PROCESSING SPEED ON METALINGUISTIC AND NON-LINGUISTIC COGNITIVE TASKS IN BILINGUALS AND MULTILINGUALS

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MAY 2012

CERTIFICATE

This is to certify that this dissertation entitled **"Processing Speed on Metalinguistic and Non-linguistic Cognitive Tasks in Bilinguals and Multilinguals"** is a bonafide work in part fulfillment of the degree of Master of Science (Speech-Language Pathology) of the student (Registration No. 10SLP023). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore
May 2012

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DECLARATION

This dissertation entitled **"Processing Speed on Metalinguistic and Non-linguistic Cognitive Tasks in Bilinguals and Multilinguals"** is the result of my own study under the guidance of Dr. Swapna N, Lecturer in Speech 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 other Diploma or Degree.

Mysore   Registration No. 10SLP023

May 2012

DEDICATED TO MY LITTLE BROTHER, SALMAN BAKSH

Without whom I wouldn't have been where I'm and wouldn't have been doing what I do.

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"Having a place to go - is a home. Having someone to love - is a family. Having both - is a blessing"

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A friend like you is a treasure to cherish **Sanu**, Read the above paragraph with an extra emotional baggage. Thanks for being there in all thicks and thins. xx

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Introduction

"I have never known what is Arabic or English, or which one was really mine beyond any doubt. What I do know, however, is that the two have always been together in my life, one resonating in the other, sometimes ironically, sometimes nostalgically, most often each correcting and commenting on, the other. Each can seem like my absolutely first language, but neither is."

- Edward Said (1999)

The ability to speak two languages is often seen as something of a remarkable achievement, particularly in the English-speaking countries. Trask (1999) reported that 70% of the earth's population is bilingual or multilingual, hence there is a good reason to believe that bilingualism is the norm for the majority of people in the world. In countries like India too, the idea of an uncontaminated monolingual is probably a fiction. The exposure to fragments of languages other than the native language is unavoidable.

Individuals acquire languages in a variety of ways at different points of time in their life and in a variety of circumstances and contexts. Some people live in home environments where the language of the extended family reveals an ethnic, cultural, or national background that is different from that of the community. Here the adults function in two languages, and children born into these families may well learn some of that heritage language through familial interaction. In some of these situations, home bilinguals are created by the deliberate decision of parents to speak to the child in a different language, usually with one parent speaking each language. In other cases, casual knowledge the child picks up in conversation can be supplemented by extra language classes. Often, however, there is little opportunity for formal study of this language and little expectation that the child will learn much of it, apart from that needed for ordinary domestic routines. The increasing trend of bi/multilingualism is also consequent to several factors such as migration from one state to the other in search of jobs, interstate marriages between two individuals, and exposure to a school environment with two or more languages etc.

Children who encounter other languages, experience different kinds of interactions with each language, interact in different types of social situations with each, encounter different opportunities for formal study, and may also develop different kinds of attitudes towards each language. For these reasons, various configurations that lead to multilingualism leave children with different levels of competence in each of the languages.

Children who have the ability to communicate in two languages i.e., bilingual children are different from monolingual children in many ways. There is a growing body of literature on how bilingualism affects an individual's cognitive and metalinguistic performance. Cognitive and metalinguistic abilities are closely interrelated and are influenced by the input received in one or more languages from the very beginning of linguistic development. Cognition plays an important role in the development of linguistic and metalinguistic skills in an individual. It involves a wide range of mental processes such as attention, pattern recognition, memory, organization of knowledge, language, reasoning, problem solving, classification, concept and categorization (Best, 1999). These cognitive processes are interrelated with one another rather than existing in isolation.

Metalinguistic awareness is the ability to separate the individual himself from language he has learnt and to separate language from communication so that he can identify, analyze, study and think about the elements of language. This ability is acquired as the child moves from preschool to the school years and continues to develop through middle school years [(Gleason, 2005) (cited in Angell, 2010)]. This ability permits not only to produce and understand utterances in that language but, in addition, to reflect upon and evaluate those utterances. Tunmer, Pratt, and Herriman (1984) defined metalinguistic awareness as the ability to reflect upon and manipulate the structural features of spoken language, training language itself as an object of thought. It refers to knowing about and being able to talk about how language is structured and how it functions. Metalinguistic tasks also rely on the cognitive abilities of the person and hence can be considered as a metacognitive task. Metalinguistic ability is characterized by a cognitive shift in intellectual functioning when a child can begin to treat language as an object of thought. However, metalinguistic development is not considered as a simple epiphenomenon. The boundaries between using and reflecting upon language are not clearly drawn and there is controversy about the age at which children are said to be able to demonstrate awareness of language and indeed what constitutes evidence of awareness (Tunmer, Pratt, & Herriman, 1984)

It has been documented in the recent literature that bilinguals have an advantage over the monolinguals on the cognitive and metalinguistic domains, although early in the 1900's it was felt that bilingualism could suppress intellectual function and cause emotional problems (Hakuta, 1986). Several studies published have reported that bilinguals were better in cognitive linguistic tasks such as memory, concept formation, divergent thinking, problem solving, visual memory, general reasoning and verbal abilities etc. compared to monolinguals (Peal & Lambert, 1962; Liedtke & Nelson, 1968; Landry, 1973; Cummins & Gulutsan, 1974; Ben-Zeev, 1977a, 1977b; Duncan & De Avila, 1979; Samuels & Griffore, 1979; Diaz, 1982; Hakuta, 1985; Kessler & Quinn, 1987; Foster & Reeves, 1989; Bamford & Mizokawa, 1991; Stephens, Advisor, Esquivel, & Giselle, 1997; Bialystok, 1999, 2005, 2009; Kormi-Nouri, Moniri, & Nilsson, 2003; Stephen, Sindhupriya, Mathur, & Swapna, 2010; Wodniecka, Craik, Luo, & Bialystok, 2010; Bonifacci, Giombini, Bellochi, & Contento, 2011). Bilinguals have also been reported to be superior to monolinguals in executive control of attention, although they are no different from monolinguals in their knowledge of the system. The consistent pattern is that bilingual children develop the ability to control attention and ignore misleading information earlier than monolinguals, even when the two groups are operating with the same basic knowledge of the domain.

Few other researchers have also reported higher levels of metalinguistic skill in bilingual children when compared to their monolingual counterparts. Research on the effects of bilingualism on metalinguistic awareness has associated bilingualism with a higher ability to reflect on language and to manipulate it (Ianco-Worrall, 1972; Ben-Zeev, 1977a, 1977b; Cummins, 1978; Mohanty, 1982; Mohanty & Babu, 1983; Patnaik & Mohanty, 1984; Galambos & Hakutta, 1988; Galambos & Goldin-Meadow, 1990; Mohanty, 1992; Ricciardelli, 1993; Ben-Zeev, 1997; Gathercole & Montes, 1997; Bialystok, 1998, 1991, 2001, 2008; Samasthitha & Goswami, 2009).

Bilinguals are at an advantage since they already know a great deal about languages, often unconsciously, including grammatical knowledge, such as how different languages handle verb conjugation, and sociocultural knowledge, such as understanding that what is considered polite in one language may be rude in another. In addition, those who speak more than one language are also generally more aware of sociolinguistic variables and functions than those who speak one language, and they are adept at switching between different regional varieties, registers, and formal and informal language styles. This knowledge, especially when it is brought to a conscious level is a special advantage of bi/multilingualism (Cook, 1995; Jessner, 2006; Svalberg, 2007).

Further, the differences seen on these tasks between bilinguals and monolinguals could arise probably because of the differences in terms of language storage in their brain. Bilinguals learn to differentiate the two language codes that they are learning. Up to the age of two, children exposed to two languages have only one linguistic system which is same as that of the linguistic system of monolinguals. The difference is that the bilingual child's system is a mixed one which has features from both the language models. During the third year, one code gradually unfolds into two, and each language is assigned fairly rigidly to the person who speaks it or to the context in which it typically occurs. Initially the phonological and lexical aspects of the two codes are separated first followed by a separation of syntactic aspects. Finally, by the age of 3-4, bilingual children begin to decontextualize their language and realize that they speak two distinct languages. The bilinguals' advantage over monolinguals could be attributed to the fact that learning to differentiate two language codes requires extensive attention to the form of the language which is not essential when a acquiring a first and only one language.

There also have been some changes that have been documented in the brain of these individuals who have the awareness of more than one language. Individuals who speak a second language have been shown to have increased density of grey matter in the left inferior parietal cortex, a change that is more pronounced in early bilinguals and those with greater proficiency in the second language (Mechelle, Martin, & Bialystok, 2008). This region has been shown to be responsive to vocabulary acquisition in monolinguals and bilinguals as well as producing enlargements in slightly different areas depending on the two languages of the bilingual (Green, Crinion, & Price, 2007) cited in Bialystok (2008).

Although many studies have tapped the bilinguals' cognitive and metalinguistic abilities through standardized tests, the processing speed on these tasks has not been investigated exhaustively. Processing speed is one of the measures of cognitive proficiency. It involves the ability to automatically and fluently perform relatively easy or over-learned cognitive tasks, especially when high mental efficiency is required. The brain requires time and capacity to process information and plan an appropriate response. The duration of 'thinking' time is known as processing speed, and is closely associated with attention. The children's abilities in terms of the processing speed can be studied by adopting reaction time tasks. Reaction time is the time between the presentation of the stimulus and a motor response. Reaction time or brain time is very closely related to integration between the two hemispheres of the brain. Successful integration between the two hemispheres of the brain requires an efficient brain to process information more efficiently; the processing speed must be faster. Thus reaction time is considered by some researchers as a reflection of global processing speed (Cerella & Hale, 1994).

The studies pertaining to measuring processing speed in typically developing bilinguals are scanty. A few such studies have been conducted on the population with communication disorders especially in the children with learning disability (Czudner & Rourke, 1970, 1972; Dykman, Walls, & Suzuki, 1970; Spring, 1971; Hayes, Hynd, & Wisenbaker, 1986). However such studies in the bi/multilingual population are limited.

Bonifacci, Giombini, Bellocchi, and Contento (2010) aimed to evaluate whether the bilingual advantage in non-verbal skills could be best defined as domain-general or domain-specific, and, in the latter case, at identifying the basic cognitive skills involved. Bilingual and monolingual participants were divided into two different age groups (children, youths) and were tested on a battery of elementary cognitive tasks which included a choice reaction time task, a go/no-go task, two working memory tasks (numbers and symbols) and an anticipation task. Bilingual and monolingual children did not differ from each other except for the anticipation task, where bilinguals were found to be faster and more accurate than monolinguals. These findings suggest that anticipation, which has received little attention to date, is an important cognitive domain which needs to be evaluated to a greater extent both in bilingual and monolingual participants.

Further, the studies pertaining to measuring processing speed to assess the cognitive efficiency carried out on multilinguals is also scanty. A pilot study was conducted by Ring (2010) to study the cognition in multilinguals using Go/No Go task and to discover whether an online task was a suitable tool for studying reaction times. 100 individuals in three groups (monolinguals, bilinguals, and multilinguals) took part in the study. Each participant took two online reaction time tests, one of which required attentional control. Results showed a trend for multilinguals to be faster at the attentional control task, though this was not statistically significant. It was concluded that reaction times are faster for respondents who speak three or more languages and they have better attentional control than those who speak fewer languages. Bilinguals have been shown to use additional parts of the brain in responding to these tasks when compared to monolinguals (Bialystok et al., 2005). It is possible that the neural networks of bilinguals are simply more connected than that of monolinguals, acting (to make the crude analogy) as extra memory chips in a computer. Just as a computer with more memory runs faster, brains with more connections may also do so. Multilinguals may simply have more neural connections than bilinguals.

Importantly, these processing differences between monolinguals and bilinguals are not confined to non-linguistic tasks but have been found for a variety of linguistic tasks too. The recent work on metalinguistic awareness in bilinguals (Bialystok, Craik, Green, & Gollan, 2009) differentiated between two kinds of tasks, those which involve control of linguistic processing, and those calling for a more analytical approach to language. It was also found that bilingual children outperformed monolinguals in tasks involving the cognitive control of linguistic processes.

Martin, Costa, Dering, Hoshino, Wu, and Thierry (2012) found that bilingual speakers generally manifest slower word recognition than monolinguals. They investigated the consequences of the word processing speed on semantic access in bilinguals. The paradigm involved a stream of English words and pseudowords presented in succession at a constant rate. English–Welsh bilinguals and English monolinguals were asked to count the number of letters in pseudowords and actively disregard words. They were not explicitly told that pairs of words in immediate succession were embedded and could either be semantically related or not. The authors expected that slower word processing in bilinguals would result in semantic access indexed by semantic priming. As expected, bilinguals showed significant semantic priming, indexed by an N400 modulation, whilst monolinguals did not. Moreover, bilinguals were slower in performing the task. The results suggest that bilinguals cannot discriminate between pseudowords and words without accessing semantic information whereas monolinguals can dismiss English words on the basis of subsemantic information.

Need for the study

In general, a look into literature on various cognitive linguistic studies and neuroimaging studies reveals that bilinguals have advantages over monolinguals in various aspects of language (metalinguistic skills) and cognition. There are some studies which also indicate that the individuals acquiring multiple languages from early childhood have more cognitive advantages than those acquiring just two languages. Kave, Eyal, Shorek, and Cohen-Mansfield (2008) reported significantly higher maintenance of cognitive status in older age in trilinguals than in bilinguals and even greater maintenance by multilinguals. Despite enormous research done on bilingual population, not much work has been done to explore the capabilities of a multilingual persons especially in the Indian context. Multilingualism is a language related phenomenon which is extremely prevalent in the present day scenario. India is a developing, multicultural and multilingual nation and provides an appropriate platform for carrying out such studies. Census India (2001) reported that 19.44 percent are bilinguals and 7.22 percent are trilinguals. The evidence on whether multilingualism leads to even greater benefits than bilingualism is scanty.

Studies investigating the processing speed as a measure of the bi/multilingual individuals' cognitive and metalinguistic skills are limited. Further, over the decades, studies of processing speed have primarily focused on isolated linguistic or non-linguistic tasks**.** Lima, Hale, and Myerson (1991) proposed a distinction between lexical and non-lexical task (which were infact non-linguistic). The main difference between these tasks is that the linguistic tasks depend on the language knowledge while the non-linguistic tasks rely minimally on such knowledge. Such differences between linguistic and non-linguistic skill may reflect differences between particular processes. However, there are limited studies which address or compare the deficits of such children across both types of tasks especially in multilinguals. It would be interesting to examine whether the bilingual and multilingual children demonstrate similar performance across all different domains including linguistic and non-linguistic. Hence, a need was felt to provide further corroborative evidence to the existing research findings. Therefore this study was taken up incorporating both language and non language tasks.

Further, such studies would provide insight into the interaction between cognitive and linguistic mechanisms in both the groups of children. This study also would have implications in the assessment and intervention of children with communication disorders. Research on these aspects would help us to find answer to questions such as should we consider these two as two different groups while carrying out the assessment and would the interpretation vary accordingly. Keeping this in view, this study was planned.

Aim of the study

The main aim of the study was to investigate the processing speed for metalinguistic and non-linguistic cognitive tasks through reaction time and accuracy measures in bilingual and multilingual children in the age range of 9-10 years. The specific objectives of the study were

1. To compare the differences in reaction time if any, between bilingual and multilingual children with respect to metalinguistic and non-linguistic cognitive tasks.

2. To investigate the reaction time on the metalinguistic and non-linguistic cognitive tasks within each group of children.

3. To compare the differences in the accuracy of responses if any, between both the groups on metalinguistic and non-linguistic cognitive tasks.

4. To investigate the accuracy of responses on the metalinguistic and non-linguistic cognitive tasks within each group.

5. To investigate the gender differences if any, across the tasks within each group.

Chapter 2

Review of Literature

The term *bilingual*, on the surface means knowledge of two languages. If a speaker is fluent in two languages, then he or she is said to be bilingual and if a speaker is fluent in more than two languages, then he or she is said to be *multilingual.* In the current scenario, everyone is bilingual or multilingual. Monolinguals are becoming an extinct species (Degroot, 2010), that is, there could hardly be anyone in this world who does not know at least a few words in languages other than the maternal variety. Weinreich (1953) defined bilingualism as the alternate use of two languages. In the same year, Haugen suggested that bilingualism began with the ability to produce complete meaningful utterances in the second language. However, the question of how to define bilingualism or multilingualism has engaged researchers for a very long time. More recently, however, researchers who study bilingual and multilingual communities around the world have argued for a broad definition that views bilingualism as a common human condition that makes it possible for an individual to function, at some level, in more than one language. The key to this very broad and inclusive definition of bilingualism is 'more than one'. Multilingualism refers exclusively to the presence of several languages in a given space, independently of those who use them: for example, the fact that two languages are present in the same geographical area does not indicate whether inhabitants know both languages, or only one (Council of Europe: 2007a:17). There are individuals who use more than two languages in their day to day life and they are called as multilinguals.

Bi/multilingualism is not a static and unitary phenomenon. It is shaped in different ways, and it changes depending on a variety of historical, cultural, political, economic, environmental, linguistic, psychological and other factors. Children who encounter other languages, experience different kinds of interactions with each language, interact in different types of social situations with each, encounter different opportunities for formal study, and may also develop different kinds of attitudes towards each language. For these reasons, various configurations that lead to multilingualism leave children with different levels of competence in each of the languages.

It is a historically common view that one’s personality grows with the extra languages- particularly among those who are already bilingual and, more particularly still, among the social elite for whom an additional language or two was always an integral part of life. Apart from the influence on personality, the knowledge of extra languages also affect other domains such as cognition, linguistic and metalinguistic skill. There is a growing body of literature on how bilingualism affects an individual's cognition, linguistic and metalinguistic performance. Since the beginning of the century, a number of studies have compared the performance of bilinguals and monolinguals on variety of tasks measuring intelligence, creativity, flexibility, reasoning, problem solving, memory and metalinguistic skills.

Cognition

Humans and other animals can do more than reflexively react to sensory information that is immediate and salient. We engage in complex and extended behaviors geared towards often far-removed goals. To do so, we have evolved mechanisms that can override or augment reflexive and habitual reactions in order to orchestrate behavior in accord with our intentions. These mechanisms are commonly referred to as 'cognitive' in nature and their function is to control lower level sensory, memory and/or motor operations for a common purpose. So cognitive control is essential for what we recognize as intelligent behavior (Miller, 2000). In science, cognition refers to mental processes. These processes include attention, memory, producing and understanding language, solving problems, and making decisions.

To flexibly allot mental resources to mentor thoughts and actions in light of internal goals is referred to as cognitive control (Solomon, Ozonoff, Cummings, & Carter, 2008). There are the two basic functions of cognitive control. The first one being they help in inhibiting a response by blocking inappropriate but prevalent response tendencies. For e.g., a bilingual (English/Hindi) speaking individual in English says /billi/ for cat, then he did not inhibit the word 'billi' though it was a dominant response, however was inappropriate in this context. Therefore it involves processing of task-relevant information over competing information. Cognitive control also helps in filtering out irrelevant information from the environment which is also referred to as inference suppression.

Development of cognitive abilities

As children develop their understanding of the world, they begin to discover that other people have mental lives, and that these other minds are important to understanding their environment. Even before they can speak, children appear to show an interest in the mental lives of others: they follow eye gaze, sharing attention with their caregivers; they attract attention with gestures; and they appear able to distinguish intentional from accidental actions (Carpenter, Nagell, & Tomasello, 1998; Johnson, 2000; Brooks & Meltzoff, 2002). These abilities are found to varying degrees in our closest primate relatives (Call, Hare, Carpenter, & Tomasello, 2004; Tomasello & Call, 2008). What seems special about humans, however, is that as adults we are able to explicitly reason about abstract mental states, understanding both that people have beliefs about the world and that these beliefs can be false.

Several studies have examined the development of cognitive and/or executive control in typically developing children and young adults. In typical development, more strategic and complex aspects of cognitive control continue to develop well into adolescence. For example, task switching associated with inhibition (Davidson, Amso, Anderson, & Diamond, 2006) and distraction related error rates (Ridderinkhof, Ullsperger, Crone, & Nieuwenhuis, 2004) may not stretch to adult levels until late adolescence or early adulthood.

The cognitive and neural bases of conflict processing in adults have been studied in detail in the Stroop task (e.g., Botvinick, Braver, Carter, Barch, & Cohen, 2001; Yeung, Botvinic, & Cohen, 2004). Processing is modeled as a functional circuit that involves both the anterior cingulate cortex (ACC) and areas of the prefrontal cortex (PFC). The goal—naming ink color— is processed in the lateral prefrontal cortex (LPFC; Cohen & Servan-Schreiber, 1992; Miller & Cohen, 2001) along with information about context. While the color word activates a semantic (reading) response, activation of the conflicting ink color is computed as a function of the goal. The ACC is then responsible for detecting the conflict between these two responses (Botvinick, Braver, Barch, Carter, & Cohen, 2001; Yeung, Botvinick, & Cohen, 2004; Liston, Mathalon, Hare, Davidson, & Casey, 2006). It signals that conflict has been detected in the LPFC and other circuits, causing them to slow responding and direct attention to the source of the conflict and the goal. This slower, more attentive processing increases the likelihood of the correct response being produced. The Dimensional Change Card Sort (DCCS) makes similar response-conflict demands to the Stroop task without requiring reading (Kirkham, Cruess, & Diamond, 2003; Diamond, Carlson, & Beck, 2005; Zelazo, 2006; Moriguchi & Hiraki, 2009). In the DCCS, children are presented with two target cards and a set of test cards that can be sorted according to two dimensions. For example, the two target cards may be a blue boat and a red flower, and the test cards a red boat and a blue flower. Children are asked to sort according to one dimension (e.g. shape) and after a few trials are then asked to sort according to the other dimension (e.g. color), requiring them to switch their responses to an alternative stimulus dimension. Children around three years of age fail to successfully sort the cards by the second dimension and perseverate on the first, continuing to sort by the initial dimension even if they understand that the task has changed. It is not until around the age of four that, children reliably make the switch and sort the cards using the conflicting dimension correctly (Kirkham, Cruess, & Diamond, 2003).

Bunge, Dudovic, Thomason, Vaidya, and Gabrieli, (2002) conducted a study where event-related fMRI was employed to characterize differences in brain activation between children ages 8–12 and adults related to two forms of cognitive control: interference suppression and response inhibition. It was found that children were more susceptible to interference and were less able to inhibit inappropriate responses than were adults. Effective interference suppression in children was associated with prefrontal activation in the opposite hemisphere relative to adults. In contrast, effective response inhibition in children was associated with activation of posterior, but not prefrontal, regions activated by adults. Children failed to activate a region in right ventrolateral prefrontal cortex that was recruited for both types of cognitive control by adults. Thus, children exhibited immature prefrontal activation that varied according to the type of cognitive control required.

Bilingualism and cognition

The relationship between bilingualism and its effects on childrens' cognitive development has been the centre of long running and often emotional debate by educationalists, psychologists, sociologists and bilingual communities alike. There is a growing body of literature on how bilingualism affects an individual's cognitive performance. Research on the effects of bilingualism on cognition goes at least as far as the early 1900's. Since the beginning of the century, a number of studies have compared the performance of bilinguals and monolinguals on variety of tasks measuring intelligence, creativity, flexibility and other skills. With regard to the advantages and disadvantages of bilingualism or multilingualism, different views have been expressed by researchers in the field.

Until the early 1960's bilingualism was widely believed to have detrimental effects on children's cognitive development. In the early 1900's, there were claims that teaching a child a second language could suppress intellectual function and cause emotional problems (Hakuta, 1986). The typical view of a bilingual child prior to 1960's was that bilingualism was a disease and that it was a mental burden causing intellectual fatigue. Jensen (1962a, b) reviewed over 200 studies and found evidence of negative intellectual and academic consequences of bilingualism. Other reviews up to 1960 have also showed negative consequences of bilingualism on development of intelligence, cognition and personality. In a review of research on bilingualism and possible links to personality problems, Diebold (1968) concluded that bilingualism could cause schizophrenia in the most severe cases and lesser adjustment problems in many cases.

