Utrecht University

Master Thesis

The Effect of Bilingualism on Selective Attention, Interference Suppression and Control in Five and Six Year Old Dutch Preschool Children

Student:	Shanna ten Dam
Studentnummer:	3465519
Begeleider:	Tessel Boerma
Tweede beoordelaar:	Elma Blom
Datum:	20 juni 2014
Instelling:	Universiteit Utrecht
Opleiding:	Masteropleiding Orthopedagogiek
	Masterprogramma Leerlingenzorg

Foreword

This master thesis is my final work in order to complete my Orthopedagogiek masters degree at Utrecht University. Over the course of the past year I studied the influence of bilingualism on the ability to resolve conflict in tasks measuring selective attention, interference suppression en control. I would like to thank Elma Blom, Tessel Boerma and Mona Timmermeister for making it possible to write my thesis within the Cognitive Development in Emerging Bilingualism (CoDEmBi) pilot study. Especially I would like to thank Tessel Boerma for here continuous guidance and support during my long and arduous struggles finishing this thesis. Also I would like to thank Ellen Dekker, Titam Elnems and Ellen Rehorst for their cooperation, patience and support. Especially Titam Elnems; you made the week we locked ourselves behind our computers at the university library so much more endurable and fun. I also thank the schools, parents and children who consented to participate in this study. Lastly, I would like to thank my boyfriend, Sebastiaan, for his patience, help and support during my entire master's year. I love u and could not have done it without you.

Abstract

The present study tried to investigate if bilingualism selectively affects the ability to resolve conflict, and if a difference between monolingual and bilingual children emerges in carefully matched children from the same age when the effect of SES was controlled for. Five and six year old monolingual and bilingual children performed tasks measuring selective attention (*Sky Search Task*) and interference suppression (*Flanker Task).* There was a significant difference between the monolingual and bilingual children on selective attention, interference suppression and attentional control, even after controlling for the effect of parental education. Contradictory to the study of Engel de Abreu and colleagues (2012) bilingualism negatively affected the performance of the bilingual children.

Samenvatting

Dit onderzoek probeerde te onderzoeken of tweetaligheid van invloed is op de mogelijkheid om conflictsituaties op te lossen. Er werd gekeken of er een verschil bestaat tussen eentalige en tweetalige kinderen wanneer zij zorgvuldig worden gepaard op leeftijd in maanden en wanneer er werd gecontroleerd voor het opleidingsniveau van ouders. Vijf en zes jaar oude eentalige en tweetalige kinderen hebben taakjes gemaakt die Selectieve Aandacht (Sky Search taak) en respons inhibitie (Flanker taak) meten. Er was een significant verschil tussen de eentalige en tweetalige kinderen op selectieve aandacht, interferentie onderdrukking en aandachtscontrole, zelfs wanneer gecontroleerd werd voor het effect van het opleidingsniveau van ouders. In tegenstelling tot het onderzoek van Engel de Abreu en collega's (2012) beïnvloedt tweetaligheid de prestatie van tweetalige kinderen op negatieve wijze.

Introduction

Over the last couple of years, numerous publications have been printed concerning executive functioning (Ardila, Rosselli, Matute, & Guajardo, 2005; Best, Miller, & Jones, 2009; Garon, Bryson, & Smith, 2008; Hughes & Ensor, 2009), the association between executive functioning and socio-economic status (SES) (Arán-Filippetti & Richaud de Minzi, 2012; Hughes & Ensor, 2009; Mezzacappa, 2004; Noble, Norman, & Farah, 2005; Noble, McCandliss, & Farah, 2007; Sarsour et al., 2011) and the association between executive functioning and bilingualism (Bialystok, 2011; Barac & Bialystok, 2012; Poulin-Dubois, Blaye, Coutya and Bialystok, 2011). Engel de Abreu, Cruz-Santos, Tourinho, Martin & Bialystok (2012) tried to integrate the former researches into one. They tried to examine whether bilingual children from a low SES had better executive functioning skills compared to monolingual children within the same SES group. This present study tried to replicate part of the research by Engel de Abreu and colleagues (2012) in the Netherlands by examining the association between executive functions (EF) and SES of five and six year old monolingual and bilingual Dutch preschool children.

Executive functioning is an umbrella term for several higher cognitive processes, including working memory, inhibition and cognitive flexibility (Arán-Filippetti & Richaud de Minzi, 2012; Best et al., 2009; Garon et al., 2008; Hughes & Ensor, 2009; Sarsour et al., 2011). EF's are essential for adaptive and goal-directed behavior (Arán-Filippetti & Richaud de Minzi, 2012) and EF override automatic processes of thought and responses (Garon et al., 2008). Throughout infancy and the preschool period, the core foundation of EF starts developing. The first component of executive functioning to develop is working memory. This is the ability to maintain and actively manipulate information of short-term memory over a brief period of time (Best et al., 2009; Carlson & Meltzoff, 2008; Garon et al., 2008; Sarsour et al., 2011). The second component of EF to develop is inhibition. This is the ability to withhold or restraint a well-learned prepotent or a dominant, automatic response (Best et al., 2009; Garon et al., 2008; Sarsour et al., 2011). The third component of EF to develop is cognitive flexibility. This is the capacity to adapt behavior to changing situations in a quick and flexible manner (Sarsour et al., 2011). Cognitive flexibility involves shifting from one mental set to another. Ardila and colleagues (2005) and Klenberg, Korkman and Lahti-Nuuttila (2001) state that the development of EF is continuous at least until adolescence. In spite of the early onset of the development of working memory, inhibition and cognitive flexibility, all three EF components require an extended period of time to fully mature (Best et al., 2009).

The long lasting and mainly postnatal development of EF makes it susceptible to environmental influences (Arán-Filippetti & Richaud de Minzi, 2012; Best et al., 2009; Hughes & Ensor, 2009; Noble et al., 2005; Sarsour et al., 2011). A well-known and frequently researched environmental influence is the SES of families. SES looks at someone's position within the social stratification of a society (Verweij, 2010). The social stratification within a society originates from a disproportionate distribution of resources such as knowledge, labor and possessions. When the SES of a family is high, more of these resources are available to the family members (Verweij, 2010). Research has found a relation between SES and EF. Children within a higher SES group show better EF compared to children within a lower SES group (Arán-Filippetti & