Research Article

Lexical-Semantic Production and Inhibitory Control Skills in Monolingual (Kannada) and Bilingual (Kannada-English) Children

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Abstract

The study aimed to evaluate lexical semantic production and inhibitory control skills in monolingual and bilingual children. A total of 240 children in the age range of 8 to 10 years with one year age interval belonged to monolingual and bilingual groups participated in the study. Timed picture naming task was used to assess lexical semantic production. Two subtasks namely verbal inhibition and nonverbal motor inhibition was used to examine the inhibitory control skills in all the participants. Response accuracy and reaction times were the two parameters measured in each task. The results of the present study revealed that the age and gender did not have any significant effect on the performance of these tasks. Further, the result showed that there was a significant difference between monolingual and bilingual children in picture naming, where monolinguals named more number of pictures accurately with faster reaction time. In both subtasks of inhibition bilinguals were fast in inhibiting the verbal and nonverbal responses. To conclude better picture naming skills observed in monolinguals and enhanced inhibitory control skills noted in bilinguals are discussed in the study.

Background

The majority of the population across the world is either bilingual or multilingual (Marian & Shook, 2012). Normal children possess the ability to acquire more than one language during their childhood. Bilingualism is defined as having ability to use two or more languages. Kohnert's (2009) definition of bilingual is operational and practical: Bilinguals can be defined as individuals who have systematic experience with two or more languages to meet present or future communication needs. According to Bialystok (2010) the cognitive and linguistic processes involved in the acquisition and use of two languages are systematically different from those processes engaged in monolingual language use. Hence bilingual language acquisition may lead to detectable changes in language and cognitive outcomes.

Language acquisition can vary in bilinguals compared to monolinguals, naming which is one of the most essential parts of effective communication can also be influenced by bilingualism. Picture naming is one of the most frequently measured skills in both experimental and clinical settings. Picture naming has long been used with children and adults in both educational and clinical settings to investigate lexical-semantic knowledge. Picture naming in experimental studies is used as a means of tapping into the cognitive operations underlying the lexical conceptual systems (Glaser, 1992; Snodgrass, 1993). Lezak, (1995) reported that several cognitive skills (e.g., visual analysis; object recognition; semantic, lexical, and phonological processing) are involved in the process of picture naming. Therefore, picture naming task may be vulnerable to a variety of cognitive impairments.

Differences can be found in the development of word learning in monolingual and bilingual children. Research has found that around one and half years of age a vocabulary of 50 words is achieved by both monolingual and bilingual children for total vocabulary across two languages (Bates & Goodman, 1997; Conboy & Thal, 2006). Evidences show that after that age bilinguals know considerably smaller number of words in each language when compared to monolingual children (Pearson, Fernandez & Oller, 1993; Petitto, 1987; Petitto, Katerelos, Levy, Gauna, Tetreault & Ferraro, 2001).

Receptive vocabulary of bilingual and monolingual children in the age range of 3 to 10 years was assessed by Bialystok, Luk, Peets, and Yang (2010). They reported that the mean standard score of receptive vocabulary on the English Pea body Picture Vocabulary Test (Dunn & Dunn, 1997) was found to be higher for monolinguals than bilingual peers. Based on these findings the authors also reported that the nature of the smaller vocabulary of bilingual children in each language than that of monolingual children is not completely understood (Bialystok, Luk, Peets & Yang, 2010).

Nicoladis and Giovanni (2000), found a smaller productive vocabulary in 1;0 to 1;6: years bilinguals compared with their monolingual counterparts. Mindt et al. (2008) stated that "as bilinguals know two labels for same concept, by logical extension bilinguals have a much larger vocabulary than monolinguals when words from both languages are counted; however, within each language bilinguals have a smaller vocabulary size relative to monolinguals in their one respective language". Hamers and Blanc (2000) said that bilinguals catch up to monolinguals in vocabulary in first language knowledge by adulthood. Gollan and Brown (2006) compared vocabulary of young adult bilinguals(mean age of 21-23 years) in their first acquired and dominant language with that of the monolinguals and their results indicated that bilinguals recognized fewer difficult vocabulary words and had more retrieval failures than monolinguals.

Bialystok, Craik , Green, and Gollan (2009), suggested that normal conversation instances usually may not indicate observable deficits in bilingual language processing. However, controlled experimental procedures like reaction time with which the target words are retrieved or named may reveal subtle differences between monolingual and bilingual groups. Cumulatively, the differences in the linguistic representations and differences in the selection mechanisms lead to sustained differences between monolinguals and bilinguals in fluent speech production. It was reported that the simple act of retrieving a common word seems to be more effortful for bilinguals (Ransdell & Fischler, 1987). Research shows that bilingual participants take longer reaction time and make more errors than monolinguals on naming tasks, on timed picture naming, monolinguals performed faster than did bilinguals (Gollan, Montoya, Fennema-Notestine, & Morris, 2005). Similar results (slower reaction times in bilinguals) were obtained in both reception (Ransdell & Fischler, 1987) and production of words (Ivanova & Costa, 2008), even when bilinguals responded in their first and dominant language. In the Boston Naming Task (Kaplan, Goodglass, & Weintraub, 1983), bilinguals produced fewer correct responses (Roberts, Garcia, Desrochers, & Hernandez, 2002; Gollan, Fennema Notestine, Montoya, & Jernigan, 2007) and made more errors on a speeded version of the task (Bialystok et al., 2008a) than did monolinguals.

Based on a functional magnetic resonance imaging (fMRI) study of picture naming in first and second language of Spanish-English bilinguals, Hernandez and Meschyan (2006) found that naming the pictures in the weaker second language produced greater activity in the executive control network. Based on their results they speculated that naming is always carried out in a strong language in monolingual speakers; hence this executive control network which is involved in word retrieval for bilinguals may not be required by monolingual language production. Studies (Luce & Large, 2001; Mirman & Magnuson, 2008; Vitevitch, 2002) have found that when bilinguals try to communicate in one language two languages are activated simultaneously. This creates a need for selection of one language and process further. Hence, bilinguals resolve competition not only from within-language alternatives as in monolinguals who may select the target among close semantic neighbors but also from between-language alternatives for the same concepts. For this reason, a set of attention and control processes may be necessary for speech production in bilinguals than is necessary for monolinguals (Green, 1998). According to Green (1998), "bilinguals receive an early opportunity to practice inhibitory control so that when they communicate in one language, the non-target language is suppressed by the same executive functions used generally to control attention and inhibition". The contribution of bilingualism in children's performance on executive function (EF) tasks has been an emerging research topic in development of cognition according to Bialystok (2001). EF broadly refers to higher cognitive processes that are involved in the conscious control of action and thought (Zelazo & Müller, 2010). This includes working memory, response inhibition, and shifting, among other processes (Garon, Bryson & Smith, 2008).

Bialystok (2001) reviewed studies of the effects of bilingualism on cognitive processes of children and reported that "the most consistent empirical finding about the cognition of bilingual children is their advantage in selective attention and inhibition". The researchers have concluded that the constant need to inhibit the lemma nodes of the unused language generalized to more effective inhibition of nonverbal information (Bialystok, 1988, 1992). Bunge, Dudukovic, Thomason, Vaidya & Gabrieli (2002); Zelazo, Muller, Frye & Marcovitch (2003) stated that because of their presumably higher level of control of linguistic processing, bilingual children have more experience than monolingual children in attention control.

Kamath and Prema (2003) conducted a study in which they investigated older monolinguals and bilinguals using Cognitive Linguistic Assessment Protocol (CLAP), they reported that bilingual adults and elderly performed better on all the domains of CLAP than monolinguals indicating a cognitive-linguistic advantage. Bialystok and Viswanathan (2009) compared monolingual children with bilingual children in Canada and bilingual children in India on a set of executive function tasks. The results showed that the two bilingual groups performed similarly and both were different from the monolingual group, irrespective of country. Sangeetha and Swapna (2011) conducted a study on 7-8 years Kannada-English bilingual children, using the CLAP protocol. The test consisted of three domains attention/discrimination, memory and problem solving and each domain consists of three auditory and three visual tasks. They reported that in comparison of all domains, simultaneous bilinguals (who acquire two languages simultaneously) performed better than sequential bilinguals (who acquire one language first followed by second language) on all tasks. According to McLaughlin(1978) children who are introduced to a second language before three years of age are simultaneous bilinguals and children in whom to a second language is introduced after three years will be considered to have had one language established and acquire the second language successively are successive bilinguals.

Most of the children in India are exposed to more than two languages at least when they enter the school. Previous studies imply that continued need to control the activation of two languages in the cognitive system leads to a more efficient executive control system in bilingual relative to monolingual children. However, these results may not be generalized to Indian context considering the nature of bilingualism in Indian context. Very few studies have focused on interaction of bilingual language processing and executive control system in the Indian bilingual children. Further research on bilinguals is warranted, which may acquaint more about effect of bilingualism on cognitive skills and the role of executive control skills in language processing. The aim of the study was to investigate lexical semantic production and inhibitory control skills in monolingual and bilingual children. The following objectives were formulated. a) To compare the lexical semantic production between monolinguals and bilinguals children and b) To compare the verbal and nonverbal motor inhibition skills between monolingual and bilingual children.

Materials and Methods

Participants

Simple random sampling procedure was used to select six Kannada medium schools and six English medium schools in urban areas of Mysore city. Twenty children from each school (n = 240) participated in the study. Table 1 shows the age and gender information and table 2 shows the inclusionary criteria of the participants.

Participants with history of speech and language delay/ impairment; visual and hearing problems; and any other neurological and behavioral problems were not included in the study.

Stimuli

Picture naming task was used to assess lexical semantic production in the present study. Two subtasks namely verbal and nonverbal motor inhibition was incorporated to evaluate inhibitory control in monolingual and bilingual children.

Task 1 - Picture Naming: It was decided to use 100 colored pictures from ten semantic categories to assess picture naming in the present study. For the selection of pictures to be used in the present study, initially a total of 150 pictures were selected from fourth and fifth standard text books. A pilot study was conducted on 10 normal children in the age range of 9-10 years to check the familiarity of pictures. Three point rating scale was used to check the familiarity of the stimuli where 1 was most familiar and 3 was not familiar. Based on the responses obtained from children 100 pictures which were rated as most familiar and familiar were used in the present study. Care was taken to avoid ambiguous pictures where pictures with good image agreement (that is how well the picture represents the target stimuli/lexical item) were selected. The picture stimuli were presented using laptop monitor programmed using DMDX software.

Task 2 - Verbal Inhibition and Nonverbal motor inhibition: Verbal Inhibition, Motor inhibition (VIMI) task developed by Henry, Messer and Nash (2011) was adopted in the present study. It was computerized to evaluate the inhibitory control, which is found to be an important component of executive function. This task comprised of two sub- tasks namely verbal task and non-verbal motor task. Each sub-task had two parts namely part A and part B. Each part used two different words as stimuli. In the first subtask (verbal) the word stimuli were prerecorded and stored in the laptop and timing of presentation was programmed in DMDX software. The word stimuli were presented randomly through the headphones from a SONY laptop at comfortable listening level, the task was to either verbally copy (repeat) the word or to inhibit the response to the auditory stimuli presented and say the alternate word. Visual presentations of pictures of words were used as stimuli in the second subtask that is nonverbal motor inhibition task. In this task the participants had to press certain keys on the key board either to inhibit or copy the response according to the instructions given to them. This task was also designed using DMDX software.

Procedure

Each child was tested individually in a noise free room in their school. Instructions were given

Table 1: Number of subjects in each age group of monolinguals and bilinguals

Groups	Monolinguals	Bilinguals
$>8 \leq 9$ years (Group 1)	60 participants (30 male and 30 female)	60 participants (30 male and 30 female)
$>9\leq 10$ years (Group 2)	60 participants (30 male and 30 female)	60 participants (30 male and 30 female)

Table 2: Subject selection criteria of study participants

	Groups	
Content	Monolingual	Bilingual
Language exposure	Predominantly to one language (Kannada) since birth	Exposed to one language (Kannada) since birth up-to 3 years and then exposed to English from 3 years of age (Early sequential bilinguals)
Medium of instruction in school	Kannada	English
Language Proficiency	Proficiency 0 + Formulaic proficiency in International Second Language Proficiency Ratings (ISLPR): Wylie & Ingram (2006)	Proficiency 3 vocational proficiency in English International Second Language Proficiency Ratings (ISLPR): Wylie & Ingram (2006)
Socioeconomic status (SES)	Participants belonging to middle SES in National Institute for the mentally Handicapped Socio Economic Status Scale (Venkatesan, 2009)	

in Kannada Language for both the groups and repeated if, required. The procedure for data collection was as follows:

Task 1 - Picture Naming: In this task pictures were presented one after the other randomly on the laptop screen (12"screen in a Sony laptop). The order and duration of presentation of the pictures were programmed using DMDX software. The participants were instructed to name the stimulus as fast as they can in their first language Kannada when each picture appeared on the screen. The stimulus appeared on the screen for duration of 2500ms and duration of five seconds was given for the response and the successive stimulus appeared after that. No feedback was provided for the participants. The responses were scored as correct or incorrect response, the correct response was given a score of '1' and the incorrect response was given a score of '0'. Total correct response was calculated for each participant and considered as response accuracy for naming pictures. The reaction time for naming pictures was also measured for each correct response and an average reaction time was obtained for picture naming task.

Task 2 - Verbal Inhibition and Nonverbal motor Inhibition: This task comprised of two sub tasks namely verbal task and non-verbal motor task. In each subtask there were two conditions/responses either to repeat (copy) the response or to inhibit it and produce an alternative response. In verbal subtask the stimuli were prerecorded and stored in the laptop and timing of presentation was programmed in DMDX software. In the part A of the verbal task the stimuli words 'bus' or 'car' were presented through the headphones from a SONY laptop at comfortable listening level. The response choice was between only two stimuli alternatives and participants were instructed to say the word 'car' as soon as possible if they hear the word 'car' for copy trials (block 1). For inhibitory trials (block 2) they were instructed to inhibit the verbal response 'car' and say 'bus' if the word 'car' was heard and say 'car' if the word 'bus' was heard. In each block the presentation of auditory stimuli was randomized. Participants were given 3 seconds time to respond. In the part B of the verbal task the whole procedure was repeated with the new stimuli 'pen and bag'.

The nonverbal motor inhibition task was designed in a similar way but the pictorial representation of numbers 'one or two' were used as stimuli in part A. In this task participants were instructed to press the response key (right and left shift keys) on which sticker of numbers one and two were covered on a keyboard according to instructions given to them. Participants were instructed to press key 'one' if they see picture of one on screen and 'two' if they see 'two' on screen in copy trial(block 1). For the inhibit trial they were instructed to press 'two' if they see 'one' and press 'one' if they see 'two' on screen(block 2). They were asked to respond as quickly as possible without making errors. The response keys were placed comfortably one under each hand and participants placed each index finger over one of the keys. Same procedure was repeated with stimuli 'bat and ball' in part B. Each recording block consisted of 16 trials. One block of experimental trials (inhibit block) and one block of the control trials (repetition/copy block) were alternately tested in each part of both verbal inhibitory and motor subtasks. A practice trial of 10 items was given before testing to avoid any primacy effect. Response accuracy (total correct response) and average reaction times (RTs) for correct responses were obtained for the experimental blocks (inhibit block).

Statistical Analyses

The response accuracy on naming pictures (total correct response), average reaction time for naming pictures, response accuracies of verbal and nonverbal motor inhibition and average reaction time of correct responses of verbal and nonverbal motor inhibition was obtained from study participants. The statistical tests were carried out in SPSS (version 17) software. These data were subjected to Shapiro-Wilk normality test to investigate normality. A non-parametric Kruskal-Wallis test was conducted to investigate the differences among the gender in each group on response accuracy, reaction time; of naming pictures, verbal inhibition and nonverbal motor inhibition, in monolingual and bilingual children. Further, a Mann-Whitney U test was performed to compare the median value of response accuracy, reaction time; of naming pictures, verbal inhibition and nonverbal motor inhibition between monolingual and bilingual children.

Results

Task1: Picture Naming

The data of response accuracy and average reaction time of picture naming task were subjected to Shapiro-Wilk normality test. The result of normality test revealed a significance ($p<0.05$) on response accuracy and average reaction time of picture naming task of males and females of each group of monolinguals and bilinguals. This indicated that the data was not normally distributed.

Median response accuracy and reaction time of naming for males and females of both the groups is shown in table 3. The results showed that males in both the groups had faster reaction times of naming, however no definite pattern of variation according to gender was observed for correct responses. A non-parametric Kruskal-Wallis test was conducted to evaluate differences among the gender in each group on response accuracy and reaction time of naming pictures, in monolingual children. The result revealed that there was no significant effect of gender on response accuracy [group1: (χ^2=0.11, df=1, p=0.73), group2: (χ^2=5.19, df=1, p=0.12)] and reaction time of picture naming [group1: (χ^2=1.01, df=1, p=0.31), group2: (χ^2=1.8, df=1, p=0.17)], in each group of monolingual children. Thus, the data of response accuracy and reaction time in picture naming obtained from two genders were combined, in each group. The median reaction time of naming in group 1 was faster than group 2. Median response accuracy was higher in males of group two than group 1 and females of group 1 had better median response accuracy than group 2. Further, a Kruskal-Wallis test was conducted to determine whether these differences were statistically significant and the results indicated that the differences between the groups [response accuracy: (χ^2=0.06, df=1, p=0.79) and reaction time: (χ^2=0.56, df=1, p=0.45)] had no statistical significance (Table-3).

The median response accuracy and median reaction time with standard deviation scores for bilinguals are given in Table 4. It is observed (from Table 4) that in group 1 male had higher response accuracy and slower reaction time than in females. In group two females had higher response accuracy and slower reaction time of picture naming compared to males. Differences among the gender in each group on response accuracy and reaction time of naming pictures, in bilingual children were examined using Kruskal-Wallis test. Gender had no statistically significant effect on correct response [group1: (χ^2=1.42, df=1, p=0.23); group2: (χ^2=4.05, df=1, p=0.05)] and reaction time of picture naming [group1:(χ^2=3.91, df=1, p=0.05); group2: (χ^2=1.13, df=1, p=0.28)], in each group of bilingual children. Thus, the data of correct response and reaction time in picture naming obtained from genders were combined, in each group. It is evident from Table 4 that the median response accuracy was higher and median reaction time is faster for picture naming in group 2 compared to group 1. Table 4 also shows that the standard deviation scores are relatively more in group 1 compared to group 2. Comparisons of groups using the Kruskal-Wallis test revealed that these differences were not significant statistically [response accuracy: (χ^2=2.90, df=1, p=0.08) and reaction time: (χ^2=2.66, df=1, p=0.10)].

Further, comparison was made between monolingual and bilingual children on response accuracy and reaction time of picture naming. Shapiro-Wilk normality test and Levene Test for Equality of Variances were conducted on the correct response and reaction time. It was noted that the data of response accuracy was normally distributed ($p>0.05$), but significant variance was found between monolingual and bilingual group ($p<0.05$) in Levene Test for Equality of Variances. This was true for reaction time of picture naming also.