A few other studies also suggested that bilingualism was associated with negative consequences (for e.g., Printer & Keller, 1922; Saer, 1923; Anastasi & Cordova, 1953; Darcy, 1953). These studies supported the idea that bilingual children suffered from academic retardation, had a lower IQ and were socially maladjusted as compared with monolingual children. Reduced vocabulary has also been found to be an accompaniment of bilingualism, whether the bilinguals show quite high levels of language processing (Ben-Zeev, 1972; Rosenblum & Pinker, 1983) or lower levels (Ben-Zeev, 1975). Other research suggested that bilingual children, because they appeared to have limited linguistic abilities, were retarded in verbal intelligence, if not in overall intelligence. Tsushima and Hogan (1975) found the performance of Japanese-English bilinguals in grades four and five in verbal and academic skills lower compared to their monolingual counterparts matched on nonverbal ability. The findings of the early studies also showed that bilingualism can adversely affect, to different degrees, cognitive skills particularly in the areas of verbal intelligence and scholastic achievement.

On the other hand, a few studies found no differences between monolingual and bilingual groups in cognitive-linguistic abilities (Rosenblum & Pinker, 1983). Toukomma and Skutnabb-Kangas (1977) found that children with native competency in one language only, normally their mother tongue but with a much less command of the other language, showed neither positive nor negative cognitive effects i.e. their performance did not differ from that of monolingual children.

It is a well known fact that factors such as socioeconomic class and dominant versus nondominant language, proficiency level of each language, the context in which the language was learned are critically important variables in research that compares such groups of children. In many of these studies mentioned above, some of these factors were not controlled which could have probably contributed to the poor performance of bilingual subjects (Paradis, 1986; Grosjean, 1998). The bilingual subjects were children from low socioeconomic background than the monolingual children with whom they were being compared i.e. the variable socioeconomic status was not controlled. In addition, the bilingual children were often tested in their nondominant language, giving the impression that their language skills and their cognitive skills were lower than they actually were. Another possible reason for the poor performance of the bilinguals was their fluency in each language, the context in each which the language was learned etc. was not assessed. Most of the time, little was said about children's proficiency in each of their languages and the amount of time the parents/caregivers/teachers spent using the languages with the children (Redlinger & Park, 1980; Vihman, 1985).

There are evidences which support the fact that the benefits of bilingualism accrues to an individual only beyond a certain level of proficiency in both languages, i.e. there is a threshold level of bilingual proficiency beyond which the positive consequences of bilingualism on cognitive growth are available to the individual. The threshold hypothesis was developed by Cummins (1976, 1979, 1981, and 1984) and Toukomaa and Skutnabb-Kangas (1977) to explain this aspect. The threshold hypothesis assumes that those aspects of bilingualism that might positively influence cognitive growth are unlikely to come into effect until children have attained a certain minimum or threshold level of proficiency in the second language. The hypothesis proposes two thresholds; 'the lower threshold level of bilingual proficiency would be sufficient to avoid any negative effect, but the attainment of a second, higher level of bilingual proficiency might be necessary to lead to accelerated cognitive growth. In support of the threshold hypothesis, studies showed that proficient bilinguals performed better on a variety of cognitive tasks compared to partial and limited bilinguals. The threshold hypothesis showed that a set of socio-cultural and educational conditions gives rise to different forms of bilingualism which in turn lead to different levels of cognitive performance.

Subsequently, in the late 1900's, there were ample studies that supported the view that speaking two languages does not tax either the cognitive or the linguistic system; rather bilingualism confers advantages upon children with respect to various cognitive and linguistic abilities. A major turning point in the area of bilingualism came in the early 1960's, when findings showed a positive relationship between intelligence and bilingualism. The result obtained by Peal and Lambert (1962) was a landmark in bilingualism research and the study suggested that there were no detrimental effects of bilingualism and there may even be some cognitive advantages. In their study, 10 year old French-Canadian balanced bilinguals were compared with their English or French counterparts. All the subjects were matched for age, socioeconomic level and gender. The subjects were tested on measures of nonverbal and verbal intelligence. Besides using intelligence measures, which were standardized in each of the two languages, the study also included measures of attitude towards each linguistic community. The results revealed that on both the intelligence measures, the bilingual group performed better than the monolingual group. The bilinguals were also rated better than the monolinguals in general school achievement. They concluded that bilingualism provides greater mental flexibility: the ability to think more abstractly, more independently of words, providing superiority in concept formation; that a more enriched bilingual and bicultural environment benefits the development of IQ, and there is a positive transfer between bilinguals' two languages, facilitating the development of verbal IQ. Their research broke a new territory in the area of bilingualism and provided a stimulus for future research.

Peal and Lambert's study set a pattern for future research mainly in various aspects. First, it overcame many of the methodological deficiencies of the period of detrimental effects. Second, it found evidence that bilingualism need not have any detrimental or even neutral consequences. Rather, there is the possibility that bilingualism leads to cognitive advantages over monolingualism. Third, their research moved towards a broader look at cognition (e.g., thinking styles and strategies).

In addition, Peal and Lambert's study had a major impact on at least two aspects of childhood bilingualism. First it sparked a new interest in the study of childhood bilingualism among psychologists and educators. Second it provided one of the major justifications for the establishment of bilingual education programs during the late 1960's and early 1970's. The number of studies dealing with childhood bilingualism increased dramatically throughout the rest of 1960's and 1970's. Most of this research concentrated on cognitive development.

Following Peal and Lambert's study many other studies appeared which supported a positive linkage between bilingualism and intelligence. Subsequent research has supported this notion. Ricciardelli (1992), for example, found that few tests in a large battery of cognitive and metalinguistic measures were solved better by bilinguals, but those that were included tests of creativity and flexible thought. Carefully controlled studies suggested that bilingualism does not adversely affect cognitive development but, in fact, strengthens it. Bilingual children performed better than monolingual children on a number of cognitive tasks, including selective attention, forming concepts, and reasoning analytically. In addition, children who spoke two or more languages were more cognitively agile or flexible than children who spoke just one language (Hakuta, Ferdman, & Diaz, 1989; Bialystok, 1999).

Liedtke and Nelson (1968) studied two samples of Grade 1 pupils, 50 monolinguals and 50 bilinguals. They were tested on a specially constructed Concepts of

Linear Measurement Test based on Piaget's test items. The bilingual sample proved to be significantly superior to the monolingual sample on the concept formation test.

Landry (1973) studied the flexibility in thinking through experience with a foreign language. Comparisons were made between second language learners and single language learners. The second language learners scored significantly higher than the monolingual students. Second language learning appeared, therefore, not only to provide children with the ability to depart from the traditional approaches to a problem, but also to supply them with possible rich resources for new and different ideas.

Cummins and Gulutsan (1974) replicated the study of Peal and Lambert (1962) in Western Canada in which balanced bilingual group matched with a monolingual control group on socioeconomic status, gender and age performed better than the controls on verbal and nonverbal ability measures and on verbal originality measure of divergent thinking.

Barik and Swain (1976) presented findings of a study of IQ data collected over a 5-yr period (kindergarten to Grade 4) on pupils in a French immersion program (anglophone pupils receiving all instruction in French except English language arts) and pupils in the regular English program. Although year-by-year results failed to show IQ differences between the two groups, repeated measures analysis indicated that the immersion group had a higher IQ measure over the 5-yr period. Further analysis on the data of immersion students classified as "high" vs. "low" French achievers showed that the high achievers obtained significantly higher IQ measures and subtest scores than low achievers, even when scores were adjusted for initial IQ and age differences.

Ben-Zeev (1977a) compared two groups of 5-8 year old middle class Hebrew-English bilinguals, Hebrew monolinguals and English monolinguals respectively on the IQ subtests of Wechsler Intelligence scale for Children (WISC) such as similarities, digit span, picture completion and picture arrangement tasks. In spite of lower vocabulary level, bilinguals showed more advanced processing of verbal material, more discriminating perceptual distinctions, more propensities to search for structure in perceptual situations, and more capacity to reorganize their perceptions in response to feedback. She concluded that exposure to two languages causes children to develop a mental facility for seeking out the rules and for determining which are required by the circumstances.

Ben-Zeev (1977b) tested whether similar strategies and response patterns found in the previous study will appear when the children involved are from different language groups and from relatively disadvantaged inner-city neighborhoods. The results showed that Spanish-English bilingual children manifested similar strategies to those found in the previous study (distinctive perceptual strategies and more advanced processing in certain verbal tasks), although with some attenuation. The strategies apply to nonverbal as well as verbal material. These results appeared in spite of deficiencies in vocabulary and syntax usage for the Spanish-English bilinguals relative to their control group of similar ethnic and social background.

Duncan and De Avila Edward (1979) tested Hispanic children in grades 1 and 3 to examine the relationship between degree of bilingualism in English and Spanish, intellectual development level, and performance on two tests of cognitive-perceptual functioning or field dependence /independence. A positive, significant relationship was found between relative language proficiency and cognitive perceptual performance.

Samuels and Griffore (1979) examined the effects of a year's attendance in a French Language Immersion Program (FLIP) on children's verbal and performance sections of the Wechsler Intelligence Scale for Children (WISC) and self-esteem, measured by the Purdue Self Concept Scale (PSCS). Eighteen 6-year-olds attended the program, while 13 6-year-olds constituted a control group which attended a regular English program. Analyses of data showed that differences between the FLIP & English control groups at the end of the school year were not significant for Verbal IQ or PSCS. Significant differences were found between groups on overall Performance IQ, picture arrangement, and object assembly. The increments in Performance IQ in the FLIP group were consistent with previously reported data suggesting that bilinguals have greater cognitive flexibility than monolinguals.

Diaz (1982) investigated the development of verbal and spatial abilities over time within a group of Spanish (L1)-English (L2) bilingual children attending kindergarten and first-grade bilingual education programs. The study was designed in response to methodological gaps in current research on bilinguals' cognitive development; in particular, the study examined the cognitive effects of bilingualism on children who were just beginning to learn a second language and proposed a measure of degree of bilingualism that effectively controls for basic ability in the dominant language. The results firmly supported the claim that bilingualism fosters the development of verbal and spatial abilities. The relationship between degree of bilingualism and cognitive abilities was particularly strong for children of low second-language proficiency.

Hakuta (1985) investigated to see if intellectual abilities are related to the student's degree of bilingualism. He found a positive relation between bilingualism and various abilities, such as the ability to think abstractly about language and to think nonverbally. Kessler and Quinn (1987) reported that bilingual children outperformed the monolinguals in the ability to form scientific hypothesis in a problem solving setting and on semantic and syntactic measures. This was perceived as an indication of enhanced linguistic and cognitive creativity related to their bilingual proficiency.

Foster and Reeves (1989) studies the effects of an elementary school foreign language program on basic skills by looking at the relationship between months of elementary foreign language instruction in French and scores on instruments designed to measure cognitive and metacognitive processes. The study included 67 sixth-grade students who were divided into four groups that differed by lengths of time in the foreign language program. There was a control group of 25 students who had no French instruction and three groups of students who had participated in the program for different lengths of time (6.5 months, 15.5 months, and 24.5 months). The students who did receive foreign language instruction had received 30 minutes of French instruction daily after 30 minutes of basal reading in English. The control group received an additional 30 minutes of reading instruction in place of foreign language instruction. The results of the analysis showed that the groups who received foreign language instruction scored significantly higher in three areas (evaluation on the Ross test, total score of all cognitive functions on Ross test, and total score on Butterfly and Moths test) than the control group. In particular, the students who had received foreign language instruction scored higher on tasks involving evaluation which is the highest cognitive skill according to Bloom's taxonomy. The linear trend analysis showed that the students who had studied French the longest performed the best.

Bamford and Mizokawa (1991) examined the second grade additive-bilingual (Spanish-immersion) classroom, compared to a monolingual classroom for nonverbal problem-solving and native-language development, found significant differences in problem solving in favor of the bilingual class and no significant differences in native-language development.

Rodriguez (1992) investigated the effects of bilingualism on the cognitive development and linguistic performance of children at various ages living in the same cultural environment. It also studied the relationship between formal operational thought and a prerequisite cognitive style as typified by field independence/field dependence for both bilingual and monolingual subjects. The bilingual subjects were tested for both language dominance and language proficiency. To investigate the interrelationships between bilingualism and cognitive function, it was necessary to include both verbal and non-verbal tests of cognition. No significant differences in performance could be attributed to bilingualism, grade, or age with the exception of language proficiency correlated with cognitive level on analytical reasoning. The children's overall cognitive level indicated some justification for the theoretical relationship between verbal and non-verbal measures of abstract thinking. The bilingual children used higher order rules more frequently than the monolingual children. The evidence seems to suggest that bilingualism may scaffold concept formation and general mental flexibility.

Fardeau (1993) investigated the relationship between bilingualism in children and cognitive development. French-Italian bilingual children (aged 7-11) were categorized into four groups: (1) equally fluent in both languages, acquired at home; (2) equally fluent in both languages, acquired scholastically; (3) dominant in French; & (4) dominant in Italian. A control group of monolingual Italian children was included. A series of cognitive tests was administered to the students and to the control group. It was concluded that bilingualism in early childhood exerts a positive effect on the formation of cognitive processes in children.

Ricciardelli (1993) studied the cognitive development of Italian-English bilingual & Italian monolingual children (aged 5-6) based on measures of metalinguistic awareness, creativity, nonverbal abilities, and reading achievement. Following proficiency testing in both languages, students were assigned to groups of high and low Italian proficiency & high & low English proficiency, producing six groups for comparison. Results of comparison of performance on the measures of cognitive development indicated that students who demonstrated high proficiency in both English & Italian achieved higher scores on the creativity, metalinguistic awareness, and reading achievement tests.

Stephens, Advisor, Esquivel, and Giselle (1997) investigated the effects of bilingualism on the creativity and social problem-solving skills on a group of Spanish-English bilinguals and Spanish monolinguals. The Torrance Test of Creative Thinking was administered as a measure of creativity, and the Preschool Interpersonal Problem Solving Scale was used to measure social problem-solving abilities. The results indicated that the bilingual children outperformed their monolingual counterparts in the area of social problem solving, but not in the area of creativity.

Bialystok (1999) assessed the cognitive complexity and attentional control in 60 bilingual preschool children. In order to assess cognitive complexity and control, the dimensional change card sort task and the moving word task was administered on a group of bilingual and monolingual children. The results revealed that the bilingual children were more advanced than the monolinguals in the solving of experimental problems requiring high levels of control. Bialystok (2001) found that bilingual children were superior to monolingual children in terms of cognitive control of linguistic process.

Kormi-Nouri, Moniri, and Nilsson (2003) assessed the episodic and semantic memory in a group of 60 bilingual and 60 monolingual children. Episodic memory was assessed using the subject-performed tasks (with real or imaginary objects) and verbal tasks, with retrieval by both free recall and cued recall. Semantic memory was assessed by word fluency tests. The positive effect of bilingualism was found on both episodic memory and semantic memory. It was suggested that bilingual children could integrate and/or organize the information of two languages and so bilingualism creates advantages in terms of cognitive abilities (including memory). Bilingualism extended the individuals' capabilities and promotes mental processing (problem solving, thinking, flexibility and creativity) (Kormi-Nouri, Moniri, & Nilsson, 2003).

Colom, Contreras, Arend, Garcia Leal, and Santacreu (2004) investigated differences in two computerized tests, one thought to reflect verbal reasoning and one thought to reflect dynamic spatial performance. The sample comprised 1,593 university graduates (794 females and 799 males). The verbal reasoning was based on linear syllogisms or three-term series (John is better than Peter: Peter is better than Paul: Who is worse?) is accurately predicted from a model of human information processing based on the mental transformation of the verbal information into a mental spatial diagram or a mental model. Results showed that males outperform females in both tests. The results indicated male advantage in overall spatial processing for their better performance in verbal reasoning tests. However, gender differences in verbal reasoning turn to be nonsignificant when sex differences in dynamic spatial performance are statistically removed.

Bialystok (2005) investigated the effect that bilingualism might have on specific cognitive processes rather than domains of skill development. Three cognitive domains were examined: concepts of quantity, task switching and concept formation, and theory of mind. The common finding in these disparate domains was that bilingual children were more advanced than monolinguals in solving problems requiring the inhibition of misleading information. She concluded that bilingualism accelerates the development of a general cognitive function concerned with attention and inhibition, and that facilitating effects of bilingualism were found on tasks and processes in which this function was most required.

Levin (2005) investigated both behavioral and neural sex differences in sex-specific spatial abilities. In Experiment 1, sixty-six (30 males, 36 females) participants completed computerized mental rotation (MR) and spatial working memory (SWM) tasks. In Experiment 2, twelve (6 males, 6 females) participants were given slightly modified versions of the same tasks during functional magnetic resonance imaging (fMRI). In both experiments, males outperformed females on the MR task, but no behavioral sex difference was observed on the SWM task.

Bell, Willson, Wilman, Dave, and Silverstone (2006) conducted a study to examine the effect of gender on regional brain activity, utilizing functional magnetic resonance imaging (fMRI) during a motor task and three cognitive tasks; a word generation task, a spatial attention task, and a working memory task in healthy male (n = 23) and female (n = 10) volunteers. Males had a significantly greater mean activation than females in the working memory task with a greater number of pixels being activated in the right superior parietal gyrus and right inferior occipital gyrus, and a greater BOLD magnitude occurring in the left inferior parietal lobe. However, despite these fMRI changes, there were no significant differences between males and females on cognitive performance of the task. In contrast, in the spatial attention task, men performed better at this task than women, but there were no significant functional differences between the two groups. In the word generation task, there were no external measures of performance, but in the functional measurements, males had a significantly greater mean activation than females, where males had a significantly greater BOLD signal magnitude in the left and right dorsolateral prefrontal cortex, the right inferior parietal lobe, and the cingulate. In neither of the motor tasks (right or left hand) did males and females perform differently.

Shabani and Sarem (2008) investigated the learning strategy use of monolinguals and bilinguals in approaching English as a foreign language. It was also an attempt to compare the strategy use of male and female bilinguals. For this purpose, 30 Persian-speaking monolinguals (15 males and 15 females) and 30 Kurdish-Persian speaking bilinguals (15 males and 15 females) were selected from among Iranian EFL learners studying English Literature at Ilam State and Azad universities. They were asked to fill out Oxford's (1980, 1990) the Strategy Inventory for Language Learning (SILL). 50-item version of SILL, used in this study, comprised of six parts: memory strategies (9 items), cognitive strategies (14 items), compensation strategies (6 items), metacognitive strategies (9 items), affective strategies (6 items), social strategies (6 items). The authors concluded that there was a significant difference between the strategy use of male and female Kurdish-Persian speaking bilinguals in favor of the male learners. Also, male bilinguals have used more memory, cognitive, and metacognitive strategies compared to the female bilinguals. But there was no significant difference between male and female bilinguals with regard to the compensation, affective and social strategy use.

Bialystok (2009) investigated whether bilingual children showed an advantage in working memory. A group of seven year old monolinguals and bilinguals were compared on tasks such as sequencing span test, frog matrix task to assess temporal memory, faces and pictures task, and digit span tasks. In all the tasks, the bilinguals outperformed their monolingual peers which indicated bilingual children enjoy more advanced levels of working memory.

Bialystok and Viswanathan (2009) investigated three components of executive control: response suppression, inhibitory control, and cognitive flexibility. They used a behavioral version of an anti-saccade task, called the ‘faces task’ which was used to isolate the components of executive functioning responsible for previously reported differences between monolingual and bilingual children and to determine the generality of these differences by comparing bilinguals in two cultures. Ninety children, 8-years old, belonged to one of three groups: monolinguals in Canada, bilinguals in Canada, and bilinguals in India. The bilingual children in both settings were faster than monolinguals in conditions based on inhibitory control and cognitive flexibility but there was no significant difference between groups in response suppression or on a control condition that did not involve executive control. The children in the two bilingual groups performed equivalently to each other and differently from the monolinguals on all measures in which there were group differences, consistent with the interpretation that bilingualism is responsible for the enhanced executive control. These results contribute to understanding the mechanism responsible for the reported bilingual advantages by identifying the processes that are modified by bilingualism and establishing the generality of these findings across bilingual experiences.

Wodniecka, Craik, Luo, and Bialystok (2010) reported the effect of bilingualism on memory performance. Following previous reports of a bilingual advantage in executive control that sometimes shows a greater advantage in older adults, they compared younger and older monolinguals and bilinguals on a memory paradigm that yielded separate measures of familiarity and recollection. There were no consistent effects in familiarity, but there were age and language differences in recollection, a measure reflecting executive control. Younger adults were superior to older adults on this measure, but there was minimal support for a bilingual advantage in the younger group.

Older bilingual adults did show such an advantage, especially on non-verbal tasks. The results provide some initial evidence for the interrelations among processing abilities, types of material, bilingualism, and aging in assessments of memory performance. Similar findings have also been reported by Bialystok and her colleagues. They have shown that early bilingualism and constant daily use of two or more languages leads to precocious development of certain cognitive processes for children, advantages that persist across the lifespan (Bialystok, Craik, Klein & Viswanathan, 2004; Bialystok, Craik & Ryan, 2006) (cited in Bialystok, 2001).

In a study using a behavioral version of an anti-saccade task, blocks with mixed congruent and incongruent trials were performed more rapidly by bilinguals than monolinguals with faster bilingual reaction times on both types of trials, but blocks with single trial types produced different results. In that case, monolinguals and bilinguals performed the same on blocks of congruent trials but bilinguals were faster than monolinguals on blocks of incongruent blocks (Bialystok et al., 2006). In young adults, reaction time differences are not always evident in comparing performance across the two language groups (Bialystok, 2006). In a study using magneto-encephalography (MEG) with young adults performing the Simon task, monolingual and bilingual participants did not differ in the speed of response but employed different frontal regions (Bialystok et al., 2005). Specifically, the activation for the bilinguals included regions overlapping with Broca's area while those for monolinguals did not. Again, the differences between monolinguals and bilinguals were found equally for congruent and incongruent trials of the Simon task. Together, these studies show that the Simon task is performed differently by monolinguals and bilinguals, with more efficient performance by the bilinguals.

Recent research with adults has shown that early exposure to two languages may facilitate the acquisition of novel words (Kaushanskaya & Marian, 2009). The existence of this bilingual advantage has not been examined in bilinguals with less proficiency. In a paper presented at International Conference on Bilingualism and Comparative Linguistics, Nair, Mathew, Bhat, and Demuth, (2012) report the findings of a novel word learning task comparing monolinguals with a group of low and high proficient Tamil - English bilinguals who differed in their language learning histories and exposure to a second language. Sixty Tamil monolinguals and Tamil - English bilinguals in the age range of 18 - 25 were selected as participants. Linguistic proficiency was examined by using a language proficiency rating scale. Since word learning has found to be correlated with phonological working memory (Gupta, 2003), a set of non-word repetition tasks was also administered to all participants. This was followed by a novel word learning task. The novel words were real words in Hindi, a language which participants were unfamiliar with. Ten novel words were presented via head phones as the visual referents were shown simultaneously on a computer monitor. Participants were asked to repeat each novel word aloud three times. Participants were then tested immediately for their retention of these novel words by using identification and a naming task. The results showed a significant difference in identification and naming of the novel words, with high proficient bilinguals outperforming the less proficient bilinguals. However, the less proficient bilinguals also outperformed monolinguals in both the identification and naming tasks, suggesting a bilingual advantage even with limited proficiency. Interestingly, performance on the non-word repetition task did not differ for monolinguals or bilinguals, failing to establish a direct link between phonological working memory and word learning ability. This suggests that bilinguals with different language histories respond differently to novel word learning; even limited exposure to a second language can contribute some amount of word learning advantage.

Few studies have been carried out in the Indian context. Stephen, Sindhupriya, Mathur and Swapna (2010) compared the cognitive linguistic performance in twelve bilingual and twelve monolingual children in the age group of 7-8 years. These two groups of children were tested on three domains such as attention/discrimination, memory and problem solving using the Cognitive Linguistic Assessment Protocol for children (CLAP-C) developed by Anuroopa and Shyamala (2008). The results revealed that bilingual children performed superior to the monolingual children on all the three cognitive linguistic domains.

In summary, the research evidence suggests that bilingual acquisition involves a process that builds on an underlying base for both languages. There does not appear to be a competition over mental processes by the two languages leading to confusion or poor performance on various domains and there are possible cognitive advantages to bilingualism. It is evident that the duality of the languages per se does not hamper the overall language proficiency or cognitive development of bilingual children. Bilinguals can extend the range of meanings, associations and images, and think more fluently, flexibly, elaborately and creatively. Studies also showed that the bilinguals exhibit better memory, divergent thinking, and problem solving. These studies provide evidence that the experience of controlling attention to two languages boosts the development of executive control processes in childhood for bilinguals, sustains cognitive control advantages for bilinguals through adulthood and protects bilingual older adults from the decline of these processes with ageing. Learning of two languages affects cognition because of the characteristics of the language involved, age at which the languages are acquired, the context in which the language was acquired, and how the languages code a given aspect of the world.

Bilinguals, in other words, are superior to monolinguals in executive control of attention, although they are no different from monolinguals in their knowledge of the system. The consistent pattern is that bilingual children develop the ability to control attention and ignore misleading information earlier than monolinguals, even when the two groups are operating with the same basic knowledge of the domain. This dissociation is the basis for the claim that bilingualism has a specific impact on the development of executive processing but no effect on basic cognitive performance (Bialystok & Feng, 2009).

Metalinguistic awareness

Hulit and Howard in 2002 described metalinguistic awareness as the individual's ability to use language to analyze study and understand language. The construct describes the ability to make language forms objective and explicit and to attend to them in and for themselves. The individual with well developed metalinguistic skills is able to view and analyze language as a "thing," language as a "process," and language as a "system." These skills allow an individual to think about the elements of language used by themselves and others and evaluate the utterances as correct or incorrect. It is also termed metalinguistic ability.

The difference between linguistic and metalinguistic knowledge may be in the level of generality at which rules are represented. If the rules are the record of the structure of a particular language, such as how to form past tense, what word order is needed for different sentence types, how relative clauses are constructed, then they essentially are the grammar. Although such knowledge of grammar may be part of metalinguistic knowledge, it is insufficient to justify a concept at the level of theoretical importance occupied by metalinguistic. Hence metalinguistic knowledge minimally needs to include the abstract structure of language that organizes sets of linguistic rules without being directly instantiated in any of them. This would include insights such as canonical word order and productive morphological patterns. Knowledge of these abstract principles is distinct from knowledge of a particular language and supports a separate concept to describe it.

The implication of this condition is that the content of metalinguistic must be broader than any that applies to knowledge of a particular language. When one has metalinguistic knowledge, one has knowledge of language in its most general sense, irrespective of the details of a specific linguistic structure. If there are *cognitive benefits* from acquiring metalinguistic knowledge, they accrue because it is abstract knowledge and not particular language. On this view, metalinguistic knowledge is the explicit representation of abstract aspects of linguistic structure that become accessible through knowledge of a particular language.

Any linguistic skill is a candidate for a metalinguistic counterpart in development. Therefore, metalinguistic abilities (or tasks) are sometimes classified according to the aspect of linguistic skill from which they derive, creating subcategories of metalinguistic proficiency in syntax, word awareness, and phonology. Tunmer and Bowey (1984) identified four levels of metalinguistic awareness: word awareness (metalexical/metasemantic), sound awareness (metaphonological), form awareness (metasyntactic) and pragmatic (metapragmatic) awareness. They hypothesized that these levels play a vital role at different stages of reading acquisition.

Metaphonological awareness: Metaphonological ability refers to the individual's explicit awareness and the ability to process and manipulate the speech sound segments of words. Phonological awareness usually refers to the ability to conceive spoken words as sequences of smaller units of sound segments (syllables, onsets, rimes, or phonemes) (Liberman, Shankweiler, Liberman, Fowler, & Fischer, 1977; Goswami, 1999). It is a kind of metalinguistic ability that requires the explicit knowledge of the phonological structure of speech, as opposed to normal conversation that is interpreted and produced largely automatically (Tunmer, Herriman, & Nesdale, 1988). This requires non lexical processing which has to look beyond the meaning of the word to focus on the sound structure of the word. Metaphonological awareness includes awareness of phonological strings (awareness of phonological length, sound similarity etc), awareness of syllables, awareness of phonemes and awareness of phonetic features (Morais, Alegria, & Content, 1987). Awareness of rhyme and breaking words into syllables are two of the early metaphonological skills to emerge. There are several factors affecting the development of these skills in children. Linguistic aspects such as syntax, semantics, learning to read does play key role in the development of metaphonological skills. Goswami and Bryant (1990) studied the development of phonological awareness skills in English language. The results revealed that the preschoolers demonstrated good phonological awareness of syllables, onsets, and rimes in most languages. Syllable awareness was usually present by about age 3 to 4, and onset–rime awareness was usually present by about age 4 to 5 years. Phoneme awareness only develops once children are taught to read and write, irrespective of the age at which reading and writing is taught.

The studies on investigation of metaphonological/phonological awareness have utilized tasks such as syllable stripping, word-pseudo word and non-word reading, phoneme/syllable deletion, isolation, segmentation, matching, blending, completion, counting, odd word out (rhyming vs. non rhyming word pairs), spoken rhyme recognition and production.

Metalexical/metasemantic awareness: Metasemantic awareness is the ability to abstract and play with words. Word awareness is the understanding of a word as a constituent part of speech. Metasemantics is the ability to analyze words, to look at and recognize synonyms, antonyms, homonyms, and multiple definitions. It also includes the ability to segment sentences and phrases into words, separation of words from their referent, ability to substitute words (Tunmer & Cole, 1985). Two related insights are required for children to fully appreciate the abstract level of linguistic structure designated by words. The first is awareness of a segmentational process that isolates words as significant units. Tasks assessing this aspect of word awareness typically ask children to count the number of words in a sentence or define what a word is to demonstrate knowledge of appropriate boundaries. The second is awareness of how words function to carry their meaning. This aspect, sometimes called lexical or referential arbitrariness, indicates the extent to which children understand the conventional relation by which words convey designated meanings. The tasks used to assess metasemantic awareness generally include analyzing sentence into lexical units or words, free word association, word definitions, synonyms, antonyms, multiple meanings for homonyms or lexically ambiguous words, identifying the grammatical category for a word, semantic anomaly, syntagmatic and paradigmatic relations, lexical/referential arbitrariness etc.

Metasyntactic awareness: Syntactic awareness is the ability to reason consciously about the syntactic aspects of language, and to exercise intentional control over the application of grammatical rules (Gombert, 1992). Studies on metasyntactic ability used either a grammaticality judgement task or a revision task or both tasks to assess children's awareness of different syntactic constructions. In a judgement task, the subject is presented with both grammatical and ungrammatical sentences. He/she is required to indicate which are grammatical and which are ungrammatical. In a revision task, the subject is presented with only ungrammatical sentences and is required to correct them. Findings revealed that syntactic awareness improves with age. Children perform better on the judgement task than on the revision task. Owing to the possibility of a response bias in judgement tasks, a revision task is thought to be a more sensitive measure of syntactic awareness (Pratt, Tunmer, & Bowey, 1984; Blackmore, Pratt, & Dewsbury, 1995).

The tasks used to assess metasyntactic awareness generally include unscrambling jumbled sentences, determining if two sentences have the same or different meanings, determining if a sentence is grammatical or not, correcting grammatical errors, recognizing or producing a paraphrase of a sentence, recognizing or detecting a lexically or structurally ambiguous sentence etc.

Metapragmatic awareness: It includes an awareness of the relationship between language and the social context in which it is being used (Hickmann, 1985; Ninio &

Snow, 1996). Common examples of metapragmatic awareness include the ability to judge referential adequacy, the ability to determine comprehensibility, and the ability to describe explicitly the social rules (e.g., politeness rules) governing language use.

Development of metalinguistic abilities

Using language to communicate is a skill achieved by children experiencing a wide range of environments and thus considered a robust phenomenon. Metalinguistics provides the base for the children to move from social to increasingly instructional uses of language by treating language as a focus of cognitive reflection. During the preschool period, children view language as a means of communicating. They do not focus on the manner in which language is conveyed. During the school-age years, children begin to reflect on language as decontextualized object. This metalinguistic ability enables children to think and to talk about language- that is, to treat language as an object of analysis and to use language to talk about language.

The development of metalinguistic abilities takes place during middle childhood, between 5 and 8 years of age (Scholl & Ryan, 1980; Van Kleeck, 1982, 1984; Pratt, Tunmer & Bowey, 1984). There appears to be a developmental continuum based on explicitness of awareness starting from spontaneous repair of their own speech, later by correcting the utterance of others, and finally by explaining why certain sentences are possible and how they should be interpreted and the endpoint being overt verbalized metalinguistic judgments (Clark, 1978). Clark (1978) reported the evolution of metalinguistic abilities in children which have been listed below:

- Can differentiate basic units of language- i.e., sounds, syllables, words, and sentences.

- Can attach correct inflections to unfamiliar words.
- Can recognize when words are used incorrectly in sentences, and knows when word order is incorrect.
- Can understand how it is possible to construct varying sentence types, and can convey their understanding to other people.
- Knows when utterances are acceptable, based upon who the listener is and/or the setting in which the communication is taking place.
- Knows how to define words in a manner that makes their meaning clear to others.
- Can demonstrate an understanding of the language forms used in creating humorous constructions, such as riddles.

Bi/multilingualism and metalinguistic ability

Metalinguistic ability is the most commonly studied phenomenon in biliteracy learning or in bilinguals that transfers across languages and enhances literacy learning among bilingual learners (Koda, 2008). These abilities referred to and studied include all aspects of components of language and its purposeful, functional uses. Metalinguistic ability in bilingual learners is the ability to objectively function outside one language system and to objectify languages' rules, structures and functions. Code-switching and translation are examples of bilinguals' metalinguistic ability. Research has shown that metalinguistic awareness in children is a crucial component because of its documented relationships and positive effects on language ability, symbolic development and literacy skills.

The progression from metalinguistic awareness and transfer from L1 to L2 proceeds from implicit understanding and unarticulated knowledge through non-structured experiences towards explicit understanding and articulated language through structured experiences such as direct instruction in transference knowledge and skills. This explicit knowledge formation in turn results in increase in student’s self regulatory control and enhanced language use in cognitive performance on literacy tasks (Mora, 2001).

Metalinguistic awareness is tested by means of tasks which require the subject to differentiate between form and meaning. Focussing on the form of the linguistic information instead of the meaning involves the deliberate control of linguistic processes. Most metalinguistic tasks incorporate word awareness and syntactic awareness. Word awareness is normally investigated by assessing children’s ability to recognize linguistic units that correspond to individual words and syntactic awareness by some form of grammaticality judgement task. In both cases, the tasks require children to focus on a formal property of language and demonstrate an ability to make judgments about its structure.

The most widely used test of metalinguistic (semantic) awareness is Piaget's (1929) sun/moon test. In this test children are asked whether it would be possible to call the sun 'moon', and which time of day it would be if that 'moon' was up in the sky. It had been suggested that bilingual children should be able to agree to this exchange of labels and predict the ensuing consequences at an earlier age than monolingual children. In the grammaticality judgement task children are trained to decide whether a sentence is ‘said the right way’ (i.e. grammatical) or ‘said the wrong way’ (i.e. not grammatical) irrespective of its meaning (Bialystok, 1986a, 1988). The children are persuaded that silliness is fine in this game, and they only have to decide if the sentence is said the right way. The ability to identify a grammatical error, such as in the sentence, 'Apples growed on trees', requires a representation of correct linguistic structure. In contrast, the ability to recognize that the grammar is correct in the sentence, 'Apples grow on noses', requires the ability to ignore the misleading anomaly in meaning and focus attention only on the form of the sentence. Thus, the first judgement reflects representational knowledge of linguistic structure and the second, attentional control to use that structure. Consistently, bilingual children have been shown to be more able than monolinguals to ignore the meaning and agree that the second sentence is correct but the two groups are equivalent in determining which of a set of meaningful sentences contain grammatical errors. Bilinguals, in other words, are superior to monolinguals in executive control of attention, although they are no different from monolinguals in their knowledge of the system.

Research comparing monolinguals and bilinguals on metalinguistic tasks reported bilingual advantages i.e., the bilinguals have accelerated metalinguistic awareness (Cummins, 1978; Mohanty, 1982; Galambos & Hakuta, 1988; Galambos & Goldin-Meadow, 1990; Bialystok, 1991; Ricciardelli, 1992). Bilingual and Multilingual children develop metalinguistic awareness in a different manner or at a different rate from monolingual children, as some studies have reported. They also excel at paying selective attention to relatively subtle aspects of language tasks, ignoring more obvious linguistic characteristics (Bialystok, 1992; Bialystok & Majumdar, 1998; Cromdal, 1999). Bilingual children also learn at an early age about the arbitrary relation between words and their referents than monolingual children (Reynolds, 1991).

Ianco-Worall (1972) tested the metalinguistic ability in bilingual and monolingual children where children had to make choices according to semantic or phonetic criteria reported that bilingual children, brought up in one-person, one-language home environment, were significantly more sensitive than unilingual children matched on IQ, to semantic relations between words and were also more advanced in realizing the arbitrary assignments of names to referents. On the other hand, unilingual children were more likely to interpret similarity between words in terms of an acoustic rather than a semantic dimension (e.g., cap-can rather than cap-hat) and felt that the names of objects could not be interchanged. Among older children she discovered that both monolinguals and bilinguals tended more towards semantic relations rather than phonetic, thus inferring that compared to their monolingual counterparts, young bilingual children were at a more advanced stage of metalinguistic awareness, that is, a further developed ability in their consciousness of language forms and properties.

Cummins (1978) administered four metalinguistic tasks of the word awareness to bilinguals and monolinguals. There were performance differences between the groups on only some of the tasks, or on some parts of the tasks. For example, one task tested whether a child considered a word to be stable even when the object the word referred to had ceased to exist, such as the continued existence of the word “giraffe” if there were no giraffes left in the word. This task showed a bilingual advantage, especially by the older children. In another task, children were asked whether particular words had the physical properties of the objects they represented, for example, “Is the word *book* made of paper?” Here there were no differences in bilinguals and monolinguals. Cummins concluded that bilinguals had a greater linguistic flexibility but not a greater reasoning ability for problems that extended beyond the domain of language.

Bialystok (1988) conducted three studies each involving around 120 children from age five to nine. In the experiments children were asked to judge or correct sentences for their syntactic acceptability irrespective of meaningfulness. Sentences could be meaningfully grammatical, meaningful but not grammatical, anomalous and grammatical, or anomalous and ungrammatical. These sentences tested the level of analysis of a child's linguistic knowledge. The findings revealed that the bilingual children in all the three studies consistently judged grammatically more accurately than did monolingual children at all the ages tested.

Bialystok (1988) reported two studies in which children differing in their level of bilingualism were given metalinguistic problems to solve that made demands on either analysis or control. The hypotheses were that all bilingual children would perform better than monolingual children on all metalinguistic tasks requiring high levels of control of processing and that fully bilingual children would perform better than partially bilingual children on tasks requiring high levels of analysis of knowledge. The results were largely consistent with these predictions.

Galambos and Hakutta (1988) compared monolinguals and bilinguals for their ability to solve two kinds of metalinguistic tasks. The first was a standard task in which children were asked to judge and then to correct the syntactic structure of the sentences. The second asked children to determine the ambiguity in sentences and then to paraphrase the various interpretations. The research was conducted longitudinally which showed that bilingual children had consistent advantage over monolinguals in the syntax task but only the older children were better than the monolinguals in the ambiguity task.

Hyde, J. S., & Linn, M. C. (1988) located 165 studies that reported data on gender differences in verbal ability. The weighted mean effect size was +0.11, indicating a slight female superiority in performance. The difference was so small that the authors argue that gender differences in verbal ability no longer exist. Analysis of tests requiring different cognitive processes involved in verbal ability yielded no evidence of substantial gender differences in any aspect of processing. Similarly, an analysis of age indicated no striking changes in the magnitude of gender differences at different ages, countering Maccoby and Jacklin's (1974) conclusion that gender differences in verbal ability emerge around age 11 yrs.

Galambos and Goldin-Meadow (1990) observed the development of metalinguistic awareness and tested the bilingual hypothesis, by comparing metalinguistic skills in 32 Spanish-speaking and 32 English-speaking monolinguals and in 32 Spanish-English bilinguals aged 4 yrs 5 months to 8 yrs. The Spanish and English metalinguistic tests each contained 15 different ungrammatical constructions and 15 grammatically correct "fillers." For each item, the children were asked in the appropriate language to note whether the construction was correct or incorrect, to correct the errors they noted, and to explain why those errors were wrong. Data suggested that the experience of learning two languages hastens the development of certain metalinguistic skills in young children but does not alter the course of that development.

Rodriguez (1992) investigated the effects of bilingualism on the cognitive development and linguistic performance of children at various ages living in the same cultural environment. It also studied the relationship between formal operational thought and a prerequisite cognitive style as typified by field independence/field dependence for both bilingual and monolingual subjects. The bilingual subjects were tested for both language dominance and language proficiency. To investigate the interrelationships between bilingualism and cognitive function, it was necessary to include both verbal and non-verbal tests of cognition. No significant differences in performance could be attributed to lingualism, grade, or age with the exception of language proficiency correlated with cognitive level on analytical reasoning. The childrens' overall cognitive level indicated some justification for the theoretical relationship between verbal and non-verbal measures of abstract thinking. The bilingual children used higher order rules more frequently than the monolingual children. The evidence seems to suggest that bilingualism may scaffold concept formation and general mental flexibility.

Ricciardelli (1993) studied the cognitive development of Italian-English bilingual & Italian monolingual children (aged 5-6) based on measures of metalinguistic awareness, creativity, nonverbal abilities, & reading achievement. Following proficiency testing in both languages, students were assigned to groups of high & low Italian proficiency & high & low English proficiency, producing six groups for comparison. Results of comparison of performance on the measures of cognitive development indicated that students who demonstrated high proficiency in both English & Italian achieved higher scores on the creativity, metalinguistic awareness, & reading achievement tests.

Ben-Zeev (1997) developed a creative task to assess children’s awareness of the formal properties of words. The task, symbol substitution, assessed children’s level of awareness of referential arbitrariness. She said to children, "In this game, the way to say *we* is with spaghetti. How would you say, *We are good children*?" Defying all sense, children had to say, "Spaghetti are good children". She found that bilingual children were more reliable in making this substitution than were monolinguals. For some reason it was easier for them to ignore the meaning and deal with the formal instructions. This study indicates that monolingual children are more wedded to the familiar meanings of the words than are their bilingual peers. It is as though the meaning is inherent in the word, an immutable property of it. In contrast, bilingual children are more willing to accept that the meaning of a word is more convention than necessity, more agreement than truth.

Gathercole and Montes (1997) used a more traditional grammatical judgement task to determine whether Spanish-English bilingual children could make appropriate decisions about sentences containing violences of that trace. They found that monolinguals were better than bilinguals for both judging and correcting the sentences, but the performance of the bilinguals was significantly influenced by the amount of English input they received at home. This research identifies some areas in which bilingual do as well as monolinguals, but none in which they do better.

Bialystok (2008) identified analysis (representation) and control (selective attention) as components of language processing and has shown that one of these, control, develops earlier in bilingual children than in comparable monolinguals. A grammaticality judgement task (Bialystok, 1986a) was administered and it was found that bilingual children consistently were more able than monolinguals to ignore the meaning and agree that the second sentence is correct but the two groups were equivalent in determining which of a set of meaningful sentences contained grammatical errors.

The recent work on metalinguistic awareness in bilinguals (Bialystok, Craik, Green, & Gollan, 2009) is differentiated between two kinds of tasks, those which involve control of linguistic processing, and those calling for a more analytical approach to language. It was also found that bilingual children outperformed monolinguals in tasks involving the cognitive control of linguistic processes.

In the Indian scenario a few studies have been carried out to investigate the metalinguistic ability in bilinguals. Mohanty (1982) supported the notion that bilingualism confers metalinguistic (and general cognitive) advantages on children. The study examined the metalinguistic development of 300 grades 6, 8 and 10 bilingual and monolingual children from urban and tribal cultures matched for socioeconomic status. A significant main effect was found for bilingualism and an interaction between language and culture was found indicating that bilingualism had somewhat more positive effect on metalinguistic skills in urban culture than among tribals.

Mohanty and Babu (1983) administered a metalinguistic ability test and a measure of nonverbal intelligence on 180 monolingual and balanced bilingual Kond children from the same grades. 30 monolinguals and 30 bilinguals were included in each grade. The socioeconomic status was controlled by taking all the subjects from lowest socioeconomic status families. The findings of the study showed that even when the difference between the bilinguals and monolinguals in nonverbal intelligence was not significant, the two groups differed in the metalinguistic scores, i.e., bilinguals showed an advantage in their metalinguistic task performance.

Patnaik and Mohanty (1984) studied the relationship between bilingualism and cognitive and metalinguistic development. Their sample consisted of 120 children including 60 bilinguals and 60 monolinguals in the age groups of 6+, 8+, and 10+ years from grades one, three and five respectively. Within age level there were 20 bilingual and 20 monolingual children. The children were administered a metalinguistic test, piagetian conservation tasks and Raven's progressive matrices as nonverbal measure of intelligence. The metalinguistic ability test included items involving recognition of rhymes at the word level, judgement of appropriateness of utterances in different social contexts, correction of grammatically anomalous sentences, tasks of substitution of linguistic symbols in context of sentences. The piagetian conservation test included six conservation tasks from Goldsmid-Bentler's concept assessment kit and children's judgment and explanation of judgment were scored for accuracy in case of each of the conservation measures and the scores were added up for the total conservation score. The results revealed that in each of the grade levels, except for grade 3 groups, the bilinguals scored better than their monolingual counterparts. The effects of bilingualism and grade 10 bilingualism interaction were not significant for Ravens progressive matrices scores nor for conservation. Further, metalinguistic test scores did not correlate significantly with the conservation and progressive matrices scores in the different grade and language groups with the single exception of the significant correlations with progressive matrices scores in case of grade one bilingual. The significance of the findings indicated superiority of bilinguals over monolinguals in metalinguistic awareness in the absence of any difference in intelligence and cognitive operations task. Results suggest that bilingualism enhances the metalinguistic ability of children but does not improve their cognitive abilities because bilinguals are capable of switching from one linguistic code to the other. The primacy of metalinguistic awareness in accounting for bilinguals is further substantiated by the observation that the metalinguistic test scores were unrelated to the general cognitive and intellectual skills. They concluded that metalinguistic abilities constitute a set of abilities independent from cognitive abilities and that the better performance of bilinguals is due to their ability to reflect on language regardless of their cognitive development.

Mohanty (1992) explained that the bilinguals' superiority over unilinguals on cognitive, linguistic, and academic achievement measures in terms of a metalinguistic hypothesis that suggests that use of two or more languages endows the language users with special awareness of objective properties of language and enables them to analyze linguistic input more effectively. A series of studies compared unilingual and balanced bilingual Kond children to investigate the metalinguistic hypothesis. These studies show that the bilinguals outperform the unilinguals on a number of cognitive, linguistic, and metalinguistic tasks, even when the differences in intelligence are controlled. However, a study with unschooled bilingual and unilingual children showed no significant differences in metalinguistic skills. The metalinguistic hypothesis of bilinguals' superiority in cognition may need to be reexamined in the context of the effect of schooling on metalinguistic processes.

A recent study by Samasthitha and Goswami (2009) was conducted to compare the metaphonological abilities and reading skills in monolingual (Kannada) and bilingual (Kannada and English) children, in the age range of 8-9 years. Results revealed that there was a developmental trend in the acquisition of metaphonological skills. Rhyme and syllable awareness appeared to be the earliest skills to be developed followed by phoneme awareness. Results also showed that the bilingual group performed better than the monolingual group on the meta-phonological and reading tests. This suggested that bilinguals have an added advantage in fine tuning and growth of metaphonological and reading skills.

Viewing bilinguality in the framework of metalinguistic awareness, Segalowitz (1977) suggested that the internalization of two languages rather than one will result in a more complex, better equipped mental calculus enabling the child to alternate between two systems of rules in the manipulation of symbols. Further, Bialystok (1986) hypothesized that bilingual children have an advantage over monolinguals in their control of the linguistic processing needed for metalinguistic problems. Research evidence suggests that acquiring more than one language creates different kinds of connections in the brain, which gives bi/multilingual individuals an advantage in some respects compared to monolingual individuals.

Bilinguals are at an advantage since they already know a great deal about languages, often unconsciously, including grammatical knowledge, such as how different languages handle verb conjugation, and sociocultural knowledge, such as understanding that what is considered polite in one language may be rude in another. In addition, those who speak more than one language are also generally more aware of sociolinguistic variables and functions than those who speak one language, and they are adept at switching between different regional varieties, registers, and formal and informal language styles. This knowledge, especially when it is brought to a conscious level is a special advantage of bi/multilingualism (Cook, 1995; Jessner, 2006; Svalberg, 2007).

Further, the differences seen on these tasks between bilinguals and monolinguals could arise probably because of the differences in terms of language storage in their brain. Bilinguals learn to differentiate the two language codes that they are learning. Up to the age of two, children exposed to two languages have only one linguistic system which is same as that of the linguistic system of monolinguals. The difference is that the bilingual child's system is a mixed one which has features from both the language models. During the third year, one code gradually unfolds into two, and each language is assigned fairly rigidly to the person who speaks it or to the context in which it typically occurs. Initially the phonological and lexical aspects of the two codes are separated first followed by a separation of syntactic aspects. Finally, by the age of 3-4, bilingual children begin to decontextualize their language and realize that they speak two distinct languages. It is at this point that bilinguals exhibit a variety of explicit metalinguistic behaviours i.e. they begin to translate spontaneously, ask for transitions, tag constructions according to their linguistic affiliations, and sharply reduce mixing of the two codes (Hakuta, 1986). They also noted more grammatical errors than the monolinguals. They had an advantage over the monolinguals with respect to noting and correcting errors. This bilingual advantage was not seen for explanation task. The younger children tended to give grammar-oriented corrections based on the awareness of isolated linguistic markers while the older children gave grammar-oriented corrections based on an awareness of a more complex linguistic system. A progression was seen in children's corrections from content-oriented corrections to grammar-oriented corrections. The bilinguals' advantage over monolinguals could be attributed to the fact that learning to differentiate two language codes requires extensive attention to the form of the language which is not essential when a acquiring a first and only one language.

Learning a second language permits children to view their language as one system among others, thereby enhancing their linguistic awareness. It is believed that the systematic separation of form and meaning that is experienced in early bilingualism gives children added control of language processing. The general pattern of the effects of bilingualism is as follows: bilinguals achieve higher scores than monolinguals on tests of arbitrariness (Edwards & Christofersen, 1988; Ben-Zeev, 1997) phonological awareness (Dash & Mishra, 1992), and lower scores than monolinguals on tests of vocabulary size (Doyle, Champagne & Segalowitz, 1978).

There also have been some changes that have been documented in the brain of these individuals who have the awareness of more than one language. Individuals who speak a second language have been shown to have increased density of grey matter in the left inferior parietal cortex, a change that is more pronounced in early bilinguals and those with greater proficiency in the second language (Mechelle, Martin, & Bialystok, 2008). This region has been shown to be responsive to vocabulary acquisition in monolinguals and bilinguals as well as producing enlargements in slightly different areas depending on the two languages of the bilingual (Green, Crinion & Price, 2007) cited in Bialystok (2008).

In sum, although the findings are not equivocal, it seems clear that bilingualism enhances the metalinguistic ability. However, this depends on the proficiency level in languages. These studies provide evidence that the experience of controlling attention to two languages boosts the development of executive control processes in childhood for bilinguals, sustains cognitive control advantages for bilinguals through adulthood and protects bilingual older adults from the decline of these processes with ageing.

Processing speed in bilinguals and multilinguals

Although many studies have tapped the bilinguals' cognitive and metalinguistic abilities through standardized tests, the processing speed on these tasks has not been investigated exhaustively. Processing speed is one of the measures of cognitive efficiency or cognitive proficiency. It involves the ability to automatically and fluently perform relatively easy or over-learned cognitive tasks, especially when high mental efficiency is required. The brain requires time and capacity to process information and plan an appropriate response. The duration of 'thinking' time is known as processing speed, and is closely associated with attention. The children's abilities in terms of the processing speed can be studied by adopting reaction time tasks. Reaction time is the time between the presentation of the stimulus and a motor response. Reaction time or brain time is very closely related to integration between the two hemispheres of the brain. Successful integration between the two hemispheres of the brain requires an efficient brain to process information more efficiently; the processing speed must be faster. Thus reaction time is considered by some researchers as a reflection of global processing speed (Cerella & Hale, 1994). Kail, 1991b and Cerella and Hale, 1994 reported that over the course of normal development, reaction times become faster, peaking in adolescence and young childhood and slows again as adults' age.

The studies pertaining to measuring processing speed in typically developing bilinguals are scanty. Bonifacci, Giombini, Bellocchi, and Contento (2010) aimed to evaluate whether the bilingual advantage in non-verbal skills could be best defined as domain-general or domain-specific, and, in the latter case, at identifying the basic cognitive skills involved. Bilingual and monolingual participants were divided into two different age groups (children, youths) and were tested on a battery of elementary cognitive tasks which included a choice reaction time task, a go/no-go task, two working memory tasks (numbers and symbols) and an anticipation task. Bilingual and monolingual children did not differ from each other except for the anticipation task, where bilinguals were found to be faster and more accurate than monolinguals. These findings suggest that anticipation, which has received little attention to date, is an important cognitive domain which needs to be evaluated to a greater extent both in bilingual and monolingual participants.

Further, the studies pertaining to measuring processing speed to assess the cognitive efficiency carried out on multilinguals is also scanty. A pilot study was conducted by Ring (2010) to study the cognition in multilinguals using Go/No Go task and to discover whether an online task was a suitable tool for studying reaction times. 100 individuals in three groups (monolinguals, bilinguals, and multilinguals) took part in the study. Each participant took two online reaction time tests, one of which required attentional control. Results showed a trend for multilinguals to be faster at the attentional control task, though this was not statistically significant. It was concluded that reaction times are faster for respondents who speak three or more languages and they have better attentional control than those who speak fewer languages. Bilinguals have been shown to use additional parts of the brain in responding to these tasks when compared to monolinguals (Bialystok et al., 2005). It is possible that the neural networks of bilinguals are simply more connected than those of monolinguals, acting (to make the crude analogy) as extra memory chips in a computer. Just as a computer with more memory runs faster, brains with more connections may do so. Multilinguals may simply have more neural connections than bilinguals.

Importantly, these processing differences between monolinguals and bilinguals are not confined to non-linguistic tasks but have been found for a variety of linguistic tasks too. The recent work on metalinguistic awareness in bilinguals (Bialystok, Craik, Green, & Gollan, 2009) differentiated between two kinds of tasks, those which involve control of linguistic processing, and those calling for a more analytical approach to language. It was also found that bilingual children outperformed monolinguals in tasks involving the cognitive control of linguistic processes.

Martin, Costa, Dering, Hoshino, Wu, and Thierry (2012) found that bilingual speakers generally manifest slower word recognition than monolinguals. They investigated the consequences of the word processing speed on semantic access in bilinguals. The paradigm involved a stream of English words and pseudowords presented in succession at a constant rate. English–Welsh bilinguals and English monolinguals were asked to count the number of letters in pseudowords and actively disregard words. They were not explicitly told that pairs of words in immediate succession were embedded and could either be semantically related or not. The authors expected that slower word processing in bilinguals would result in semantic access indexed by semantic priming. As expected, bilinguals showed significant semantic priming, indexed by an

N400 modulation, whilst monolinguals did not. Moreover, bilinguals were slower in performing the task. The results suggest that bilinguals cannot discriminate between pseudowords and words without accessing semantic information whereas monolinguals can dismiss English words on the basis of subsemantic information.

In sum, a look into the literature revealed that bilingualism has two possible cognitive outcomes. One is that the very knowledge and use of two languages affects cognition, regardless of the languages involved, for e.g., increased metalinguistic awareness (Bialystok, 2001). Another outcome is that the learning of two languages affects cognition because of the characteristics of the language involved, age at which the languages are acquired, the context in which the language was acquired, and how the languages code a given aspect of the world. The research evidence support the bilingual advantages in cognitive skills such as memory, divergent thinking, problem solving, and in tasks involving metalinguistic awareness. However such kinds of studies are limited with multilinguals. Considering the advantage seen in bilinguals, it could be hypothesized that the mutilinguals also have similar or better advantages which needs to be investigated further.

However, over the decades, the studies have primarily focused on isolated linguistic or non-linguistic tasks. The main difference between these tasks is that the linguistic tasks depend on the language knowledge while the non-linguistic tasks rely minimally on such knowledge. Such differences between linguistic and non-linguistic skill may reflect differences between particular processes. It would be interesting to examine whether the bi/multilingual children demonstrate similar performance across all different domains including metalinguistic and non-linguistic cognitive tasks. However, there are no studies which address or compare the performance of such children across both types of tasks. There is a need to further explore the differences in linguistic and cognitive processing among bilingual and multilingual children in order to reach a more coherent understanding of how they process language.

Moreover despite the growing body of literature on bi/multilingualism, there have been very limited research reports with reference to the processing speed in these children across various tasks, especially in the Indian context. Hence, a need was felt to provide further corroborative evidence to the existing research findings. Therefore this study was taken up incorporating both language and nonlanguage tasks with the main aim of investigating the processing speed and accuracy of response for metalinguistic and non-linguistic cognitive tasks in bilingual and multilingual children.

Chapter 3

Method

The current study was designed to investigate the processing speed for metalinguistic and non-linguistic cognitive tasks in bilingual and multilingual children. The study was undertaken in the following phases:

Phase I: Development of the test stimuli for the metalinguistic and the non-linguistic cognitive tasks.

Phase II: Administration on the bilingual and multilingual children.

Phase I: Development of the test stimuli for the metalinguistic and the non-linguistic cognitive tasks

The stimuli which were taken from several available standardized Indian tests was programmed on the DMDX software accordingly such that the children responded by pressing the key on the computer as soon as they finished listening/seeing the stimuli. The stimuli were presented in Kannada language to the children. The tasks were divided into the following:

Metalinguistic tasks: Stimuli were included to test the three components of the metalinguistic ability viz. metaphonological, metasemantic and metasyntactic ability. Under each of these subdomains two subtasks were included. Altogether there were six subtasks included under the metalinguistic tasks. Under each subtask six stimuli were included. The details of the reaction time tasks and the instructions provided have been included in the appendix.

a) Metaphonological tasks: The stimuli were taken from a test to assess reading abilities viz. Reading Acquisition Profile in Kannada (RAP-K) by Prema (1997). The stimuli were programmed on the DMDX software. The two subtasks included the following.

- Rhyming task: Two words were presented auditorily through iBall Rocky Headphones. The words were either rhyming or not rhyming and the participants had to acknowledge their judgment through a key press. The participants were asked to strike a key marked with green if the pair of words are rhyming, or red if they are not. E.g., /ka:gada/ - /ta:gada/, /ka:gada/ - /kel.ge/.
- Syllable oddity: Four words each with CVCV configuration were presented auditorily through iBall Rocky Headphones and each word was provided with a key. The participants were asked to choose the one which did not belong to the set with an appropriate key press. Four keys were programmed for the response and the participant was instructed to strike a key which corresponded to the odd syallable out of four CVCV words presented. E.g.,/Charata/ /Chamacha/ /Chatura/ /Seragu/

b. Metasemantic tasks: The test stimuli were taken from Linguistic Profile Test in Kannada (LPT) by Karanth (1980). The task was programmed on the DMDX software such that the stimuli stayed on the screen for 4 seconds for both the tasks.

- Synonym task: Two words were displayed one below the other. The words were either synonyms or not and the participants had to acknowledge their judgment through a key press. E.g., /daje/ - /karuɳe/, /ra:dʒa/ ---- /tel.u/

- Semantic similarity: Two words were displayed one below the other. The words were either related to each other meaningfully or not. The participants were required to indicate their judgement through a key press. E.g., /a:du/ - /a:ta/, /o:du/- /u:ta/

c. Metasyntactic tasks: The test stimuli were taken from Linguistic Profile Test in Kannada (LPT) by Karanth (1980). The task was programmed on the DMDX software such that the stimuli stayed on the screen for 6 seconds for both the tasks.

- Comparatives: Sentences with and without comparatives were displayed on the monitor one at a time. The participants were required to indicate if the sentence had a comparative or not, through the key press. E.g., /giri:ʃ / /sure:ʃaniginta/ /tʃikkavanu/
- Grammaticality judgement task: Grammatically correct and incorrect sentences were presented on the screen in random order and the participants had to indicate which of the sentences were syntactically correct and incorrect through key press. E.g., /avanu/ /sinimage/ /hogo:ηa/

Non-linguistic cognitive tasks: The six tasks under this domain considered were viz. All the stimuli in the 6 subtasks were programmed on DMDX software.

1. Go task: In this task the participant had to simply respond to a single stimuli (green dot) as soon as it appeared on the screen with a key press.
2. No-Go task: In this task the reaction time was measured when dealing with an incongruent situation which required inhibitory control. The participant was instructed to give a key press response when he/she saw the green dot, and not to respond when he/she saw the patterned dot. On each trial, the child first saw the word "Ready," followed by the response signal (three asterisks) after a delay of 1, 2, or 5 sec. The conditions were randomly ordered, so that the child could not anticipate the length of the delay.

3. Visual search: The stimuli were extracted from a sub-section of the test of Early Reading Skills (ERS, Rae & Potter, 1981) i.e. Visual Discrimination level-1. Four pictures were presented on the bottom screen and one picture was presented on the top of the screen simultaneously. The participant was required to judge whether the picture stimulus on top of screen was present or absent among the four pictures on the bottom screen. If the picture presented above was present in the pictures presented below, the participant was instructed to press the green button on the keyboard and if the picture was not present, the red button had to be pressed. The stimuli were displayed on the screen for 4 seconds each.

4. Odd-one-out: Three geometrical pictures were displayed on the screen and the child had to indicate the response with a key press. One among the three pictures was the odd picture. Each picture was given a number key and the participant was required to press the number key of the odd picture as soon as possible. The stimuli were taken from Bhatia's battery of performance test **(Bhatia, 1955)** The stimuli were displayed on the screen for 4 seconds each.

5. Mental rotation task: In the mental rotation task, the same figures were used as in the visual search. A target figure was shown on the left, simultaneously with the same figure on the right. The child pressed one key (marked with a green dot) when the second figure was exactly the same as the target or a different key (marked with a red dot) when it was a mirror image. The second figure was rotated 0°, 60°, or 120° clockwise from its canonical position. The stimuli were displayed on the screen for 6 seconds each.

6. Find the missing element: The test stimuli were taken from set A of the Colored Progressive Matrices by Raven (1976). Here a picture with a missing element was

presented on the top portion of the screen with six options in the bottom. Each option was given a key. The child had to find out the missing element which completes the pattern and indicate the correct answer by pressing the appropriate key. The stimuli were displayed on the screen for 6 seconds each.

Phase II: Administration on the bilingual and multilingual children

Participants: Sixty typically developing children in the age range of 9-10 years were selected and divided into two groups based on the number of languages known, that is, bilingual who were proficient in two languages (n=30) and a multilingual group, who were proficient in three languages (n=30). Equal number of males and females (15 males and 15 females) were included in each group.

Inclusion criteria: The following criteria were adhered to while selecting the participants.

- The participants had to have visual and hearing acuity within normal limits.
- They should have no history of neurological, cognitive, communicative, academic and/or psychological disorders which was ensured using the ‘WHO Ten question disability screening checklist’ (Singhi, Kumar, Malhi & Kumar, 2007).
- They should have had a minimum of two years of formal training at school.
- They should be native speakers of Kannada studying in English medium schools. The bilingual group consisted of children with the knowledge of two languages, Kannada & English and the multilingual group consisted of children with the knowledge of Kannada, English and Hindi, with Hindi being taught in school as a subject.
- They should belong to the middle socio-economic status (SES) as ascertained by using the NIMH SES scale (Venkatesan, 2009). The scale has sections such as

occupation and education of the parents, annual family income, property, and per capita income to assess the socioeconomic status of the participants.

- The participants should have a transactional proficiency in second and third languages which was determined using International Second Language Proficiency Rating Scale Wylie and Ingram (2006). ISLPR describes language performance at eight points along the continuum from zero to native like proficiency in each of the four macro skills (speaking, listening, reading and writing). The bilingual group obtained a score of 1+ on the second language (Transactional proficiency) and the multilingual group obtained a score of 1+ (Transactional proficiency) on the second language and 1 (Basic transactional proficiency) on the third language. The listening and the reading skills of ISLPR, 2006 was used.

The participants were selected from various state and central schools in and around Mysore. Ethical standards used in the study for the selection of participants. Participants were selected by adhering to the appropriate ethical procedures. Participants and/parents were explained the purpose and procedures of the study, and an informal verbal and/or written consent were taken. They were randomly selected based on the inclusionary criteria.

A pilot study was carried out in which all the twelve subtasks under the metalinguistic and non-linguistic cognitive domains were administered on five typically developing children from each group. The pilot study was carried out to determine the duration of each task on the DMDX software and to assess if the children were able to carry out the task and to rule out the practical difficulties, if any. The pilot study was also conducted to check the ease with which the tasks could be administered, the appropriateness of the tasks, and the approximate time to administer the tasks. Further, this was also carried out so that the experimenter becomes experienced in the administration and response recording. Following the pilot study, the screen time for each stimuli for various tasks was decided. Also, since the administration time was around 60 minutes, an interval of 5 minutes was provided between the administration of metalinguistic and non-linguistic cognitive tasks.

Procedure: The testing was carried out in a quiet environment and without any distractions. The environment was conducive for the children to maintain their focus and attention. Good rapport was built with the child before introducing the tasks. All tasks were presented on a laptop computer using the DMDX software, and children responded by striking a key on the keyboard. For each task two trials were given, following which the actual six stimuli were presented which were randomly ordered. For all the tasks, the children were expected to give a key press response, and the child pressed one key (marked "yes" in green colour) for a yes or positive response and a different key (marked "no" in red colour) for a negative response. The children were instructed well before the task had begun and later the trials were provided to make sure that they understood the task well.

The tasks were divided into two sessions; which required a total of 60 minutes to complete. Both sessions contained two tasks, each of metalinguistic and non-linguistic cognitive type. All the children performed the tasks in the same order. Children were instructed always to respond as quickly as possible without affecting the accuracy. They were also instructed to rest both their hands just above the keys to be used, which was marked by words "yes" and "no" in specific colors and respond appropriately. The reaction time was measured (milliseconds) as the duration between the presentation of the stimuli and the completion of the response (key press). The children were reinforced using a token reinforcement (stickers and pencils) which were given at the end of the session.

Analysis: The mean reaction time and the accuracy were analyzed for both the bilingual and multilingual groups for each of the metalinguistic and non-linguistic cognitive tasks. This was later averaged across participants for the different tasks and compared within and across various tasks for both groups.

Statistical analysis: The tabulated scores were used for obtaining the mean and standard deviation. The data was analyzed and statistically treated using the SPSS software to determine if there was any significant difference in the reaction time and accuracy between bilingual and multilingual children on metalinguistic and non-linguistic cognitive tasks. Parametric tests were utilized for the same. One way ANOVA was done to check for the significant difference, if any, between each task across the group. Repeated measure ANOVA was used to see the main effect of group, task and interaction between them. Bonferroni multiple comparison test was used to investigate which pair of the tasks was different within the groups. Repeated measure ANOVA was used to check for gender differences within each group, if any and one way ANOVA was used to see if there was any significant difference across each task between the gender.

Chapter 4

Results

The main aim of the present study was to investigate the processing speed on metalinguistic and non-linguistic cognitive tasks in multilingual and bilingual children in the age range of 9-10 years. Specifically, the study aimed at investigating the reaction time and accuracy measures across both the groups of children on both the tasks and also to find the gender differences, if any. The data collected from both the groups of children was averaged, tabulated and subjected to statistical measures. SPSS software (Version 17.0) package was used to compare the reaction time and accuracy across both the groups as well as between the gender. The following statistical procedures were used in the study:

1. Descriptive statistical procedures were used to compute mean and standard deviation values in the both the groups on both the tasks.
2. One way ANOVA was done to check for the significant difference, if any, between each task across the group. This was also used to check for any significant differences within the groups and across males and females for each task.
3. Repeated measure ANOVA was used to see the main effect of group, task and interaction between them. It was also used to see the main effect of task on gender within the groups.
4. Bonferroni's pairwise comparison test was used to investigate which pair of the tasks was significantly different within the groups compared.

The findings of the study have been broadly presented under the following headings:

I. Quantitative analysis of reaction time measures of bilingual and multilingual children on metalinguistic and non-linguistic cognitive tasks.

II. Quantitative analysis of accuracy measures of bilingual and multilingual children on metalinguistic and non-linguistic cognitive tasks.

III. Quantitative analysis of gender differences across the metalinguistic and non-linguistic cognitive tasks, within each group.

I. Quantitative analysis of reaction time measures of bilingual and multilingual children on metalinguistic and non-linguistic cognitive tasks

a. Comparison of reaction time of bilingual and multilingual children across the metalinguistic and non-linguistic cognitive tasks:

The mean and standard deviation values of reaction time for bilingual and multilingual groups were computed using descriptive statistics across the metalinguistic and non-linguistic cognitive tasks and these values have been presented along with the overall mean values on both the tasks in Table 1. On comparing the total mean values of both the tasks between the groups, it was seen that the bilinguals obtained a lower mean score (lesser reaction time) compared to the multilinguals. When the performance of the bilingual and the multilingual group were compared separately on each task, it was seen that the bilinguals obtained a lower mean score (lesser reaction time) compared to the multilinguals on the metalinguistic task. This indicated that the bilinguals outperformed the multilinguals on this task, i.e., they were quicker in responding to the tasks compared to the multilinguals. However, bilingual group obtained a higher mean score (greater reaction time) compared to the multilinguals on non-linguistic cognitive tasks. This indicated that the multilinguals outperformed the bilingual children, i.e. they were quicker in responding to the tasks compared to the bilinguals. The total mean values of both the tasks were subjected to repeated measure ANOVA which revealed no statistical significant difference between the two groups [$F(1,58)=0.44$, $p>0.05$]. Further the mean values of the bilinguals and the multilinguals on the metalinguistic task and the nonlinguistic cognitive task was subjected to one way ANOVA to check for significant difference if any. The results revealed that there was no significant difference between the two groups on both of these tasks. The F and p values have been depicted in Table 1.

Table 4.1: *Mean, standard deviation (SD), F and p values of reaction times in bilingual and multilingual children for metalinguistic and non-linguistic cognitive tasks.*

Task	**Bilinguals**		**Multilinguals**		**F values (1,58)**	**p values**
	Mean	**SD**	**Mean**	**SD**		
Metalinguistic	1947.10	282.12	2044.92	219.50	2.25	0.14
Non-linguistic cognitive	1762.65	210.46	1729.28	138.03	0.53	0.47
Total	1854.88	224.34	1887.10	140.95	0.44	0.50

The mean values of reaction time for the metalinguistic and non-linguistic cognitive tasks were compared within the bilingual group. The bilingual group had greater reaction time for the metalinguistic task which revealed that they performed better on the non-linguistic cognitive task compared to the metalinguistic task. The data was subjected to repeated measure ANOVA which revealed a significant statistical difference across tasks with [F (1, 26) = 21.546 and p<0.05].

The mean values of reaction time for the metalinguistic and non-linguistic cognitive tasks were compared within the multilingual group. The multilingual group had greater mean score in the metalinguistic task which implied that they performed better on the non-linguistic cognitive task. The data was subjected to repeated Measure

ANOVA which revealed a statistical significant difference across the metalinguistic and non-linguistic cognitive tasks with [F (1, 28) = 55.117 p<0.05].

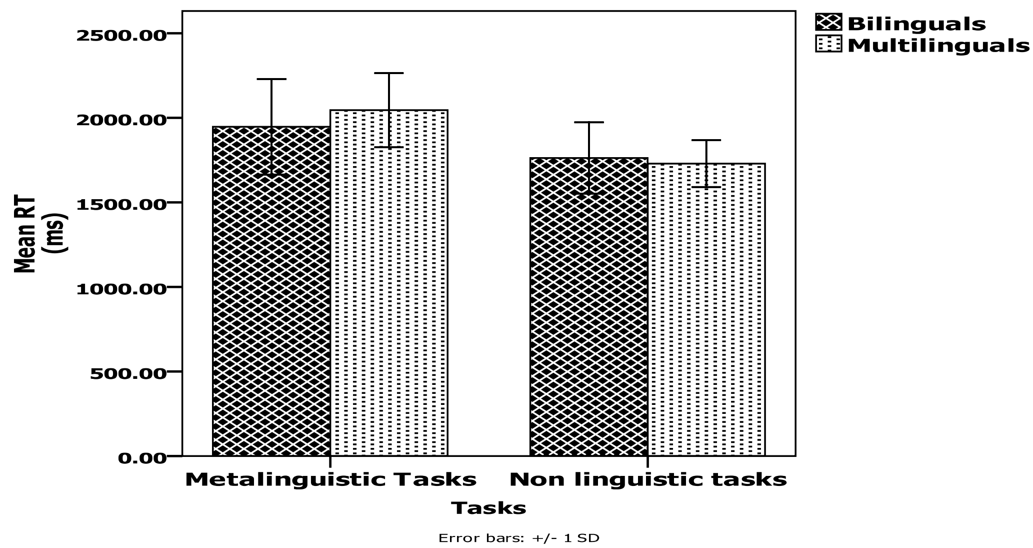

Figure 4.1: Mean and Standard Deviation of Reaction time on metalinguistic and non linguistic cognitive tasks across bilingual and multilingual group.

The performance of reaction time measures of both the groups on metalinguistic and non linguistic task is shown in Fig 4.1. It is evident that the bilingual group had lesser mean score on metalinguistic tasks indicating that they performed faster than the multilingual group. However, the multilingual group had lower mean scores for the non linguistic tasks indicating that they performed faster than the bilingual group

b. Comparison of reaction times of bilingual and multilingual children across the subtasks included under the metalinguistic and non-linguistic cognitive tasks:

The groups were compared on each of the subtasks of the metalinguistic task which included rhyming, syllable oddity, synonyms, semantic similarity, comparatives and grammatical judgement. They were also compared on each of the subtasks of the non-linguistic cognitive task which included go task, no go task, visual search, mental rotation, odd one out and find the missing element. On comparing the means of both the groups on the metalinguistic task, it was found that the bilingual group performed better on all the subtasks except the rhyming and syllable oddity task on which the multilingual group performed better. The mean of both the groups on non-linguistic tasks when compared revealed that the multilinguals performed better on all the subtasks except no go task and visual search task. The mean and standard deviation values have been depicted in the Table 2.

Table 4.2: *Mean and standard deviation (SD) of reaction time in bilingual and multilingual participants across the subtasks of metalinguistic and non-linguistic cognitive tasks.*

Task	Subtask*	Bilinguals	Multilinguals

		Mean	SD	Mean	SD
Metalinguistic	Rhyming	785.81	356.50	595.31	289.99
	S.O	597.56	386.64	593.05	302.47
	Synonyms	2416.29	529.06	2564.94	459.99
	SS	2256.76	569.53	2397.93	493.59
	Comparatives	2721.43	841.80	3072.96	474.00
	GJ	2836.83	437.79	2964.64	273.08
Non-linguistic	Go task	552.27	132.12	496.79	154.27
cognitive	No Go task	627.46	142.82	637.85	140.07
	VS	2176.68	530.16	2239.13	336.41
	MR	1677.51	413.08	1655.71	365.96
	OOO	2902.21	467.28	2618.01	362.90
	FME	2781.27	549.36	2728.22	318.17

*SO: Syllable Oddity, SS: Semantic Similarity, GJ: Grammatical Judgement, VS: Visual Search
MR: Mental Rotation, OOO: Odd One Out, FME: Find the Missing Element

c) Quantitative analysis of reaction times for both the groups on metalinguistic tasks:

The various subtasks under the metalinguistic tasks were grouped into *metaphonological* subtask which included rhyming and syllable oddity, *metasemantic* subtask which included synonyms and semantic similarity, and *metasyntactic* tasks which included comparatives and grammatical judgement tasks. The mean and standard deviation values for these subtasks for the bilingual and multilingual group have been depicted in the Table 3. The mean values when compared across the subtasks for both the groups suggested that both the groups had lesser reaction time for the metaphonology subtask compared to the metasemantic and metasynyactic subtasks. Further, one way ANOVA revealed no significant difference between tasks across the groups. The F and p values have been depicted in Table 3.

Table 4.3: *Mean, standard deviation (SD), F and p values of reaction time in both the groups on the subtasks of metalinguistic task.*

Metalinguistic subtasks	**Bilinguals**		**Multilinguals**		**F values (1,58)**	**P values**
	Mean	**SD**	**Mean**	**SD**		
Metaphonology	695.30	249.63	594.18	219.33	2.62	0.11
Metasemantics	2315.85	483.22	2629.19	801.78	2.92	0.09
Metasyntax	2820.80	468.82	3018.80	291.72	3.48	0.07

The mean values of the bilingual group were subjected to repeated measure ANOVA. The results revealed that there was significant difference across all the three sub tasks with [$F(2, 54) = 262.90$, $p<0.05$]. Since there was significant difference across these tasks, Bonferroni's test of pairwise comparison was applied to compare the performance between pairs. It was found that there was a significant difference across all the pairs with $p<0.05$ as depicted in Table 4.

Table 4.4: *Results of Bonferroni's pairwise comparison test of subtasks on the metalinguistic task in the bilingual group w.r.t reaction time measures.*

Subtask	Metaphonology	Metasemantics	Metasyntax
Metaphonology		Significant (p<0.05)	Significant (p<0.05)
Metasemantic	Significant (p<0.05)		Significant (p<0.05)
Metasyntax	Significant (p<0.05)	Significant (p<0.05)	

The mean values of the multilingual group were subjected to repeated measure ANOVA. The results revealed that there was a significant difference across all three subtasks with [F(2, 56)=220.26, p<0.05] . Since there was a significant difference across these groups, Bonferroni test of pairwise comparison was applied to investigate which pair was significantly different. It was found that there was significant difference between all the six pairs compared, with p<0.05, the results of which have been depicted in Table 5.

Table 4.5: *Results of Bonferroni's pairwise comparison test of subtasks on the metalinguistic task in the multilingual group w.r.t reaction time measures.*

Subtask	Metaphonology	Metasemantics	Metasyntax
Metaphonology		Significant (p<0.05)	Significant (p<0.05)
Metasemantics	Significant (p<0.05)		Significant (p<0.05)
Metasyntax	Significant (p<0.05)	Significant (p<0.05)	

d) Quantitative analysis of reaction times for both the groups on sub tasks of non-linguistic cognitive tasks:

The non-linguistic cognitive tasks were divided into go, no go, visual search, mental rotation, odd one out and find the missing element tasks. The mean and standard deviation of reaction time on the subtasks of non-linguistic cognitive task was compared between the bilingual and the multilingual group and the values have been depicted in Table 6. The mean values were the least for the go task for both the groups and the highest for the odd one out task for the bilingual group and highest for the missing element for the multilingual group. When the mean values were subjected to one way ANOVA, the results revealed that there was no significant difference across both the groups for all the tasks. The F and the p values have been depicted in the Table 6.

Table 4.6: *Mean, standard deviation (SD), F and p values of reaction time measures in both the groups on the subtasks of non-linguistic cognitive task.*

Non-linguistic cognitive: subtasks	**Bilinguals**		**Multilinguals**		**F values (2,58)**	**p values**
	Mean	**SD**	**Mean**	**SD**		
Go	552.27	132.12	496.79	154.27	2.24	0.14
No Go	627.46	142.82	637.85	140.07	0.08	0.77
Visual Search	2176.68	530.16	2239.13	336.41	0.30	0.59
Mental Rotation	1677.51	413.08	1655.71	365.96	0.05	0.83
Odd One Out	2902.21	863.39	2618.01	388.49	0.28	0.60
Find the Missing Element	2781.27	882.55	2728.22	318.17	0.60	0.44

The mean values of the bilingual group were subjected to repeated measure ANOVA to check for any significant difference in the performance across each pair of subtasks in the non-linguistic cognitive task. The results revealed a significant statistical difference across all the 6 subtasks of the non-linguistic cognitive domain with [$F(5, 140) = 82.13, p<0.05$]. Since there was significant difference across these tasks, Bonferroni test of pairwise comparison was applied to investigate which pair was significantly different. It was found that there was a significant difference between all the pairs except go-no go task with $p=0.39$, visual search-odd one out with $p=0.13$, visual search-find the missing element with $p= 0.36$, and odd one out-find the missing element with $p=1.00$.

Table 4.7: *Results of Bonferroni's pairwise comparison test of subtasks on the non-linguistic cognitive task in the bilingual group w.r.t reaction time measures.*

Subtask*	**Go**	**No Go**	**V S**	**M R**	**O O O**	**F M E**
Go		**P=0.39**	P<0.05	P<0.05	P<0.05	P<0.05
No Go	**P=0.39**		P<0.05	P<0.05	P<0.05	P<0.05
V S	P<0.05	P<0.05		P<0.05	**P=0.13**	**P=0.36**
M R	P<0.05	P<0.05	P<0.05		P<0.05	P<0.05
O O O	P<0.05	P<0.05	**P=0.13**	P<0.05		**P=1.00**
F M E	P<0.05	P<0.05	**P=0.36**	P<0.05	**P=1.00**	

*VS: Visual Search, MR: Mental Rotation, OOO: Odd One Out, FME: Find the Missing Element

The mean values of the multilingual group for the subtasks under the non-linguistic cognitive task were subjected to repeated measure ANOVA to check for any significant difference in the performance across each subtask. The results revealed a significant statistical difference across all the six subtasks of non-linguistic cognitive domain with [F (5, 140) = 344.21, p<0.05]. Since there was significant difference across these tasks, pairwise comparison test was applied to compare the performance between these tasks. It was found that there was a significant difference between all the pairs except the odd one out-find the missing element pair with p=1.00, as depicted in Table 8.

Table 4.8: *Results of Bonferroni's pairwise comparison test of subtasks on the non-linguistic cognitive task in the multilingual group w.r.t reaction time measures.*

Subtask*	**Go**	**No Go**	**V S**	**M R**	**O O O**	**F M E**
Go		P<0.05	P<0.05	P<0.05	P<0.05	P<0.05
No Go	P<0.05		P<0.05	P<0.05	P<0.05	P<0.05
V S	P<0.05	P<0.05		P<0.05	P<0.05	P<0.05
M R	P<0.05	P<0.05	P<0.05		P<0.05	P<0.05
O O O	P<0.05	P<0.05	P<0.05	P<0.05		**P=1.00**
F M E	P<0.05	P<0.05	P<0.05	P<0.05	**P=1.00**	

*VS: Visual Search, MR: Mental Rotation, OOO: Odd One Out, FME: Find the Missing Element

II. Quantitative analysis of accuracy measures of bilingual and multilingual children on metalinguistic and non-linguistic cognitive tasks

a) Comparison of accuracy of bilingual and multilingual children across the metalinguistic and non-linguistic cognitive task:

The mean and standard deviation values of accuracy measures for the bilingual and multilingual groups were computed using descriptive statistics across the metalinguistic and non-linguistic cognitive tasks and these values along with the overall values for both the tasks taken as a whole have been presented in Table 9. When the total mean values of both the tasks were considered, the multilinguals obtained a higher mean score. When the tasks were considered separately, it was seen that the multilinguals obtained a higher mean score compared to the bilinguals on the both the metalinguistic task as well as the non-linguistic cognitive task, i.e. they performed more accurately than the bilinguals. This indicated that the multilinguals outperformed the bilinguals on both the tasks in terms of accuracy. The total mean values of both the tasks were subjected to repeated measure ANOVA which revealed a significant statistical difference across tasks with [$F(1, 58) = 32.08$, $p<0.05$]. Further the mean values of the bilinguals and the multilinguals on the metalinguistic task and the nonlinguistic cognitive task was subjected to one way ANOVA to check for significant difference if any. The results revealed that there was a significant difference between the two groups on both of these tasks. The F and p values have been depicted in Table 9.

Table 4.9: *Mean, standard deviation (SD), F and p values of accuracy measures in bilingual and multilingual children for metalinguistic and nonlinguistic cognitive tasks.*

Task	**Bilinguals**		**Multilinguals**		**F values (1,58)**	**P values**
	Mean	**SD**	**Mean**	**SD**		
Metalinguistic	4.44	0.60	4.86	0.46	9.01	0.004*
Non-linguistic cognitive	4.14	0.71	4.99	0.41	31.09	0.000**
Total	4.29	0.49	4.93	0.36	32.08	0.000**

*$p<0.05$, **$p<0.001$

The mean values of accuracy for the metalinguistic and non-linguistic cognitive tasks were compared within the bilingual group. The bilingual group had greater accuracy for the metalinguistic task. The data was subjected to repeated measure

ANOVA which revealed no significant statistical difference across tasks with [F (1, 29) = 3.362 and p=0.07].

The mean values of accuracy for the metalinguistic and non-linguistic cognitive tasks were compared within the multilingual group. The multilingual group had greater mean score in the non-linguistic cognitive task which implied that they performed better on the non-linguistic cognitive task. The data was subjected to repeated measure ANOVA which revealed no statistical significant difference across the metalinguistic and non-linguistic cognitive tasks with [F (1, 29) = 1.982 p=0.170].

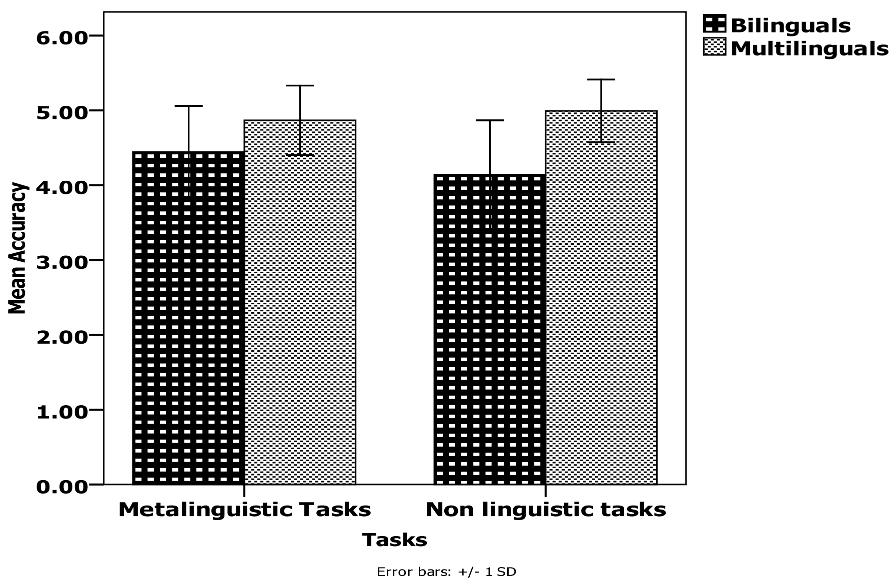

Figure 4.2: Mean and Standard Deviation of Reaction time on metalinguistic and non linguistic cognitive tasks across bilingual and multilingual group.

The performance of accuracy measures of both the groups on metalinguistic and non linguistic task is shown in Fig 4.2. It is evident from the graph that the multilingual group outperformed the bilingual group on both metalinguistic and non linguistic cognitive tasks.

b) Comparison of accuracy of bilingual and multilingual children across the subtasks included under the metalinguistic and nonlinguistic cognitive tasks:

The groups were compared on each of the subtasks of the metalinguistic task which included rhyming, syllable oddity, synonyms, semantic similarity, comparatives and grammatical judgement. They were also compared on each of the subtasks of the non-linguistic cognitive task included go task, no go task, visual search, mental rotation, odd one out and find the missing element. On comparing the means of both the groups, it was found that the multilingual group performed better on all the subtasks compared to the bilingual group. This indicated that the multilingual children outperformed their bilingual counterparts on accuracy measures on all the metalinguistic and non-linguistic cognitive subtasks. The mean and standard deviation values have been depicted in the Table 10.

Table 4.10: *Mean and standard deviation (SD) of accuracy in bilingual and multilingual participants across the subtasks of metalinguistic and non-linguistic cognitive tasks.*

Task	**Subtask***	**Bilinguals**		**Multilinguals**	
		Mean	**SD**	**Mean**	**SD**
Metalinguistic	Rhyming	5.30	0.91	5.70	0.79
	S.O	4.97	0.89	5.57	0.81
	Synonyms	4.40	1.19	4.67	0.80
	SS	4.87	0.81	4.93	1.04
	Comparatives	3.37	1.65	4.00	1.14
	GJ	3.77	1.30	4.33	1.12
	No Go task	5.37	0.85	5.73	0.58
	VS	4.40	0.85	5.00	0.58
Non-linguistic	MR	4.33	1.32	4.97	0.66

cognitive	OOO	3.27	1.55	4.53	1.38
	FME	3.33	1.51	4.73	0.94

* SO: Syllable Oddity, SS: Semantic Similarity, GJ: Grammatical Judgement, VS: Visual Search
MR: Mental Rotation, OOO: Odd One Out, FME: Find the Missing Element.

c) Quantitative analysis of accuracy for both the groups on metalinguistic tasks:

The various subtasks under the metalinguistic tasks were grouped into metaphonological subtask which included rhyming and syllable oddity, metasemantic subtask which included synonyms and semantic similiarity, and metasyntactic tasks which included comparatives and grammatical judgement tasks. The mean and standard deviation values for these subtasks for the bilingual and multilingual group have been depicted in the Table 11. The mean values when compared across the subtasks for both the groups revealed that the multilinguals were more accurate than bilinguals on all the subtasks. Further they were more accurate on the metaphonology subtask and least accurate on the metasyntactic subtask. One-way ANOVA revealed a significant difference between both the groups on metaphonological and metasyntactic task. The F and the p values have been depicted in the Table 11.

Table 4.11: *Mean, standard deviation (SD), F and p values of accuracy in both the groups on the subtasks of metalinguistic task.*

Metalinguistic subtasks	**Bilinguals**	**Multilinguals**	**F values (1,58)**	**p values**

	Mean	SD	Mean	SD		
Metaphonology	5.13	0.64	5.63	0.61	9.48	0.00*
Metasemantics	4.63	0.76	4.80	0.65	0.83	0.37
Metasyntax	3.56	1.13	4.16	0.78	5.69	0.02*

*P<0.05

The mean values of the bilingual group were subjected to repeated measure ANOVA. The results revealed that there was a significant difference across all the three subtasks with [F (2, 56) = 33.14 and p<0.05]. Since there was significant difference across these tasks, Bonferroni's test of pairwise comparison was applied to compare the performance between pairs. It was found that there was a significant difference across all the pairs with p<0.05 as depicted in Table 12.

Table 4.12: *Results of Bonferroni's pairwise comparison test of sub tasks of the metalinguistic task in the bilingual group w.r.t accuracy measures.*

Subtask	Metaphonology	Metasemantics	Metasyntax
Metaphonology		Significant (p<0.05)	Significant (p<0.05)
Metasemantics	Significant (p<0.05)		Significant (p<0.05)
Metasyntax	Significant (p<0.05)	Significant (p<0.05)	

The mean values of the multilingual group were subjected to repeated measure ANOVA. The results revealed that there was a significant difference across all the three subtasks with [F (2, 56) = 44.46, p<0.05]. Since there was a significant difference across these groups, Bonferroni test of pairwise comparison was applied to investigate which pair was significantly different. It was found that there was significant difference between all the six pairs compared, with $p<0.05$ as depicted in Table 13.

Table 4.13: *Results of Bonferroni's pairwise comparison test of subtasks in the metalinguitic task in the multilingual group w.r.t accuracy measures.*

Task	**Metaphonology**	**Metasemantics**	**Metasyntax**
Metaphonology		Significant (p<0.05)	Significant (p<0.05)
Metasemantic	Significant (p<0.05)		Significant (p<0.05)
Metasyntax	Significant (p<0.05)	Significant (p<0.05)	

d) Quantitative analysis of accuracy for both the groups on the non-linguistic cognitive tasks:

The non-linguistic cognitive tasks were divided into go, no go, visual search, mental rotation, odd one out and find the missing element tasks. The mean and standard deviation of the accuracy on the subtasks of non-linguistic cognitive task were compared between the bilingual and the multilingual group and the values have been depicted in Table 14. The mean values of accuracy were the highest for the no go task for both the groups and the least for the odd one out task for the bilingual group and the multilingual group. When the mean values were subjected to one way ANOVA, the results revealed that there was a significant difference across both the groups for all the tasks except the no go task. The F and the p values have been depicted in the Table 14.

Table 4.14: *Mean, standard deviation (SD), F and p values of accuracy in both the groups on the subtasks of non-linguistic cognitive task.*

Non-linguistic cognitive subtasks	**Bilinguals**		**Multilinguals**		**F values (2,58)**	**p values**
	Mean	**SD**	**Mean**	**SD**		
No Go	5.37	0.85	5.73	0.58	3.79	0.06
Visual Search	4.40	0.85	5.00	0.58	10.04	0.00**
Mental Rotation	4.33	1.32	4.97	0.66	5.48	0.02*
Odd One Out	3.27	1.55	4.53	1.38	11.14	0.00**
Find the Missing Element	3.33	1.51	4.73	0.94	18.43	0.00**

*p<0.05,
**p<0.01

; of the bilingual group were subjected to repeated measure ANOVA to check if there was any significant difference in the performance across each pair of subtasks in the non-linguistic cognitive task. The results revealed a significant statistical difference across all the six subtasks of non-linguistic cognitive domain with [F (4, 112) = 19.14, p<0.05]. Since there was a significant difference across these groups, pairwise comparison test was applied to compare the performance between these groups. It was found that there was a significant difference between all the pairs except visual search-mental rotation with p=1.00, visual search-find the missing element with p=0.07, odd one out-find the missing element with p=1.00. The results of the Bonferroni's test have been depicted in Table 15.

Table 4.15: *Results of Bonferroni's pairwise comparison test of subtasks on the non-linguistic cognitive task in the bilingual group w.r.t accuracy measures.*

Subtask*	**N G**	**V S**	**M R**	**O O O**	**F M E**
N G		P<0.05	P<0.05	P<0.05	P<0.05
V S	P<0.05		**P=1.00**	P<0.05	**P=0.07**
M R	P<0.05	**P=1.00**		P<0.05	P<0.05
O O O	P<0.05	P<0.05	P<0.05		**P=1.00**
F M E	P<0.05	**P=0.07**	P<0.05	**P=1.00**	

*VS: Visual Search, MR: Mental Rotation, OOO: Odd One Out, FME: Find the Missing Element

The mean values of the multilingual group for the subtasks under the non-linguistic cognitive task were subjected to repeated measure ANOVA to check for any significant difference in the performance across each subtask. The results revealed a significant statistical difference across all the six subtasks of non-linguistic cognitive domain with $F(8,112) = 8.38$ and $p<0.05$. Since there was significant difference across these groups, Bonferroni test of pair wise comparison was administered and the results revealed a significant difference between the no go task with all the four tasks, i.e. visual search, mental rotation, odd one out and find the missing element. No significant difference was found between visual search-mental rotation with p=1.00, visual search-odd one out with p=1.00, visual search-find the missing element with p=1.00, mental rotation-odd one out with p=0.31, mental rotation-find the missing element with p=1.00, and odd one out-find the missing element with p=1.00. The results of the Bonferroni's test have been depicted in Table 16.

Table 4.16: *Results of Bonferroni's pairwise comparison test of subtasks of the non-linguistic cognitive task in the multilingual group w.r.t accuracy measures.*

Subtask*	**No Go**	**V S**	**M R**	**O O O**	**F M E**
No Go		P<0.05	P<0.05	P<0.05	P<0.05
V S	P<0.05		**P=1.00**	**P=1.00**	**P=0.07**
M R	P<0.05	**P=1.00**		**P=0.31**	**P=1.00**
O O O	P<0.05	**P=1.00**	**P=0.31**		**P=1.00**
F M E	P<0.05	**P=0.07**	**P=1.00**	**P=1.00**	

*VS: Visual Search, MR: Mental Rotation, OOO: Odd One Out, FME: Find the Missing Element

III. Quantitative analysis of gender differences on reaction time and accuracy across the metalinguistic and non-linguistic cognitive tasks, within each group

a. Comparison of performance in reaction time and accuracy measures across gender in the bilingual group on metalinguistic and non-linguistic cognitive tasks:

The mean of the males and females in the bilingual group on metalinguistic and non-linguistic cognitive task were compared on reaction time and accuracy measures. The mean and standard deviation for reaction time and accuracy measures on both the tasks have been depicted in the Table 17. The males had a shorter reaction time and performed more accurately than the females.

Table 4.17: *Mean, standard deviation (SD), and F and p values of bilingual group across female and male participants on metalinguistic and non-linguistic cognitive tasks.*

Task	**Gender**	**Reaction time measures**		**F(1,28) values**	**P values**	**Accuracy measures**		**F(1,28) values**	**P values**
		Mean	**SD**			**Mean**	**SD**		
Metalinguistic	Males	1906.62	361.30	0.61	0.44	4.56	0.67	1.19	0.28
	Females	1987.57	175.54			4.32	0.54		
Non-linguistic cognitive	Males	1748.51	249.24	0.13	0.72	4.22	0.57	0.42	0.52
	Females	1776.80	170.88			4.05	0.86		
Total	Males	1827.56	305.27	0.44	0.51	4.39	0.62	1.35	0.26
	Females	1882.18	173.21			4.18	0.70		

The mean values were subjected to repeated measure ANOVA to investigate any statistically significant gender differences across the tasks in reaction time and accuracy measures. Although the mean scores indicated that the males were faster and performed more accurately than the females, it was not supported statistically. There was no significant difference found [F (1,28) = 0.44, p=0.514] between males and females in the reaction time measures and on the accuracy measures [F (1,28)=1.34.p=0.256) of the metalinguistic and non-linguistic cognitive tasks.

Further the mean values of males and females in the bilingual group on the metalinguistic and non-linguistic cognitive tasks with respect to reaction time and accuracy measures were subjected to one way ANOVA to check for any significant differences between the two genders. The results revealed that there was no significant difference between males and females in both types of measures on both the tasks. The F and p values have been provided in the Table 17.

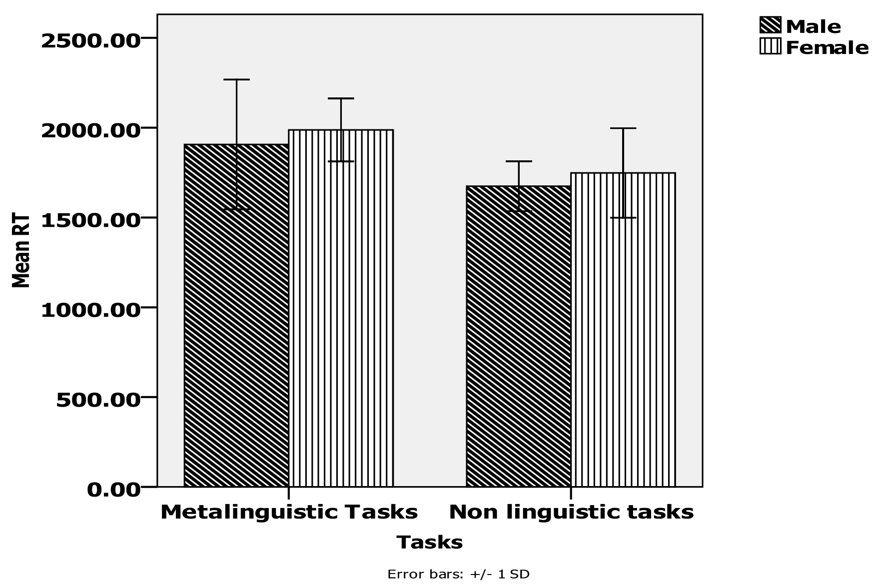

Figure 4.3: Mean and Standard deviation of reaction time measures on metalinguistic and non linguistic tasks in bilingual group.

Figure 4.3 depicts the that the males performed faster than females on the metalinguistic and non linguistic cognitive tasks in the bilingual group, though no significant statistical difference was found.

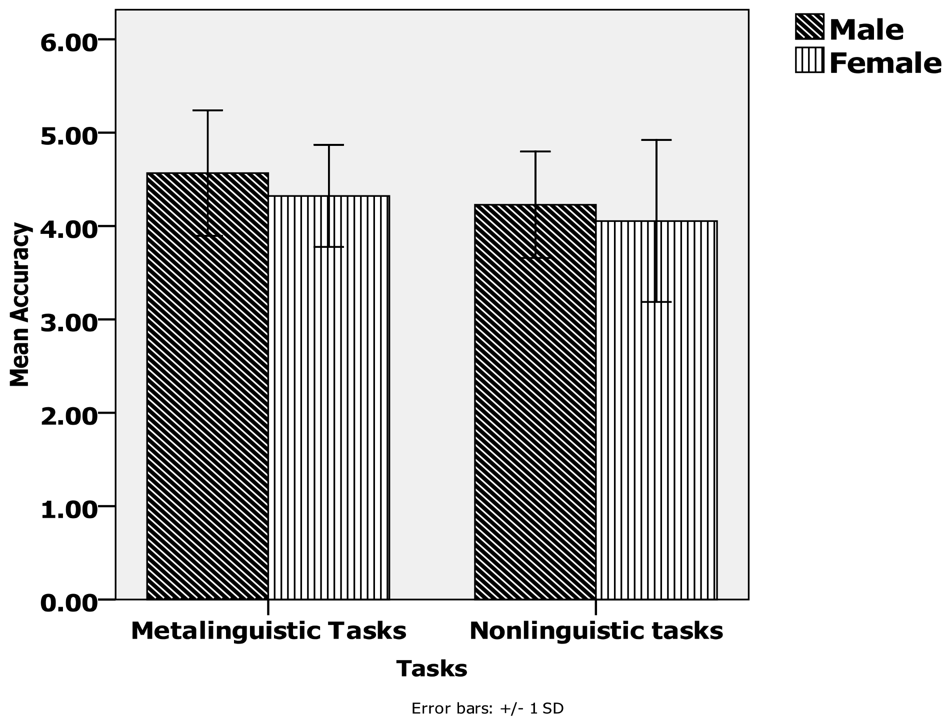

Figure 4.4: Mean and Standard deviation of accuracy measures on metalinguistic and non linguistic tasks in bilingual group.

It is evident from Fig 4.4, that the males performed more accurately than females on the metalinguistic and non linguistic cognitive tasks in the bilingual group, though no significant statistical difference was found.

b. *Comparison of performance in reaction time and accuracy measures across gender in the bilingual group on the different subtasks included under metalinguistic and non-linguistic cognitive tasks:*

The mean values of the males and females of the bilingual group on reaction time and accuracy measures were compared on the subtasks of metalinguistic and non-linguistic cognitive task. The mean and standard deviation of the males and females on the various subtasks have been depicted in the Table 18. The males had greater mean values on the reaction time measures on the metaphonological tasks and lesser on the metasemantic and metasyntactic tasks, i.e. the female participants outperformed the male participants in the metaphonology task, however, the male participants outperformed the females in the metasemantic and metasyntactic tasks. The males were more accurate on all the tasks compared to females, i.e. the male participants outperformed the female participants in metaphonogy, metasemantic and metasyntactic tasks. The reaction time was the least and accuracy was the best for the metaphonological tasks.

Table 4.18: *Mean, standard deviation (SD) and F values of bilingual group across female and male participants on sub tasks of metalinguistic and non-linguistic cognitive tasks.*

Task	Gender	Reaction Time			Accuracy		
Metalinguistic		**Mean**	**SD**	**F(1,28)**	**Mean**	**SD**	**F(1,28)**
Metaphonology	Males	719.55	297.62	0.38	5.16	0.64	0.08
	Females	669.32	193.45		5.10	0.66	
Metasemantic	Males	2248.16	576.85	0.98	4.70	0.79	0.22
	Females	2388.39	365.56		4.56	0.75	
Metasyntactic	Males	2752.17	528.64	0.88	3.83	1.23	1.70
	Females	2894.35	401.48		3.30	0.99	
Non-linguistic cognitive							
Go task	Males	558.78	138.98	0.07	NA	NA	-
	Females	545.76	129.43		NA	NA	
No go task	Males	627.55	160.72	0.00	5.53	0.74	1.15
	Females	627.38	128.16		5.20	0.94	
Visual Search	Males	2111.91	456.86	0.44	4.00	0.84	8.20*
	Females	2241.45	603.75		4.80	0.67	
Mental Rotation	Males	1562.65	458.73	2.43	4.13	1.45	0.68
	Females	1792.38	338.76		4.53	1.18	
Odd One Out	Males	2723.41	546.03	0.01	3.93	1.10	6.60
	Females	3108.51	239.58		2.60	1.68	
Find the Missing Element	Males	2906.74	551.32	4.12	3.53	1.12	0.51
	Females	2636.50	531.10		3.13	1.84	

*p<0.05

The mean values were subjected to one way ANOVA to check for any significant difference between males and females with regard to reaction time and accuracy measures on each subtask of the metalinguistic task. The F values for the individual subtasks of metalinguistic have been depicted in Table 18. The results revealed no significant difference between the males and the females.

In the subtasks under non-linguistic cognitive domain, the males had greater mean values on the reaction time measures on the go task and find the missing element task and lesser on the visual search, mental rotation and odd one out task, i.e. the female participants in these tasks outperformed the male participants, however, both the males and females performed similarly on the no go task. The males were more accurate on all the tasks compared to females, except visual search and mental rotation, where the females outperformed the males in terms of accuracy. The mean values were subjected to one way ANOVA to check for any significant difference between males and females with regard to reaction time and accuracy measures on each subtask of the non-linguistic task. The results revealed that there was no significant difference across both the groups in reaction time and accuracy measures except visual search task where there was significant difference in accuracy measures. The F values for the individual subtasks of non-linguistic tasks have been depicted in Table 18.

c) *Comparison of performance in reaction time and accuracy measures across gender in the multilingual group on metalinguistic and non-linguistic cognitive tasks:*

The mean of the males and females in the multilingual group on metalinguistic and non-linguistic cognitive task were compared on reaction time and accuracy measures.

The mean and standard deviation for reaction time and accuracy measures on both the tasks have been depicted in the Table 19. In the accuracy measures, the mean scores indicated that the males had shorter reaction time and performed more accurately than females.

Table 4.19: *Mean, standard deviation (SD), F and p values of multilingual group across female and male participants on metalinguistic and non-linguistic cognitive tasks.*

Task	**Gender**	**Reaction time measures**		**F(1,28) Values**	**P value**	**Accuracy measures**		**F(1,28) values**	**P value**
		Mean	**SD**			**Mean**	**SD**		
Metalinguistic	Males	1939.38	196.11	8.80*	0.01	4.98	0.50	2.17	0.15
	Females	2150.46	193.58			4.74	0.39		
Non-linguistic cognitive	Males	1674.28	139.12	5.50*	0.03	5.06	0.31	0.92	0.35
	Females	1784.29	116.74			4.92	0.50		
Total	Males	1806.83	167.61	14.14*	0.00	5.02	0.40	2.22	0.15
	Females	1967.37	155.16			4.83	0.44		

*p<0.05

The mean values were subjected to repeated measure ANOVA to check for any gender differences across the tasks in reaction time and accuracy measures. Although the mean scores indicated that the males were faster and performed more accurately than the females in the reaction time measures it was not supported statistically. There was significant difference found [F (1,28) = 14.136, p=0.001] between males and females in the reaction time measures and no significant difference was found on the accuracy measures [F (1,28)=2.22.p=0.147) of the metalinguistic and non-linguistic cognitive tasks.

Further the mean values of males and females in the multilingual group on the metalinguistic and non-linguistic cognitive tasks with respect to reaction time and accuracy measures were subjected to one way ANOVA to check for any significant differences between the two genders. The results revealed that there was a significant difference between males and females with regard to the reaction time measures in both the tasks between males and females. However, there was no significant difference with regard to the accuracy measures on both the tasks between the two genders. The F and p values have been provided in the Table 19.

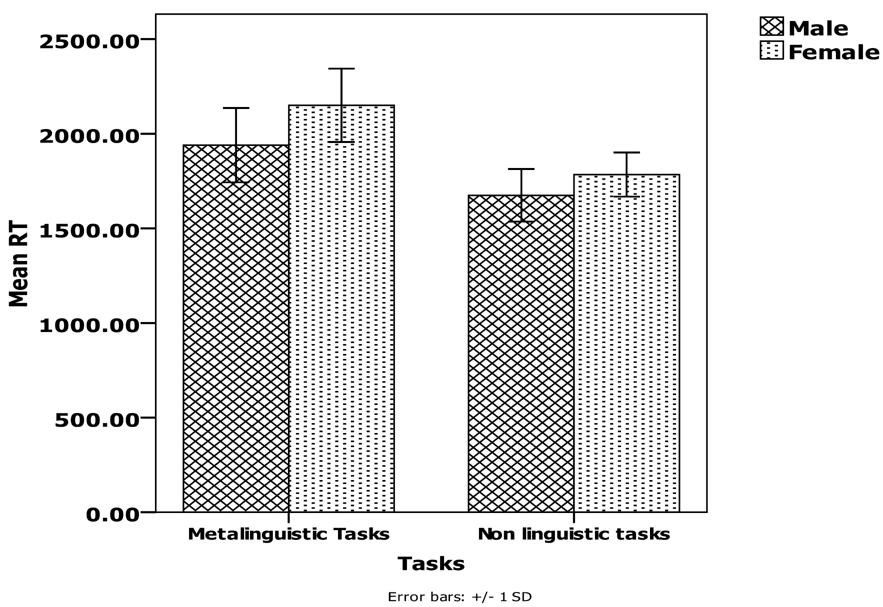

Figure 4.5: Mean and Standard deviation of reaction time measures on metalinguistic and non linguistic cognitive tasks in the multilingual group.

It is evident from Fig 4.5, that the males performed faster than females on the metalinguistic and non linguistic cognitive tasks in the multilingual group, with a significant statistical difference of $p<0.05$.

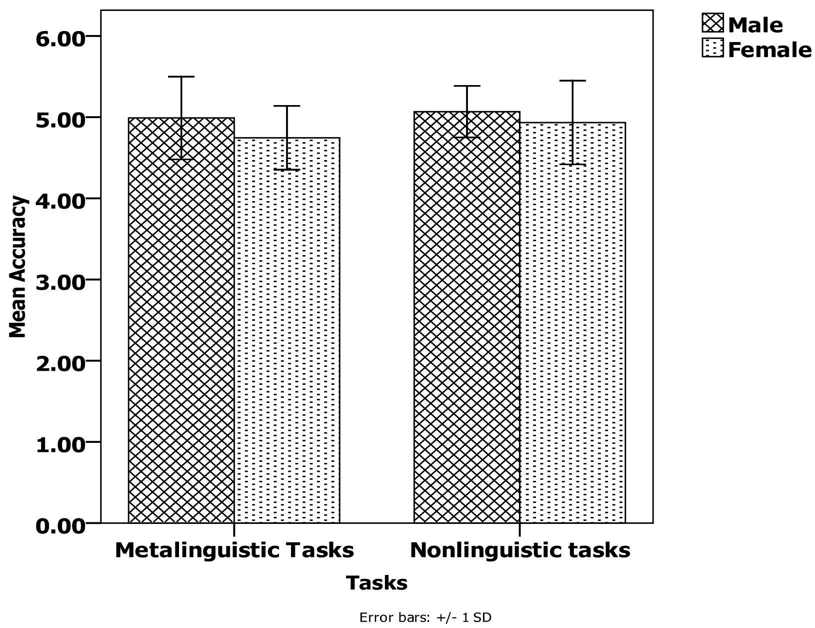

Figure 4.6: Mean and Standard deviation of accuracy measures on metalinguistic and non linguistic cognitive tasks in the multilingual group.

As depicted in Fig 4.6, that the males performed more accurately than females on the metalinguistic and non linguistic cognitive tasks in the multilingual group, though no significant statistical difference was found.

d) Comparison of performance in reaction time and accuracy measures across gender in the bilingual group on the different subtasks included under metalinguistic and non-linguistic cognitive tasks:

The mean values of the males and females of the multilingual group on reaction time and accuracy measures were compared on the subtasks of metalinguistic and non-linguistic cognitive task. The mean and standard deviation of the males and females on the various subtasks have been depicted in Table 20. The males had shorter mean values on the reaction time measures on the all the three subtasks of metalinguistic task indicating that they performed faster than the female participants.

In the accuracy measures the males had greater mean score in the metasemantic and metasyntactic subtask than females and the females outperformed males in the metaphonology task.

Table 4.20: *Mean, standard deviation (SD) and F values of multilingual group across female and male participants on the sub tasks of metalinguistic and non-linguistic cognitive tasks.*

Task	Gender	Reaction Time			Accuracy		
Metalinguistic		**Mean**	**SD**	**F(1,28)**	**Mean**	**SD**	**F(1,28)**
Metaphonology	Males	525.65	235.07	3.15	5.56	0.70	0.35
	Females	662.71	185.29		5.70	0.52	
Metasemantic	Males	2346.82	405.71	4.12*	4.96	0.66	2.04
	Females	2911.55	998.08		4.63	0.61	
Metasyntactic	Males	2945.67	295.28	1.95	4.43	0.72	3.85
	Females	3091.92	278.62		3.90	0.76	
Non-linguistic cognitive							
Go task	Males	472.61	140.40	0.73	NA	NA	-
	Females	520.96	168.33		NA	NA	

No go task	Males	608.20	169.64	1.36	5.60	0.73	1.60
	Females	667.50	99.90		5.87	0.35	
Visual Search	Males	2195.91	386.24	0.49	4.87	0.51	1.58
	Females	2282.35	285.04		5.13	0.64	
Mental Rotation	Males	1529.24	428.50	3.95*	5.07	0.45	0.66
	Females	1782.19	244.00		4.87	0.83	
Odd One Out	Males	2540.28	330.05	1.40	4.93	1.28	2.65
	Females	2695.74	388.49		4.13	1.40	
Find the Missing Element	Males	2699.46	360.54	0.24	4.87	0.83	0.59
	Females	2756.98	279.17		4.60	1.05	

*p<0.05

The mean values were subjected to one way ANOVA to check for any significant difference between males and females with regard to reaction time and accuracy measures on each subtask of the metalinguistic task. The F values for the individual subtasks of metalinguistic have been depicted in Table 18. The results revealed a significant difference between the males and the females only with regard to the reaction time measures on the metasemantic task. In the accuracy measure, there was no significant difference found on any task across the genders.

In the subtasks under non-linguistic cognitive domain, the males had shorter mean values on the reaction time measures on all the tasks indicating that they performed faster compared to their female counterparts. The males were more accurate on all the tasks compared to females, except no go and visual search task, where the females outperformed the males in terms of accuracy. The mean values were subjected to one way ANOVA to check for any significant difference between males and females with regard to reaction time and accuracy measures on each subtask of the non-linguistic task. The F values for the individual subtasks of metalinguistic have been depicted in Table 20. The results revealed that there was no significant difference across both the males and the females in reaction time measures except on the mental rotation task. In the accuracy measure, there was no significant difference found on any task across the groups.

To sum, the findings of the present study indicated that the bilinguals performed faster with respect to reaction time measures than the multilingual group when the overall performance on the metalinguistic and non-linguistic cognitive task was considered, though no significant difference on the performance was found. However, the multilinguals performed more accurately than the bilingual group on both the tasks with a statistically significant difference between the groups.

When the mean values obtained only on the metalinguistic task for both the groups were compared, the bilingual group performed faster than the multilingual group with no statistical significance. However, the multilingual group performed more accurately with significant statistical difference on the non-linguistic cognitive tasks. In the subtasks of metalinguistic task, the bilingual group performed faster on both metasemantic and metasyntactic tasks, while the multilingual group outperformed the bilingual group in the metaphonology task. In the accuracy measures, the multilingual group performed more accurately than the bilingual group on all the three subtasks. On the non-linguistic task, the multilingual group performed faster and more accurately than the bilingual group with no statistical significance.

The study also revealed that though the male participants of the bilingual group performed faster and accurately than female participants on both metalinguistic and non-linguistic cognitive tasks, there was no statistical difference found both in reaction time and accuracy measures. However in the multilingual group significant statistical difference was found on the reaction time measures between male and female participants on metalinguistic and non-linguistic cognitive task. There was no significant difference found on the accuracy measure in the multilingual group.

Chapter 5

Discussion

The study aimed to investigate the processing speed for metalinguistic and non-linguistic cognitive tasks in bilingual and multilingual children in the age range of 9-10 years. Processing speed is one of the measures of cognitive efficiency or cognitive proficiency. It involves the ability to automatically and fluently perform relatively easy or over-learned cognitive tasks, especially when high mental efficiency is required. This was studied by adopting reaction time and accuracy measures. Both of these measures are crucial in determining the performance of children on such tasks. Although accuracy measures are the important measures, they cannot explain certain processing differences. The bi/multilinguals may simply perform better on accuracy with increased processing time. Therefore both the accuracy as well as reaction time measures were used in the study. The results of the present study revealed important findings with respect to the reaction time and accuracy between bilingual and multilingual children on metalinguistic and non-linguistic cognitive task. The results also revealed some important findings with regard to the gender differences within both the groups.

First, the bilinguals outperformed their multilingual counterparts with respect to reaction time measures when the overall performance on the metalinguistic and non-linguistic cognitive task was considered, however, this difference was not statistically significant. These tasks directly or indirectly tap the cognitive abilities of the child. This finding indicated that when the linguistic and non-linguistic tasks are taken as a whole the so called advantage of the knowing more than two languages was not seen. Nevertheless, this was observed only w.r.t the reaction time measures. The multilinguals were more accurate on these tasks as a whole compared to the bilinguals and this was statistically significant. Many studies have supported the fact that knowing more than one language could lead to an advantage in the cognitive and metalinguistic skills. This has been proved through research conducted over several decades especially on individuals who are bilinguals. Although research is limited in the area of multilinguals, the findings obtained from the bilinguals could be generalized to the multilinguals. The results of the present study also suggest the fact that the multilingualism leads to cognitive advantages.

When the tasks were considered individually, the bilinguals performed better than the multilinguals on the metalinguistic task with regard to the reaction time measures. However this difference was not statistically significant. For performing a metalinguistic task, a focus on the form of the language is essential. Galambos and Goldin Meadow

(1990) suggested that the metalinguistic advantage exhibited by the bilingual children occur because they need to focus on the form in order to differentiate between their two language codes. This focus on the form could provide an essential experience from an early age in which some abstract feature of the language, especially the language which is being used, must be attended to. With that experience the bilingual children may simply find it easier to treat language as a formal system and examine its properties. Learning a second language permits children to view their language as one system among others, thereby enhancing their linguistic awareness. It is believed that the systematic separation of form and meaning that is experienced in early bilingualism gives children added control of language processing.

