variation in the Chronological Age: Although the individuals with mental Retardation and individuals with Down Syndrome were matched with typically developing participants for Developmental Age, the extent of variation in the chronological ages of the participants may have influenced their performance due to experiential factors.

6.3 Implications of the study

1) The study added to the understanding of the intricacies of implicit linguistic processing in individuals with and without cognitive impairments.
2) Some of the factors (modalities and relations) influencing the primed naming abilities of individuals with cognitive impairment were discovered.
3) The study helped in understanding the differences and similarities in the implicit linguistic processing abilities of individuals with Mental Retardation across different etiologies.

6.4 Future suggestions

1) Implicit linguistic processing in different etiologies of Mental Retardation can be explored further using a similar stimulus.
2) Comparative explorations of implicit and explicit linguistic processes could be made in individuals with various cognitive impairments.

3) The development of implicit linguistic processing abilities and their influence on priming can be compared across three such populations.

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APPENDIX 1

The 130 'prime-target' stimuli grouped according to the 'prime-target' relations (Repetition, Semantic, Phonological/Orthographic and Unrelated) and modalities of presentation (Pictorial, Orthographic and Phonological).

REPETITION RELATION					
Pictorial		**Orthographic**		**Phonological**	
Prime	***Target***	***Prime***	***Target***	***Prime***	***Target***
apple	apple	MANGO	mango	/tomaeto/	tomato
bulb	bulb	TV	TV	/ku:mb/	comb
pants	pants	SHOES	shoes	/sa:ri:/	saree
table	table	CHAIR	chair	/ɔrɛndz/	orange
soap	soap	LIPS	lips	/lɛgs/	legs
butterfly	butterfly	MONKEY	monkey	/kau/	cow
potato	potato	CAR	car	/bas/	bus
idli	idli	MILK	milk	/ʧapa:t̲i/	chapati
sun	sun	FLOWER	flower	/pɛnsil/	pencil
book	book	PLATE	plate	/spu:n/	Spoon
SEMANTIC RELATION					
Pictorial		**Orthographic**		**Phonological**	
Prime	***Target***	***Prime***	***Target***	***Prime***	***Target***
grapes	apple	CAMERA	bulb	/ʃɚrt/	pants
remote	TV	CAP	shoes	/bɛntʃ/	chair
frock	saree	PINEAPPLE	orange	/ijɚ/	legs
sofa	table	BRUSH	soap	/aent/	butterfly
tongue	lips	ELEPHANT	monkey	/trein/	car
donkey	cow	AUTORICKSHAW	bus	/brɛd/	chapati
brinjal	potato	DOSA	idli	/mu:n/	sun
juice	milk	LEAF	flower	/kap/	plate
scale	pencil	BOWL	spoon	/ɔnijən/	tomato
pen	book	BANANA	mango	/tu:t̲ braʃ /	comb
PHONOLOGICAL/ORTHOGRAPHIC RELATION					
Pictorial		**Orthographic**		**Phonological**	
Prime	***Target***	***Prime***	***Target***	***Prime***	***Target***
pig	pants	BIRD	bulb	/aed/	apple
tiffin box	TV	MOBILE	mango	/tre/	table
tap	tomato	PAINT	plate	/ʃain/	shoes
balloon	butterfly	SWEETS	soap	/kɔtən/	comb
lotus	lips	CHEETAH	chair	/pa:rk/	potato
octopus	orange	SICK	saree	/mad/	monkey
snake	sun	INK	idli	/lebəl/	legs
mat	milk	COLD	car	/bɛl/	book
bag	bus	CANDY	cow	/faet/	flower
seven	spoon	PLUG	pencil	/ʧaild/	chapati

UNRELATED					
Pictorial		**Orthographic**		**Phonological**	
Prime	***Target***	***Prime***	***Target***	***Prime***	***Target***
parrot	saree	MOUNTAIN	comb	/tʃa:rt/	tomato
chain	mango	GRASS	plate	/bɔks/	flower
teeth	bulb	BIKE	apple	/drink/	book
tub	cow	RAT	legs	/dzamp/	orange
fish	chair	RAIN	shoes	/sli:p/	TV
lollipop	soap	NECK	table	/bɛd/	pants
giraffe	pencil	NINE	chapati	/ste:r/	bus
ball	car	SALT	monkey	/ga:rdən/	lips
pillow	idli	ROAD	potato	/king/	butterfly
zebra	spoon	NUTS	sun	/flo:r/	milk

NO PRIME – Target				
lips	mango	potato	TV	shoes
cow	flower	spoon	bus	milk