Table 3: Median response accuracy and reaction time of picture naming in Monolingual children

Age	Gender	Response Accuracy Median(SD)	Reaction time(ms) Median(SD)
Group 1	Male	57.12(9.81)	951.01 (222.80)
	Female	59.23(9.52)	1003.59(158.23)
Group 2	Male	61.76(9.83)	997.88(162.31)
	Female	54.11(6.92)	1011.52(170.07)

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Table 5: Median response accuracy and reaction time of picture naming in Monolingual children

Age	Gender	Response Accuracy Median(SD)	Reaction time(ms) Median(SD)
Group 1	Male	35.50(10.52)	1307.35(102.56)
	Female	34.00(15.52)	1215.35(131.29)
Group 2	Male	40.50(11.11)	1213.88(79.28)
	Female	44.51(8.23)	1250.08(130.51)

Thus, a Mann-Whitney U test was performed in which the median value of response accuracy was higher (as shown in Figure1) in monolingual than in bilingual children, which was found to be statistically significant (Z = -10.033, p=0.00). In addition, Mann-Whitney U test showed statistically significant faster reaction time (Z = -10.036, p=0.00) in monolingual than in bilingual children as depicted in Figure 2.

Task 2: Verbal Inhibition and Nonverbal Motor Inhibition

Task 2 had two subtasks namely verbal Inhibition task and nonverbal nonverbal motor inhibition task. Each subtask was carried with two sets of stimuli as part A and part B in both verbal and nonverbal motor inhibition. Each part had two blocks of experimental trial (inhibit trials) and two blocks of the control trial (repetition block). The response accuracy and reaction time of experimental trials in verbal and motor inhibitory subtasks were obtained from monolingual and bilingual participants. These data were analyzed using descriptive and inferential statistics.

The data of response accuracy and reaction time from two parts of verbal and nonverbal motor inhibitory conditions obtained by two groups of monolingual and bilingual children were examined for normal distribution using Shapiro Wilk test. The result indicated that the data were non-normal (p¿0.05). The median response accuracy and reaction time of verbal and nonverbal motor inhibition obtained for monolingual children across gender and groups has been shown in Table 5. A non-parametric Kruskal Wallis test was conducted to test the differences in median scores of response accuracy and reaction time of verbal inhibition and nonverbal motor inhibition between genders in each group of monolinguals. The results showed no significance effect of gender on correct responses [Part A; group 1: (χ^2=0.18, df=1, p=0.67), group 2: (χ^2=0.54, df=1, p=0.46), Part B; group 1: (χ^2=0.03, df=1, p=0.85), group 2: (χ^2=8.25, df=1, p=0.51)] and reaction times [Part A; group 1: (χ^2=0.56, df=1, p=0.45), group 2: (χ^2=4.98, df=1, p=0.62), Part B; group 1: (χ^2=3.95, df=1, p=0.47), group 2: (χ^2=1.05, df=1, p=0.30)] in all the parts of verbal inhibition. The results also indicated no significant effect on gender on correct responses [Part A; group 1: (χ^2=15.62, df=1, p=0.07), group 2: (χ^2=3.61, df=1, p=0.57), Part B; group 1(χ^2=1.06, df=1, p=0.30), group 2: (χ^2=2.81, df=1, p=0.90)] and reaction times [Part A; group 1: (χ^2=0.59, df=1, p=0.44), group 2: (χ^2=2.84, df=1, p=0.09), Part B; group 1: (χ^2=026, df=1, p=0.60), group 2: (χ^2=5.15, df=1, p=0.23)] in all the parts of nonverbal motor inhi-

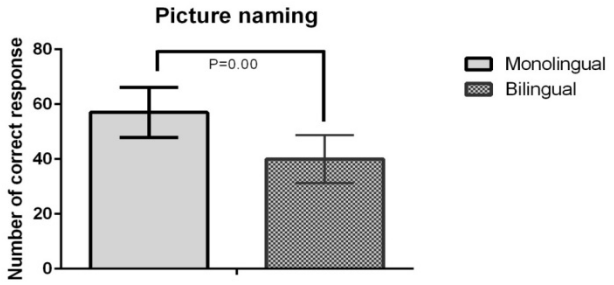

Figure 1: Median scores of response accuracy on picture naming in monolinguals and bilinguals.

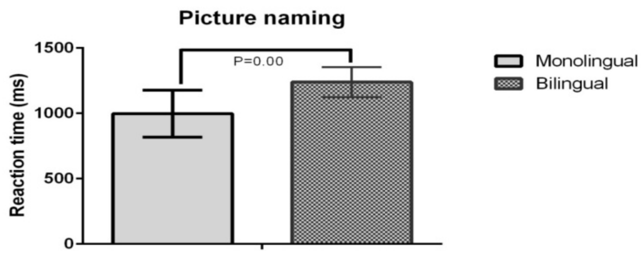

Figure 2: Median reaction time of correct responses on picture naming monolingual and bilingual children.

bition. The data obtained from participants belonging to two genders were combined and comparison was made between two groups of monolinguals using Kruskal Wallis test. The effect of group on verbal [Part A; correct response: (χ^2=4.83, df=1, p=0.28), reaction time: (χ^2=3.18, df=1, p=0.07), Part B; correct responses: (χ^2=1.17, df=1, p=0.27), reaction time: (χ^2=3.30, df=1, p=0.06)] and nonverbal motor inhibition [Part A; correct response: (χ^2=11.30, df=1, p=0.10), reaction time: (χ^2=0.58, df=1, p=0.44), Part B; correct responses: (χ^2=8.43, df=1, p=0.40), reaction time: (χ^2=0.00, df=1, p=0.99)] in both part A and Part B were found to be not significant.

The median response accuracy and median reaction time of verbal and nonverbal motor inhibition obtained by bilingual group is shown in table 6. Further, a non-parametric Kruskal Wallis test was conducted to test the differences in median scores of response accuracy and reaction time of verbal inhibition and nonverbal motor inhibition between genders in each group of bilinguals. The results showed no significant difference between genders in both the groups on correct responses in verbal inhibition on correct responses [Part A; group1: (χ^2=4.97, df=1, p=0.26), group2: (χ^2=1.28, df=1, p=0.25), Part B; group1: (χ^2=2.71, df=1, p=0.10), group2: (χ^2=0.28, df=1, p=0.59)] and reaction times [Part A; group1: (χ^2=0.00, df=1, p=0.97), group2: (χ^2=0.13, df=1, p=0.71) , Part B; group1: (χ^2=1.16, df=1, p=0.28), group2: (χ^2=1.81, df=1, p=1.17)] and nonverbal motor inhibition on correct responses [Part A; group1: (χ^2=10.48, df=1, p=0.10), group2: (χ^2=3.91, df=1, p=0.48), Part B; group1: (χ^2=12.9, df=1, p=0.05), group2: (χ^2=2.67, df=1, p=0.10)] and reaction times [Part A; group1: (χ^2=0.01, df=1, p=0.91), group2: (χ^2=0.29, df=1, p=0.58), Part B ; group1: (χ^2=0.00, df=1, p=0.92), group2: (χ^2=7.80, df=1, p=0.50)]. Hence the comparison was made between two groups of bilinguals using Kruskal Wallis test by combing the data of both the genders obtained in each group. The results showed that there was no significant difference between two groups of bilinguals for both verbal inhibition response accuracy [Part A: (χ^2=0.41, df=1, p=0.52) ,Part B : (χ^2=0.02, df=1, p=0.88)] and reaction time [Part A: (χ^2=4.72, df=1, p=0.30) ,Part B : (χ^2=0.92, df=1, p=0.33)] and also in part A [response accuracy: (χ^2=4.35, df=1, p=0.37); reaction time : (χ^2=2.05, df=1, p=0.15)] and part B[response accuracy: (χ^2=7.87, df=1, p=0.05); reaction time (χ^2=0.48, df=1, p=0.48)] of nonverbal motor inhibition subtasks.

Further, comparison was made between monolingual and bilingual children on response accuracy and reaction time in each part of verbal and nonverbal motor inhibitory conditions. Shapiro-Wilk normality test and Levene Test for Equality of Variances were conducted on the response accuracy and reaction time in each block of verbal and motor inhibitory conditions. It was noted that the data of correct response and reaction time in each block of verbal and nonverbal motor inhibitory conditions was normally distributed (p¿0.05), but variance was found between monolingual and bilingual group (p¡0.05) as evidenced by Levene Test for Equality of Variances. As shown in Table 3 and Figure 4 the reaction time in both the subtasks of inhibition was faster in bilinguals than monolinguals. Thus, a Mann-Whitney test was conducted to test the significant difference between monolin-

Table 6: Response accuracy and Reaction time measures of verbal and nonverbal motor inhibition in Monolingual children

		Group 1		Group 2	
Subtasks	Measures	Males Median(SD)	Females Median(SD)	Males Median(SD)	Females Median(SD)
Verbal Inhibition part A	Response accuracy	15.00(0.76)	15.01(1.6)	15.00(1.2)	15.00(0.95)
	Reaction time(ms)	1325.34(176.49)	1269.12(255.29)	1278.01(241.97)	1283.85(207.72)
Verbal Inhibition part B	Response accuracy	14.03(0.77)	14.04(2.12)	14.01(1.52)	14.53(1.16)
	Reaction time(ms)	1289.33(191.96)	1119.00(211.75)	1278.00(241.97)	1283.85(207.72)
Nonverbal motor inhibition part A	Response accuracy	14.56(0.80)	15.65(0.44)	15.76(0.59)	15.56(1.04)
	Reaction time(ms)	1375.59(219.2)	1413.44(206.8)	1414.39(246.9)	1498.29(261.9)
Nonverbal motor inhibition part B	Response accuracy	15.00(.67)	15.87(0.65)	15.98(0.72)	14.09(1.33)
	Reaction time(ms)	1345.72(232.2)	1293.29(225.64)	1170.21(262.50)	1405.26(283.45)

Table 7: Response accuracy and Reaction time measures of verbal and nonverbal motor inhibition in Bilingual children

		Group 1		Group 2	
Subtasks	Measures	Males Median(SD)	Females Median(SD)	Males Median(SD)	Females Median(SD)
Verbal Inhibition part A	Response accuracy	14.00(1.71)	15.00(1.12)	15.00(2.14)	15.03(1.22)
	Reaction time(ms)	902.93(196.88)	874.57(197.10)	834.66(180.29)	800.29(148.02)
Verbal Inhibition part B	Response accuracy	14.34(1.62)	15.12(2.08)	14.12(1.8)	14.21(.90)
	Reaction time(ms)	883.74(250.09)	816.78(208.48)	797.59(201.08)	851.57(219.22)
Nonverbal motor inhibition part A	Response accuracy	13.21(1.41)	15.21(1.01)	15.21(1.31)	14.51(0.61)
	Reaction time(ms)	1005.95(174.67)	990.73(189.35)	936.67(203.1)	951.46(195.48)
Nonverbal motor inhibition part B	Response accuracy	13.50(1.31)	15.0(0.62)	15.0(0.71)	15.0(0.84)
	Reaction time(ms)	921.80(205.3)	884.94(155.05)	787.53(157.02)	944.09(153.21)

gual and bilingual group in each subtasks of inhibition. The result showed that there was a significant difference between monolingual and bilinguals for reaction time in part A and part B of verbal and nonverbal motor inhibition subtask (Figure 3 and 4).

As it is evident from Figure 5 and Figure 6 the median response accuracy scores did not show difference between monolinguals and bilinguals in both verbal and nonverbal motor inhibition. The Mann-Whitney test revealed no significant difference for median response accuracy for both part A and part B of verbal and nonverbal motor inhibition subtasks.

Overall results of the study showed that monolinguals had better response accuracy and faster reaction time for naming pictures compared to bilingual participants. Gender and age group had no ef-

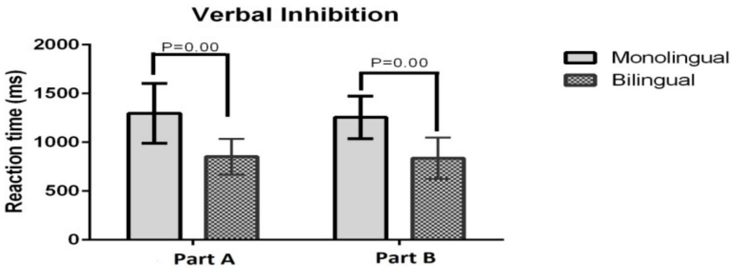

Figure 3: Reaction time for verbal Inhibition.

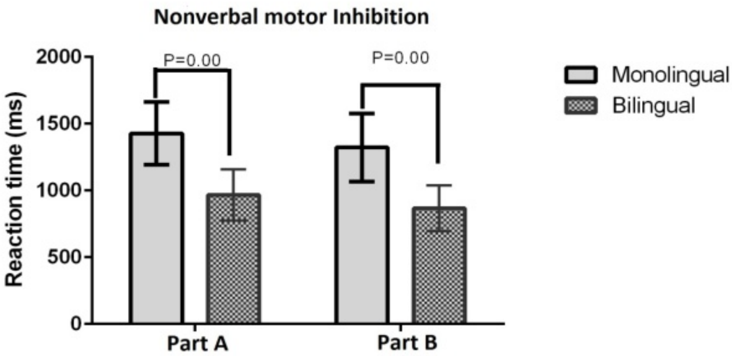

Figure 4: Reaction time for nonverbal motor inhibition.

fect on response accuracy and reaction time of naming pictures. In verbal and nonverbal motor inhibition subtasks bilinguals had faster reaction times compared to monolinguals but response accuracy did not differ significantly. Gender and age groups had no significant difference in both parts of verbal and nonverbal motor inhibition subtasks.

Discussion

In the present study picture naming task was used to assess lexical semantic production. Total correct response was calculated for each participant and considered as response accuracy for naming pictures. The reaction time for naming pictures was also measured. The results of the present study showed that monolinguals had significantly higher response accuracy and faster reaction time for naming pictures compared to bilinguals. This indicates that monolingual children named more number of pictures accurately and quickly in Kannada when compared to bilinguals.

The lower accuracy scores in bilinguals can be attributed to the fact that the task condition was to name pictures only in Kannada language; hence bilinguals who possess vocabulary in two languages may find it difficult retrieve words only in one language. The research evidences show that bilingual children know considerably smaller number of words in a language when compared to monolinguals (Pearson et al., 1993; Petitto, 1987; Petitto et al., 2001). Ten different pictures from ten different lexical categories thus, a total of hundred pictures were presented in picture naming task. It was evidenced from the study that bilinguals exhibited more retrieval failures than monolinguals in naming these pictures of different lexical categories; similar finding was also reported by Gollan and Brown (2006). Bialystok, Luk, et al., 2010 stated that the nature of the smaller vocabulary of bilinguals in first language than that of monolingual children is somewhat complex. One explanation for lower scores in naming by bilinguals was reported by Nicoladis and Giovanni (2000) who stated that as bilinguals know two labels for same concept, by logical extension bilinguals possess a much superior vocabulary than monolinguals when words from both languages are counted. However, within each language bilinguals have a lesser vocabulary size relative to monolinguals in their one respective language.

It was also revealed from the study that monolinguals consumed less time to name pictures when compared to bilingual children. This was evidenced by faster reaction time on naming pictures in monolinguals when compared to longer reaction time in bilinguals. This finding suggests that monolinguals name pictures more easily than that of bilinguals. Gollan, Montoya, Fennema-Notestine,

& Morris (2005) also reported that the effortless act of retrieving a common word seems to be more difficult for bilinguals. Present study supports to the fact that bilingual participants take longer time and make more errors than monolinguals on naming tasks. Quicker performance was observed in monolinguals on timed picture naming than did bilinguals. Similar results (slower reaction times in bilinguals) were obtained in both reception (Ransdell & Fischler, 1987) and production of words (Ivanova & Costa, 2008), even when bilinguals responded in their first and dominant language.

Longer time taken by bilingual children to name pictures can be due to simultaneous activation of lexical target in two languages, which arises the need to suppress response of non-target language and name it in the target language. Hence, bilingual language processing must resolve competition not only from within-language alternatives as in monolinguals who may select the target among close semantic neighbors (Luce & Large, 2001; Mirman & Magnuson, 2008; Vitevitch, 2002). Findings of the present study supports the earlier report that bilinguals require a set of attention and control processes necessary for speech production in bilinguals than is necessary for monolinguals (Green, 1998). According to Green (1998), "bilinguals receive an early opportunity to practice inhibitory control so that when they communicate in one language, the non-target language is suppressed by the same executive functions used generally to control attention and inhibition".

Two subtasks namely verbal and nonverbal motor inhibition was incorporated to evaluate inhibitory control in monolingual and bilingual children. The results of the present study also revealed that bilinguals had a faster reaction time compared to monolinguals in both part A and part B of inhibition subtasks. These results suggest that bilinguals took less time to inhibit a response when compared to monolinguals and it was true for inhibition of both verbal and nonverbal motor response. Reports on the effects of acquiring two languages on cognitive processes of children reveal that the cognition of bilingual children is their enhancement in their selective attention and inhibition (Bialystok, 2001). It was also reported in the studies that the constant need to inhibit the unused language in bilinguals generalized to more effective inhibition of nonverbal information (Bialystok, 1988, 1992). It was also evident from the present study that bilinguals outperformed monolinguals in speed with which they inhibit the response while inhibiting a verbal response and also while inhibiting a motor response which was nonverbal in nature. This reveals that the enhancement in inhibition skill was not only restricted to verbal task the one which they practice when they speak in one language and suppresses the other but also the nonverbal inhibition skill which does not directly involve language. Based on these finding it is logical to conclude that the cognitive processes underlying verbal and nonverbal motor inhibition may be shared. When bilinguals use one language there arises need to suppress the non target language, this gives them an early opportunity to practice inhibitory control. According to Green (1998) this same inhibitory control which is a part of executive functions may be used generally to control attention and inhibition. This claim can be supported based on the results of the present study.

Conclusions

The present study investigated the speed and accuracy of picture naming as well as verbal and nonverbal motor inhibition skills in monolingual and bilingual children in the age range of 8 to 10 years. The results of the present study did not show any effect of gender and age on the skills tested however, statistically significant differences were found on the performance of these tasks between monolingual and bilingual children. The findings of the present study suggest that monolinguals are more accurate and fast on naming pictures than bilinguals in their first language. This evidenced that bilinguals may be slow in naming pictures in their first language which can be due to the interference caused by lexical activation of the second language which makes them inhibit the second language when they have to respond only in their first language. The results also revealed that the inhibitory control skills both verbal and nonverbal motor was enhanced in bilinguals which was shown by faster reaction times on inhibition subtasks. This further supports the notion that bilinguals practice inhibition skill when they suppress one language while the demand arises to communicate in only one language, which might make them more advanced and improved on inhibitory control tasks. The findings of the present study have implications for bilingual education and also in language rehabilitation of bilinguals. However, the results are preliminary and more research in this direction is necessary to generalize these findings on different groups of bilinguals like simultaneous bilinguals or late bilinguals.

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