Further, the bilinguals are aware of only two languages, where as the multilinguals are aware of greater number of languages. According to Levelt (1989) individuals who know two or more languages find it difficult to 'switch off' their native language or even their second language and process language during speaking or listening, in a purely monolingual mode. Interactions between languages have been observed at all representational levels of language and these interactions are increased in multilinguals. Since the languages are more in multilinguals and interaction between these languages are increased, the reaction time of these individuals could have been slower compared to the bilinguals.

A review by Smith (1991) on the theory about lexical (word) representations can be used to support the results of the present study. According to this theory, the bilinguals have two separate lexicons (mental dictionaries): one lexicon that contains all the words of their native language (L1) and another lexicon that contains the words of their second language (L2). The multilinguals may simply have more lexicons depending upon the number of languages they know. In responding to a stimuli in one language, the brain has to build on a neural network that enables the segregation of one language from another, the creation of its corresponding activation and inhibitory links at the lexical, morphological, and syntactic level, and, finally, the development of the ability to correctly select a word and its syntactic properties in the required language (i.e., the language currently in use). Therefore, in the present study it is speculated that the multilinguals had greater reaction time than bilingual group due to the interaction between languages at various levels of language representation and the greater number of lexicons in these individuals, time involved in segregation of one language from the other by inhibiting links at different levels which led to increased processing time.

There has been a vast variety of studies in literature which indicate bilingual disadvantage indicating that bilingualism does introduce some processing costs. Compared to monolinguals, bilinguals name fewer pictures on standardized tests such as the Boston Naming Test (Roberts, Garcia, Desrochers, & Hernandez, 2002; Gollan, Fennema-Notestine, Montoya & Jernigan, 2007), name pictures more slowly (Gollan, Montoya, Fennema-Notestine & Morris, 2005), experience more tip-of-the-tongue (TOT) retrieval failures (Gollan & Silverberg, 2001) and have reduced verbal fluency (Monica, Alfredo, Mirtha, Mariadel, Alejandra, & Bonie, 2000; Gollan, Montoya & Werner, 2002). It could be presumed that similar disadvantage is seen in the individuals who know more than two languages. This multilingual disadvantage also extends support for the results obtained in the present study with regard to the poorer performance of multilinguals on metalinguistic tasks.

On the non-linguistic cognitive tasks, however, the multilinguals performed better with regard to the reaction time measures. Several studies have reported a bilingual advantage over monolinguals w.r.t the non-linguistic cognitive tasks (Peal & Lambert, 1962; Liedtke & Nelson, 1968; Landry, 1973; Cummins & Gulutsan, 1974; Ben-Zeev, 1977a, 1977b; Duncan & De Avila, 1979; Samuels & Griffore, 1979; Diaz, 1982; Hakuta, 1985; Kessler & Quinn, 1987; Foster & Reeves, 1989; Bamford & Mizokawa, 1991; Stephens, Advisor, Esquivel, & Giselle, 1997; Bialystok, 2005; Kormi-Nouri, Moniri, & Nilsson, 2003; Stephen, Sindhupriya, Mathur, & Swapna, 2010; Wodniecka, Craik, Luo, & Bialystok, 2010; Bonifacci, Giombini, Bellochi, & Contento, 2011). They have reported of increased cognitive flexibility, memory, concept formation, divergent thinking, problem solving, visual memory, general reasoning and verbal abilities etc. in bilinguals compared to monolinguals. Further a pilot study by Ring (2010) to study the cognition in multilinguals using Go/No Go task showed a trend for multilinguals to be faster at the attentional control task, though this was not statistically significant. They concluded that reaction times are faster for respondents who speak three or more languages and they have better attentional control than those who speak fewer languages. These studies support the fact that knowledge of additional languages adds a cognitive advantage atleast in the areas that do not incorporate language aspects in the individual. The results obtained in the present study are in consonance with these studies.

Additionally it was seen that within the both the groups, the children performed better on the non-linguistic task with respect to both reaction time and accuracy compared to the multilinguals. However there was no significant difference on the reaction time measures, although there was a significant difference w.r.t accuracy. This can be explained by the Dual Coding Theory proposed by Paivio in 1971. According to this theory, cognitive activities in human memory are mediated by two symbolic systems; one specialized for processing verbal information and the other for nonverbal (imagery) information. These two representational systems are presumed to be interconnected, but capable of functioning independently. Experiments have also clearly showed that stimuli presented in pictures are recalled more than stimuli presented verbally. This is in consonance with the current finding in which the both the groups performed better on the non-linguistic tasks than the metalinguistic task. Further, Paivio and Desrochers (1980) presented their Bilingual Dual Coding Theory (BDCT) which explained that, the nonverbal imagery system is assumed to be functionally independent of both verbal systems. The assumption implies that bilinguals can perceive, remember, and think about nonverbal objects and events without the intervention of either language system and, conversely, that they can behave or think verbally without constant input from the nonverbal system. Since the non-linguistic cognitive task in the present study did not require any verbal mediation, it can be assumed that it was independent of the verbal system and the faster reaction time and accuracy can be attributed to the same.

With regard to accuracy the multilinguals performed better than the bilinguals on all the subtasks of the metalinguistic and non-linguistic cognitive tasks. A significant difference was seen only on the metasemantic and metasyntactic tasks. Although the multilinguals had slower reaction time on metalinguistic task (took more time to respond), they could provide accurate responses which further shows that there is an advantage of knowing more languages although the processing time may be a little slow. This finding supports the notion of Bialystok, Craik, Green, and Gollan, (2009) who differentiated between the two kinds of tasks, those which involve control of linguistic processing, and those calling for a more analytical approach to language. They reported that bilingual children outperformed monolinguals in tasks involving the cognitive control of linguistic processes.

Second, within the metalinguistic task, the bilinguals performed faster on the metasemantic and metasyntactic subtasks, but not on the metaphonology tasks. However there was no statistically significant difference between the groups on any of the tasks. This result could be attributed to the differences in stimuli used in these tasks. In the metasemantic and metasyntactic tasks, words and sentences were used, whereas in the metaphonology tasks, the children had to focus only on the syllables within words. The greater interaction between languages and not switching off their native language or even their second language even during processing language during speaking or listening, in a purely monolingual mode, greater number of lexicons in these individuals, time involved in segregation of one language from the other by inhibiting links at different levels etc. could have contributed to their poor performance. In the metaphonology task, the syllables are the focus which does not involve any meaning component. Therefore this could have lead to the superior performance of the multilinguals on this task.

Within the metalinguistic skill, it was also seen that the both the groups of children performed faster and more accurately on the metaphonology task compared to the metasemantic and metasyntactic subtasks. This can also be attributed to the phonological working memory advantage in individuals knowing more than two languages. Tabares (2012) conducted a study on the phonological influences in verbal working memory in monolinguals and bilinguals. They used two experiments, that is, immediate serial recall and phonological similarity effects. It was found that the dominant language advantage effect in bilingual working memory performance was seen. The same could be generalized to the multilinguals too. In the present study since Kannada was the dominant language, being the native language, it can be assumed that the multilinguals had better working memory in the same. Also, processing speed is one of the measures of cognitive efficiency or cognitive proficiency. The multilingual group therefore had better cognitive efficiency than the bilingual group and hence better reaction times on metaphonological task.

Third, within the non-linguistic cognitive tasks, the multilingual group performed faster and more accurately than the bilingual group on most of the tasks except the no go and the visual search task. However this was not statistically significant. The multilinguals were more accurate than the bilinguals in all the tasks and this was statistically significant. The results also derive support from the study conducted by Ring (2010) who found that the multilinguals were faster than bilinguals at the attentional control task, though it was not statistically significant.

The easiest among the non-linguistic task was the ‘go’ task with respect to the reaction time measure and ‘no go’ task with respect to the accuracy for both the groups. The most difficult task where comparatively poor scores were obtained were the ‘odd one out’ for the bilingual group and ‘find the missing element’ for the multilingual groups w.r.t the reaction time measure. With respect to the accuracy measure the ‘odd one out’ task had the poorest accuracy for both the groups. However there was no significant difference seen on these tasks. This can be explained on the basis of degree of cognitive control required for these tasks. Gomez, Ratcliff, and Perea (2007) in their study mention that the ‘go’ and ‘no go’ task apparently require the same cognitive functions. Tasks like ‘odd one out’ and ‘find the missing element’ requires an essential component of working memory. This could possibly justify the finding that both the groups took longer processing time to respond to these tasks than the ‘go’, and ‘no go’ tasks which require inhibitory control alone.

Third, the results of the present study revealed that on the reaction time and accuracy measure, the males in both the groups performed better than the females. Males had shorter reaction time and performed more accurately than females on both the tasks. Within the metalinguistic task w.r.t the reaction time measures, the males outperformed their female counterparts on all subtasks except the metaphonolgy task which was performed faster by female participants. Within the non-linguistic cognitive task the males performed better than the females only on ‘go’, ‘no go’ and ‘find the missing element’ tasks. However, there were no statistically significant differences between the males and the females. In the multilingual group the males performed faster than the females on both metalinguistic and non-linguistic cognitive tasks and there was a statistical difference found only on the reaction time between genders.

The results of the present study conflicted with the research done by Hyde and Linn (1988) who located 165 studies that reported data on gender differences in verbal ability. The weighted mean effect size was +0.11, indicating a slight female superiority in performance. However, the difference was so small that they argued that gender differences in verbal ability no longer exist.

Support can be drawn for the results obtained in the present study from the study by Wallentin (2008) who revealed that differences in language proficiency do not exist between males and females and there was no consistent difference between males and females in language-related cortical regions. The present study is also supported by the investigations of Bell, Willson, Wilman, Dave, and Silverstone (2006) who found that the males performed better than females on all the tasks, but no significant statistical difference was found. Levin (2005) found that males typically outperform females on tasks dealing with mental rotation and spatial navigation, whereas females outperform males in object location, relational object location memory or spatial working memory. This study is in consonance with the present study where the females performed better on metaphonological task which contained syllable oddity which required spatial working memory, the females performed better on tasks like visual search and males performed better on mental rotation tasks.

The present finding is also supported by the Gender Similarities Hypothesis by Hyde (2005). The gender similarities hypothesis states that males and females are similar on most, but not on all, psychological variables. That is, men and women, as well as boys and girls, are more alike than they are different. Also, extensive evidence from meta-analyses of research on gender differences supports the gender similarities hypothesis.

Chapter 5

Summary and Conclusions

Processing speed involves the ability to automatically and fluently perform relatively easy or over-learned cognitive tasks, especially when high mental efficiency is required and is a measure of cognitive efficiency or cognitive proficiency. Over the decades, studies of processing speed have primarily focused on isolated linguistic or non-linguistic tasks. Further, studies investigating the processing speed as a measure of the bi/multilingual individuals' cognitive and metalinguistic skills are limited. The studies on bilinguals reported in the literature provide evidence that the experience of controlling attention to two languages boosts the development of executive control processes in childhood for bilinguals, sustains cognitive control advantages for bilinguals through adulthood and protects bilingual older adults from the decline of these processes with ageing. Research by Bialystok and her colleagues has shown that early bilingualism and constant daily use of two or more languages leads to precocious development of certain cognitive processes for children, advantages that persist across the lifespan. However such advantages whether present in those individuals who know more than two languages is unknown, since research in this area is scanty, more so in the Indian context. Keeping this in view, the current study was planned to investigate the differences in processing speed, if any, between bilinguals and multilinguals by incorporating both the linguistic and the non-linguistic tasks. Specifically, the study primarily intended to investigate the processing speed on 'metalinguistic' and 'non-linguistic cognitive' tasks in bilingual and multilingual children in the age range of 9-10 years. This was studied by adopting reaction time and accuracy measures. The precise objectives of the study were to compare the differences in reaction time and accuracy, if any, between the two groups of children with respect to metalinguistic and non-linguistic cognitive tasks and to investigate the gender differences if any, across the tasks within each group.

The study included 60 children who were divided into two groups; 30 bilingual children and 30 multilingual children (15 males and 15 females in each group). Metalinguistic and non-linguistic cognitive tasks were used in the study. Each task had six subtasks in it. The metalinguistic tasks incorporated three sections which were metaphonology tasks which included two subtasks viz. rhyming and syllable oddity, metasemantic task which included two subtasks viz. synonyms and semantic similarity task and metasyntactic task which included comparatives and grammatical judgement task. The non-linguistic cognitive task included Go, No go, visual search, mental rotation, odd one out and find the missing element subtasks. The stimuli which were drawn from several available standardized tests was programmed on the DMDX software accordingly such that the children responded by pressing the key on the computer as soon as they finished listening/seeing the stimuli. The stimuli were presented in Kannada language to the children.

A pilot study was carried out initially in which all the twelve subtasks under the metalinguistic and non-linguistic cognitive domains were administered on five typically developing children from each group following which some modifications were incorporated. The testing was carried out in a quiet environment and without any distractions. All tasks were presented on a laptop computer using the DMDX software, and children responded by striking a key on the keyboard. For each task two trials were given, following which the actual six stimuli were presented which were randomly ordered. For all the tasks, the children were expected to give a key press response, and the child pressed one key (marked “yes” in green colour) for a yes or positive response and a different key (marked “no” in red colour) for a negative response. The children were instructed always to respond as quickly as possible without affecting the accuracy. The reaction time was measured (milliseconds) as the duration between the presentation of the stimuli and the completion of the response (key press).

The mean reaction time and the accuracy were analyzed for both the bilingual and multilingual groups for each of the metalinguistic and non-linguistic cognitive tasks. This was later averaged across participants for the different tasks and compared within and across various tasks for both groups. The data was analyzed and statistically treated using the SPSS software to determine if there was any significant difference in the reaction time and accuracy between bilingual and multilingual children on metalinguistic and non-linguistic cognitive tasks. Descriptive statistical procedures were used to compute the mean and standard deviation values in the both the groups on both the tasks. Repeated measure ANOVA was administered to see the main effect of group, task and interaction between them. One way ANOVA was carried out to see the significant difference, if any, between each task across the group. Bonferroni’s multiple comparison test was used to investigate which pair of the tasks was different within the bilingual and multilingual group.

The overall findings of the study can be recapitulated as follows:

1. In the reaction time measures, the bilinguals obtained a lower mean score compared to the multilinguals when the overall performance on both the metalinguistic and non-linguistic cognitive tasks were considered indicating that they outperformed the

multilingual group. However, the multilingual group had a greater accuracy mean score when the overall accuracy values of metalinguistic and non-linguistic cognitive tasks were compared indicating that the multilingual group performed more accurately than the bilingual group. In the metalinguistic task the bilinguals performed faster than the multilingual group whereas the multilingual group performed accurately with significant statistical significance. In the non-linguistic task alone, the multilinguals outperformed the bilingual group on both reaction time and accuracy measures.

2. Both the bilingual and multilingual group performed the non-linguistic cognitive tasks faster than the metalinguistic tasks. In terms of accuracy the bilingual group performed accurately on the metalinguistic tasks than on the non-linguistic cognitive tasks, whereas the multilingual group performed more accurately on the non-linguistic cognitive tasks.

3. The study also revealed that the male participants in bilingual group performed faster and more accurately on metalinguistic and non-linguistic cognitive tasks than the bilingual group, however there was no statistical significant difference found. In the multilingual group, the males outperformed the females on both the tasks with a statistically significant difference in the reaction time measures.

Thus it can be concluded that the multilinguals have an advantage over the bilinguals on tasks involving the cognitive control of linguistic processes and non-linguistic cognitive tasks. The current finding adds onto the literature concerning the cognitive advantage seen in the population who know and speak several languages.

Implications of the study

These results firmly support the claim that the multilingualism fosters the development of cognitive and linguistic functions. The results of this study would contribute towards enriching the theoretical knowledge on the relations among bilingualism/multilingualism and cognition.

The results of the present study are of clinical significance as it is observed that there was a significant difference in the accuracy of bilingual and multilingual group on both the metalinguistic and non-linguistic cognitive task. This trend has to be borne in mind while assessing and planning intervention programs for children with communication disorders.

This study gives scope to clinicians for assessing and planning intervention procedures. Also, the intervention and assessment procedures should include linguistic and non-linguistic cognitive stimuli. In the Indian context where multilingualism is a common phenomenon, it is imperative that assessment procedures be carried out in all the languages the child knows and the interpretation to be made accordingly.

Since India is a multilingual country, there is a pressing need to carry out similar kind of research, in more number of languages and in multilingual children belonging to various cultural backgrounds to explore their cognitive and linguistic processes. In addition, further research is required considering a large sample of subjects, age groups, other cognitive domains (pattern recognition, reasoning, and orientation), different types of bilingualism (successive, co-ordinate, compound, passive, balanced) and in various speech and language disorders to discover the exact relationship between language and cognition.

References

Anastasi, A., & Cordova, F. (1953). Some effects of bilingualism upon the intelligence test performance of Puerto Rican children in New York City. *Journal of Educational Psychology,* 44, 1–19.

Angell, C. A. (2010). Language Development and disorders: A Care study approach. Jones and barlett publishers.

Anuroopa, L., & Shyamala, K. C. (2008). Development of cognitive linguistic assessment protocol for children. Student Research at AIISH Mysore (Articles based on dissertation done at AIISH), Vol: IV, Part B, 1-9.

Bamford, K.W., & Mizokawa, D.T. (1991). Additive-bilingual (immersion) education: Cognitive and language development. *Language Learning*, 41, 413-429.

Barik, H. C., & Swain, M. (1976). A longitudinal study of bilingual and cognitive development. *International Journal of Psychology, 11*(4), 251-263. from PsycINFO database.

Bell, E. C., Willson, M. C., Wilman, A. H., Dave, S., & Silverstone (2006). Males and females differ in brain activation during cognitive tasks, *Neuroimage,* 1,30(2), 529-38.

Ben Zeev, S. (1972). *The influence of bilingualism on cognitive development and cognitive strategy*. Unpublished doctoral dissertation, University of Chicago.

Ben-Zeev, S. (1975). *The effect of Spanish-English bilingualism in children from less privileged neighborhoods on cognitive development.* Research report to HEW Nat. Inst. Child Health and Human Development, USA.

Ben-Zeev, S. (1977). The influence of bilingualism on cognitive strategy and cognitive development. *Child Development, 48*(3), 1009-1018. from PsycINFO database.

Ben-Zeev, S. (1977b). The effect of bilingualism in children from Spanish-English low economic neighborhoods on cognitive development and cognitive strategy. *Working papers on bilingualism, no. 14.* Bilingual Education Project.

Best, J. B. (1999). *Cognitive Psychology* (5th Ed). Belmont: Woodsworth publishing company.

Bhatia, C. M. (1955). *Performance tests of intelligence under Indian conditions*. Bombay, Oxford University Press.

Bialystok, E. (1986a). Cognitive effects of bilingualism: How linguistic experience leads to cognitive change. *Bilingual Education and Bilingualism*.

Bialystok, E. (1988). Levels of bilingualism and levels of linguistic awareness. *Developmental Psychology,* 24, 560 – 567.

Bialystok, E. (1991). Metalinguistic dimensions of bilingual language proficiency. In. E. Bialystok, *Language processing in bilingual children* (pp.113-140). London Cambridge University press.

Bialystok, E. (1992). Attentional control in children's metalinguistic performance and measures of field independence. *Developmental Psychology*, *28*, 654-664.

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development, 70*(3), 636-644.

Bialystok, E. (2001). *Bilingualism in Development: Language, Literacy, and Cognition*. Cambridge Univ. Press, New York

Bialystok, E. (2005). *Consequences of bilingualism for cognitive development*. New York, NY, US: Oxford University Press.

Bialystok, E. (2008). Bilingualism: The good, the bad, and the indifferent**,** *Bilingualism: Language and Cognition,* 12 (1), 2009, 3–11.

Bialystok, E. (2009). Do bilingual children show an advantage in working memory. *Cognitive Psychology Papers,* 1-41.

Bialystok, E. (2010). Bilingualism. *Wiley interdisciplinary reviews: Cognitive science, 1,* 559-572.

Bialystok, E., Craik, F. I. M., Green, W. D., & Gollan, H.T. (2009). Bilingual minds. *Psychological Science in the Public Interest, 10*(3), 89-129.

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging*, 19, 290–303.

Bialystok, E., Craik, F. I. M., & Ryan, J. (2006). Executive control in a modified anti-saccade task: Effects of aging and bilingualism. *Journal of Experimental Psychology*. *Learning, Memory, and Cognition*, 32, 1341–1354.

Bialystok, E., & Feng, X. (2009). Language proficiency and executive control in proactive interference: Evidence from monolingual and bilingual children and adults. *Brain and Language,109,* 93-100.

Bialystok, E., & Majumder, S. (1998). The relationship between bilingualism and the development of cognitive processes in problem solving. *Applied Psycholinguistics,* 19, 69-85.

Bialystok, E., & Viswanathan, M. (2009). Components of executive control with advantages for bilingual children in two cultures. *Cognition,* 112(3), 494-500.

Blackmore, A. M., Pratt, C., & Dewsbury, A. (1995). The use of props in a syntactic awareness task. *Journal of Child Language,* 22, 405-422.

Bonifacci, P., Giombini, L., Bellocchi, S., & Contento, S. (2011). Speed of processing, anticipation, inhibition and working memory in bilinguals. *Developmental Science,* 14, 2, 256–269.

Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S. & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review*, 108, 624-652.

Brooks, R., & Meltzoff, A. N. (2002). The importance of eyes: How infants interpret adult looking- behavior. *Developmental Psychology*, 38, 958-966.

Bunge, S. A., Dudovic, N. M., Thomason, M. E., Vaidya, C. J., & Gabrieli, J. D. (2002). Immature frontal lobe contributions to cognitive control in children: evidence from fMRI. *Neuron, 33*, 301–311.

Call, J**.**, Hare, B. H., Carpenter, M. & Tomasello, M. (2004). 'Unwilling' versus 'Unable': Chimpanzees' Understanding of Human Intentional Action? *Developmental Science, 7, 488-498.*

Call, J., & Tomasello, M. (2008). Does the chimpanzee have a theory of mind? 30 years later. *Trends in Cognitive Science, 12*, 187-192.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social, cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development*, 63 (4, Serial No. 255).

Cerella, J., & Hale, S. (1994). The rise and fall in information- processing rates over the life span. *Acta Psychologica,* 86, 109-197.

Clark, E. (1978). Awareness of language: Some evidence from what children say and do. In A. Sinclair, R. J. Jarvella, & W. J. M. Levelt (Eds.), *The child's conception of language*, (pp. 17-44). New York: Springer- Verlag.

Cohen, J. D., & Servan-Schreiber, D. (1992). Context, cortex and dopamine: A connectionist approach to behaviour and biology in schizophrenia. *Psychological Review*, 99, 45-77.

Colom, R., Contreras, M. J., Arend, I., Garcia Leal, O., & Santacreu, J. (2004). Sex differences in verbal reasoning are mediated by sex differences in spatial ability. *The Psychological Record, 54*, 365-372.

Cromdal, J. (1999). Childhood bilingualism and metalinguistic skills: Analysis and control in young Swedish -English bilinguals. *Applied Psycholinguistics,* 20, 1-20.

Cummins, J. (1976). The influence of bilingualism on cognitive growth: A synthesis of research findings and explanatory hypothesis. *Working Papers on Bilingualism*, 9, 1 - 43.

Cummins, J. (1978). Metalinguistic development of children in bilingual education programs: Data from Irish and Canadian (Ukrainian-English) programs. In M. Paradis (Eds.), *Aspects of bilingualism.* (pp. 127- 138). Columbia, S.C.: Hornbeam Press.

Cummins, J. (1979). Cognitive/academic language proficiency, linguistic interdependence, the optimum age question and some other matters. *Working Papers on Bilingualism*, No. 19, 121-129.

Cummins, J. (1981). Age on arrival and immigrant second language learning in Canada. A reassessment. *Applied Linguistics*, 2, 132-149.

Cummins, J. (1984). *Bilingualism and special education: Issues in assessment and pedagogy.* Clevedon, England: Multilingual Matters.

Cummins, J., & Gulutsan, M. (1974). Some effects of bilingualism on cognitive functioning. S. T. Carey (Eds.), *Bilingualism, Biculturalism and Education*. Edmonton: The University of Alberta Press.

Cook, V. (1995). Multi-competence and the learning of many languages. *Language, Culture and Curriculum,* 8 (2): 93–98.

Czudner, G., & Rourke, B. P. (1970). Simple reaction time in brain damage and normal children under regular and irregular preparatory interval conditions. *Perceptual and Motor Skills,* 31, 767-773.

Czudner, G., & Rourke, B.P. (1972). Age differences in visual reaction time of “brain damage” and normal children under regular and irregular preparatory interval conditions. *Journal of Experimental Child Psychology*, 13, 516-526.

Darcy, N. T. (1953). A review of the literature on the effect of bilingualism upon the measurement of intelligence. *Journal of Genetic Psychology*, 82, 21-57.

Dash, U, N., & Mishra, H, C. (1992), Bilingualism and metalinguistic development: Evidence from kond tribal culture. *Psychological studies*, 37(2-3), 81-87.

Davidson, M.C, Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia,* 44, 2037–2078.

Degroot (2010). *Language and cognition in bilinguals and multilinguals: An Introduction,* New York: Psychology Press.

Diamond, A., Carlson, S. M., & Beck, D. (2005). Preschool children's performance in task switching on the dimentional change card sorting task: Separating the dimensions aids the ability to switch. *Developmental Neuropsychology*, 28, 689-729.

Diaz, R. M. (1982). *The impact of second-language learning on the development of verbal and spatial abilities.* Doctoral Dissertation submitted to Yale university.

Diaz, R. (1983). Thought and two languages: The impact of bilingualism on cognitive development. *Review of Research in Education,* 10, 23-54.

Diebold, A. (1968). The consequences of early bilingualism in cognitive and personality formation. In E. Norbeck, D. Price-Williams, and W. McCord (Eds.), *The Study of Personality* (pp. 253-63). NewYork: Holt, Rinehart & Winston.

DMDX. (n.d.). DMDX display software [Computer software]. Retrieved March 30, 2001, from http://www.u.arizona.edu/kforster/dmdx/dmdx.htm

Doyle, A., Champagne, M., & Segalowitz, N. (1978). Some issues in the assessment of linguistic consequences of early bilingualism. In M. Paradis (Eds.), *Aspects of bilingualism*, 13-21. Columbia, SC: Hornbeam Press.

Duncan, S. E., & De Avila, E. A. (1979). Bilingualism and cognition: Some recent findings. *NABE Journal*, 4, 15-50.

Dykman, R. A., Walls, R., & Suzuki, T. (1970). Children with learning disabilities: Conditioning, differentiation, and the effect of distraction. *American Journal of Orthopsychiatry*, 40, 5, 766-781.

Edwards, D., & Christophersen, H. (1988). Bilingualism, literacy and meta-linguistic awareness in preschool children*. British Journal of Developmental Psychology*, 6, 235–244.

Fardeau, O. (1993). Franco-italian bilingualism in early childhood and cognitive development. [Bilinguisme precoce franco-italien et developpement cognitif] *Il Forneri, 7*(2), 83-99. from Linguistics and Language Behavior Abstracts database.

Foster, K. M., & Reeves, C. K. (1989). Foreign Language in the Elementary School (FLES) improves cognitive skills. *FLES News, 2*(3), 4.

Galambos, S. J., & Hakuta, K. (1998). Subject specific and task specific characteristics of metalinguistic awareness in bilingual children. *Applied Psycholinguistics, 9, 142-162.*

Galambos, S. J., & Goldin-Meadow, S. (1990). The effects of learning two languages on levels of metalinguistic awareness. *Cognition, 34*(1), 1-56.

Gathercole, V., & Montes, C. (1997). That trace effects in Spanish-and English-speaking monolinguals and bilinguals. In A. Perez-Leroux and W. Glass (Eds.), *Contemporary Perspectives on the Acquisition of Spanish, Vol. 1: Developing grammars*. Somerville, MA: Cascadilla Press.

Green, D. W., Crinion, J., & Prince, C. J. (2007). Exploring cross-linguistic vocabulary effects on brain structures using voxel-based morphometry. *Bilingualism: Language and Cognition, 10*, 189-199.

Grosjean, F. (1988). Exploring the recognition of guest words in bilingual speech. *Language and Cognitive Processes*, 3(3), 233-274.

Gupta, P. (2003). Examining the relationship between word learning, nonword repetition, and immediate serial recall in adults. *The Quarterly Journal of Experimental Psychology*, 56A, 1213–1236.

Gollan, T. H., Montoya, R. I., & Werner, G. A. (2002). Semantic and letter fluency in Spanish-English bilinguals. *Neuropsychology,* 16, 562-576.

Gollan, T. H., Montoya, R. I., Fennema-Notestine, C. & Morris, S. K. (2005). Bilingualism affects picture naming but not picture classification. *Memory & Cognition*, 33, 1220–1234.

Gollan, T. H., Fennema-Notestine, C., Montoya, R. I. & Jernigan, T. L. (2007). The bilingual effect on Boston Naming Test performance. *Journal of the International Neuropsychological Society*, 13, 197–208.

Gollan, T. H., & Silverberg, N. B. (2001) Tip-of-the-tongue states in Hebrew–English bilinguals. *Bilingualism: Language and Cognition*, 4, 63–83.

Gombert, J. (1992). *Metalinguistic development*. New York: Wheatsheaf.

Gomez, P., Ratcliff, R., & Perea, M. (2007). A model of the Go/No-Go task. *Journal of Experimental Psychology: General*, 136.3/389–413. American Psychological Association.

Goswami, U., & Bryant, P. (1990). *Phonological skills and learning to read*. East Sussex: Erlbaum.

Hakuta, K. (1985). *Cognitive development in bilingual instruction*. U.S.; Virginia.

Hakuta, K. (1986). *Mirror of language: The debate on bilingualism*. New York: Basic Books.

Hakuta, K., Ferdman, B. M., & Diaz, R. M. (1987). Bilingualism and cognitive development: Three perspectives. In S. Rosenberg (Eds.), *Advances in Applied Psycholinguistics*. Vol. II: Reading, Writing and Language Learning. (pp. 284-319). Cambridge: Cambridge University Press.

Hayes, F. B., Hynd, G. W., & Wisenbaker, J. (1986). Learning disabled and normal college students' performance on reaction time and speeded classification tasks. *Journal of Educational Psychology, 78,* 39-43.

Hickmann, M. (1985). The implications of discourse skills in Vygotsky's developmental theory. In J.V. Wertsch (Eds.), *Culture, communication, and cognition: Vygotskian perspectives* (pp. 236-257). New York: Cambridge University Press.

Hulit, L. M., & Howard, M. R. (2002). *Born to talk: An introduction to speech and language development* (3rd edn.). Boston: Allyn and Bacon.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin, 104*, 53-69.

Hyde, J. S. (2005). The gender similarity hypothesis. *American Psychologist*, 60, 581–592.

Ianco-Worrall, A. D. (1972). Bilingualism and cognitive development. *Child Development,* 43, 1390-1400.

Jensen, J. V. (1962a). Effects of childhood bilingualism. *The New England Journal of Medicine*, 39, 132-143.

Jensen, J. V. (1962b). Effects of childhood bilingualism. *I.El Engl*, 39, 358-366.

Jessner, U. (2006). *Linguistic awareness in multilinguals: English as a third language*. Edinburgh, UK: Edinburgh University Press.

Karanth, P. (1980). *Linguistic Profile Test in Kannada*. Indian council of medical research project, India.

Kaushanskaya, M., & Marian, V. (2009). The bilingual advantage in novel word learning. *Psychonomic Bulletin & Review*, *16* (4), 705-710.

Kave, G., Eyal, N., Shorek, A., & Cohen-Mansfield, J. **(**2008). Multilingualism and cognitive state in the oldest old. *Psychology and Aging, 23*(1), 70–78.

Kessler, C., & Quinn, M. E. (1987). Language minority children's linguistic and cognitive creativity. *Journal of Multilingual & Multicultural Development,* 8, 173 – 186.

Kirkham, N. Z., Cruess, L.M., & Diamond, A. (2003). Helping children apply their knowledge to their behavior on a dimension-switching task. *Developmental Science*, 6, 449-467.

Koda, K. (2008). Impact of prior literacy experience on second-language learning to read. In K. Koda & A. Zehler (Eds.), *Learning to read across languages: Cross-linguistic relationships in first- and second-language literacy development*, (pp. 68-96). New York, NY: Cambridge. University Press.

Kormi-Nouri, R., Moniri, S., & Nilsson, L. (2003). Episodic and semantic memory in bilingual and monolingual children. *Scandinavian Journal of Psychology, 44*(1), 47-54.

Kroll, J. F., Bobb, S. C., Misra, M. M., & Guo, T. (2008). Language selection in bilingual speech: Evidence for inhibitory processes. *Acta Psychologica, 128*, 416-430.

Landry, R. G. (1973). The enhancement of figural creativity through second language learning at the elementary school level. *Foreign Language Annals, 7*(1), 111-115. from Linguistics and Language Behavior Abstracts database.

Levelt, W. J. M. (1989). Speaking: From intention to articulation. Cambridge, MA: Bradford.

Levin, S. L. (2005). Common ground for spatial cognition? A behavioral and fMRI study of sex differences in mental rotation and spatial working memory. *Evolutionary Psychology,* 3, 227-254.

Liberman, I., Shankweiler, D., Liberman, A. M., Fowler, C., & Fischer, F. W. (1977). Phonetic segmentation and recoding in the beginning reader. In A. S. Reber & D. Scarbrough (Eds.), *Toward a psychology of reading:* The proceedings of the CUNY conference. Hillsdale, NJ: Erlbaum.

Liedtke, W. W., & Nelson, L. D. (1968). Concept formation and bilingualism. *Alberta Journal of Educational Research, 14*(4), 225-232. from PsycINFO database.

Lima, S., Hale, S., & Myerson, J. (1991). General cognitive slowing in the nonlexical domain: An Experimental Validation. *Psychology and Aging, 6, 4, 512-521.*

Liston, C., Matalon, S., Hare, T. A., Davidson, M. C., & Casey, B. J. (2006). Anterior cingulate and posterior parietal cortices are sensitive to dissociable forms of conflict in a task switching paradigm. *Neuron,* 50, 4, 643-53.

Maccoby, E. E., & Jacklin, C. N. (1974). *The psychology of sex differences*. Stanford, CA: Stanford University Press.

Martin, C.D., Costa, A., Dering, B., Hoshino, N., Wu, Y.J., & Thierry, G. (2012). Effects of speed of word processing on semantic access: The case of bilingualism. *Brain and Language, 120,* (1) 61-65.

Mechelle, M., Martin, E., & Bialystok, E. (2008).The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition,* (11), 81-93.

Miller, E. K. (2000). The prefrontal cortex and cognitive control. *Nature Reviews Genetics*, 1(1), 59–65.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience,* 24, 167-202.

Miller, L. B., Leonard R.V., & Kail (2006). Response time in 14-Year-Olds with language impairment. *Journal of Speech Language and Hearing Research*, 49, 712–728.

Mohanty, A.K. (1982). Cognitive & linguistic development of tribal children from unilingual to bilingual environment. In R. Rath, H. S. Asthana, D. Sinha & J. B.

P. Sinha (Eds.), *Diversity and unity in cross cultural psychology* (pp. 78-87). Lisse: Swets & Zeitlinger.

Mohanty, A. K. (1992). Bilingualism and cognitive development of kond tribal children: Studies on metalinguistic hypothesis. *Pharmacopsychoecologia. Special Issue: Environmental Toxicology and Social Ecology, 5*(1-2), 57-66.

Mohanty, A. K & Babu, N. (1983). Bilingualism and metalinguistic ability among kond tribals in Orissa, India. *The Journal of Social Psychology*, 121, 15-22.

Monica, R., Alfredo, A., Mirtha, N. S., Mariadel, R, A., Judy, S., Alejandra, C., Bonie, L. (2000). Stroop effect in Spanish–English bilinguals. *Journal of the International Neuropsychological Society*, 8, 819–827

Mora, J. K. (2001). Effective instructional practices and assessment for literacy and biliteracy development. In S. R. H. J. V. Tinajero (Eds.), *Literacy assessment of second language learners* (pp. 149-166). Boston. MA: Allyn and Bacon.

Morais, J., Alegria, J., & Content, A. (1987). The relation between segmental analysis and alphabetic literacy. *Cahiers de psychologic cognitive*, 7, 415-438.

Moriguchi, Y., & Hiraki, K. (2009). *Neural origin of cognitive shifting in young children.* Proceedings of the National Academy of Sciences of the United States of America, 106, 6017-6021.

Nair, V. K. K., Mathew, J., Bhat, S., & Demuth, K. (2012). The effects of bilingualism on novel word learning. *Macquarie University.* In a paper presented at International Conference on Bilingualism and Comparative Linguistics, Hong Kong.

Nicolaos, S., & Yaakov, Stern. (2003). Cognitive reserve and lifestyle. *Journal of Clinical and Experimental Neuropsychology, 25,* 5, 625–633.

Ninio, A., & Snow, C. E. (1996). *Pragmatic development*. Boulder, CO: Westview Press.

Paradis, M. (1986). *Bilingualism*. International Encyclopedia of Education. Oxford: Pergamon, (pp. 498-93).

Patnaik, K., & Mohanty, A. K. (1984). Relationship between metalinguistics and cognitive development of bilingual and unilingual tribal children. *Psycho-Lingua, 14*(1), 63-70.

Peal, E., & Lambert, W. E. (1962). The relation of bilingualism to intelligence. *Psychological Monographs,* 76, 27, 1-23.

Pintner, R., & Keller, R. (1922). Intelligence tests of foreign children. *Journal of Educational Psychology,* 13, 214-221.

Paivio, A. (1971). Imagery and verbal processes. New York: Holt, Rinehart, and Winston.

Paivio, A., & Desrochers, A. (1980). A dual-coding approach to bilingual memory. *Canadian Journal of Psychology*, 34(4) , 388-399.

Pratt, C., Tunmer, W. E., & Bowey, J. (1984). Children's capacity to correct grammatical violations in syntax. *Journal of child Language*, 11, 121-141.

Prema, K. S. (1997). *Reading Acquisition Profile in Kannada- (RAP-K).* Unpublished Doctoral thesis, University of Mysore, Mysore, India.

Rae, G., & Potter, T.C. (1981) Early Reading Skills. *Informal Reading Diagnosis – A Practical Guide for the Classroom Teacher*, Prentice Hall, New Jersey.

Raven, J. C. (1976). *Standard Progressive Matrices*. Set A, Oxford. Oxford psychological press.

Redlinger, W. & Park, T. (1980). Language mixing in young bilinguals. *Journal of Child Language* , 7, 337-352.

Reynolds, A. (1991). *The cognitive consequences of bilingualism*. ERIC/CLL News Bulletin 14,1-8.

Ricciardelli, L. A. (1992). Bilingualism and cognitive development in relation to threshold theory. *Journal of Psycholinguistic Research*, 21, 4, 301-316.

Ricciardelli, L. A. (1993). An investigation of the cognitive development of Italian-English bilinguals and Italian monolinguals from Rome. *Journal of Multilingual and Multicultural Development, 14*(4), 345-346.

Ridderinkhof, K.R., Ullsperger, M., Crone, E.A., & Nieuwenhuis, S. (2004). The role of medial frontal cortex in cognitive control. Science, 306, 443-447.

Ring, H. (2010). *Multilingual cognition: Go/No-Go Reaction Times*. Fall Term Paper, Linguistics PhD Program, Singapore.

Roberts, P. M., Garcia, L. J., Desrochers, A., & Hernandez, D. (2002). English performance of proficient bilingual adults on the Boston Naming Test. *Aphasiology*, 16, 635–645.

Rodriguez, Y. E. G. (1992). *The effects of bilingualism on cognitive development* (Doctoral dissertation, Temple University). Dissertation Abstracts International, 53, 1104-A.

Rosenblum, T., & Pinker, S. A. (1983). Word magic revisited: Monolingual and bilingual children's understanding of the word-object relationship. *Child Development*, 53, 773-780.

Rubin, R., & Carlan, V. G. (2005). Using writing to understand bilingual children's literacy development. *Reading Teacher*, 58 (8), 728-739.

Saer, D. J. (1923). The effect of bilingualism on intelligence. *British Journal of Psycholinguistics*, 14, 25-38.

Samasthitha, S., & Goswami, S. P. (2009). Metaphonological abilities in monolingual and bilingual children: A comparative study, Student research at All India Institute of Speech & Hearing, Mysore (Articles based on dissertation done at AIISH) Vol. VII: 2008-2009, Part B, 249-261.

Samuels, D. D., & Griffore, R. J. (1979). The Plattsburgh French language immersion program: Its influence on intelligence and self-esteem. *Language Learning*, 29, 45-52.

Sangeetha, S. (2011). Cognitive linguistic abilities in simultaneous vs. sequential bilingual children. An unpublished master's dissertation submitted to the University Of Mysore, Mysore.

Scholl, D. M., & Ryan, E. B. (1980). Development of metalinguistic performance in the early school years. *Language and Speech*, 23, 199-211.

Segalowitz, N. (1977). Psychological perspectives on bilingual education. In B. Spolsky and R. Cooper (Eds.), *Frontiers of Bilingual Education* (pp. 119–158). Rowley, MA: Newbury House.

Shabani, M. B., & Sarem. S. N. (2008). *The study of learning strategies used by male/female monolingual and bilingual speakers as EFL learners*, Ilam University.

Singhi, P., Kumar, M, Malhi, P., & Kumar, R. (2007). Utility of the WHO ten questions screen for disability detection in a rural community – the North Indian Experience. *Journal of Tropical Paediatrics*, 83 (6), 383-387.

Smith, M. (1991). On the recruitment of semantic information for word fragment completion: evidence from bilingual priming. *Journal of Experimental Psychology: Learning, Memory, and Cognition,* 17, 234-244.

Solomon, M., Ozonoff, S., Ursu, S., Ravizza, S. M., Cummings, N., Ly, S., & Carter, C. S. (2009). The neural substrates of cognitive control deficits in Autism Spectrum Disorders. *Neuropsychologia, 47* (12), 2515-2526.

Spring, C. (1971). Perceptual speed in poor readers. *Journal of Educational Psychology*, 62, 492-500.

Stephens, Mary, A. A., Esquivel, Giselle, B. (1997). *Bilingualism, creativity, and social problem-solving.* Doctoral thesis submitted to the Fordham University.

Stephen, S., Sindhupriya, C., Rupali, M., & Swapna, N. (2010). Cognitive-linguistic abilities in bilingual children. *Journal of All India Institute of Speech & Hearing, Vol.* 29(1), 1-11.

Svalberg, A. (2007). Language awareness and language learning. *Language Teaching,* 40, (4), 287–308.

Tabares, J. G. (2012). Phonological influences in verbal working memory in monolinguals and bilinguals. Doctoral dissertation submitted to University of California, Irvine.

Turner, W., & Bowey, J. (1984). Metalinguistic awareness and reading acquisition. In W. Tunmer, C. Pratt & M. Herriman (Eds.), *Metalinguistic awareness in children: Theory, research, and implications* (pp. 144-168). New York: Springer- Verlag.

Tunmer, W., Herriman, M., & Nesdale, A. (1988). Metalinguistic abilities and beginning reading. *Reading Research Quarterly*, 23, 2, 134-158.

Tunmer, W., Pratt, C., & Herriman, M. (Eds.) (1984). *Metalinguistic awareness in children*. Berlin: Springer Verlag.

Toukomma, P., & Skutnabb-Kangas, T. (1977). *The intensive teaching of the mother tongue of migrant children at pre-school age* (Research Report No. 26). Department of Sociology and Social Psychology, University of Tempere.

Tsushima, W. & Hogan, T, (1975). Verbal ability and school achievement of bilingual and monolingual children of different ages. *The Journal of Educational Research, 68* (9), 349- 353.

Trask, R. L. (1999). *The key concepts in language and linguistics.* New York: Routledge.

Van Kleeck, A. (1994). Emergent literacy: Learning about print before learning to read. In K. Butler (Eds.), *Best practices: The classroom as an intervention context*, 3-33.

Venkatesan, S. (2009). Readapted from 1997 Version. *NIMH Socio Economic Status Scale*. Secunderabad: National Institute for the Mentally Handicapped.

Vihman, M, M. (1985). Language differentiation by the bilingual infant. *Journal of Child Language*, 12, 297 – 324.

Wallentin, M. (2009). Putative Sex differences in verbal abilities and language cortex: a critical review. *Brain and Language,* 108, 175–183.

Weinreich, U. (1953) *Languages in Contact: Findings and Problems.* Linguistic Circle of New York, New York. The Hague.

Wylie, E. & Ingram, D. E. (2006). *International Second Language Proficiency Ratings. (ISLPR): general proficiency version for English*. Centre for Applied Linguistics and Language, Mt Gravatt Campus Griffith University, Natha.

Wodniecka, Z., Craik, F. I. M., Luo, L. & Bialystok, E. (2010). Does bilingualism help memory? Competing effects of verbal ability and executive control. *International Journal of Bilingual Education and Bilingualism*, *13 (5)*, 575-595.

Yeung, N., Botvinick, M. M., & Cohen, J. D. (2004). The neural basis of error detection: conflict monitoring and the error-related negativity. *Psychological Review,* 111, 931-959.

Zelazo, P. D. (2006). The Dimensional Change Card Sort (DCCS): a method of assessing executive function in children. *Nature Protocol*, 1 (1), 297-301.

APPENDIX I

SL.No	Task Type		Description	Example Stimuli	RT measure
I	**Metalinguistic**				
1.	Metaphonolgy	Rhyming	Strike a key marked with green if the pair of words are rhyming, or red if they are not	/ka:gada/ - /ta:gada/	ms from onset of auditory stimulus to keypress
		Syllable oddity	Strike 1 out of 4 keys depending upon the word with an odd syllable.	/Charata/ /Chamacha/ /Chatura/ /Seragu/	ms from onset of auditory stimulus to keypress
2.	Metasemantics	Synonyms	Strike a key marked with green if the pair of words are synonyms, or red if they are not	/daje/ - /karuɳe/	ms from onset of stimuli on screen to keypress
		Semantic Similarity	Strike a key marked with green if the pair of words are semantically similar, or red if they are not	a:du/ ---- /a:ta/	ms from onset of stimuli on screen to keypress
3.	Metasyntactic	Comparatives	Strike a key marked with green if the sentence has a comparative, or red if it is not	/giri:ʃ/ /sure:ʃaniginta/ /tʃikkavanu/	ms from onset of stimuli (sentence) on screen to keypress
		Grammatical Judgement	Strike a key marked with green if the sentence is	/avanu/ /sinimage/ /hogo:ɳa/	ms from onset of stimuli (sentence)

		grammatically correct, or red if it not		on screen to keypress

Sl. No.	Task type	Description	Example stimuli	RT measure
II	**Non-linguistic cognitive**			
1.	Go task	Strike a key in response to “Green dot” on the screen	Green dot	ms from onset of stimuli to keypress
2.	No go task	Strike a green key in response to “Green dot” on the screen and Do not press any key when a patterned dot appears	Green dot Patterned dot	ms from onset of stimuli to keypress
3.	Visual search	Strike green key if target is present, red if absent.	Array of figures from a standardized test	ms from onset of array to keypress
4.	Mental rotation	Strike red key if second figure matches target, green if mirror image	Pair of figures from a standardized test	ms from onset of stimulus pair to keypress.
5.	Odd one out	Strike a key corresponding to the picture which is an odd one	Array of figures from a standardized test	ms from onset of stimulus pair to keypress
6.	Find the missing element	Strike a key corresponding to the figure with a missing element	Array of figures from a standardized test	ms from onset of stimulus pair to keypress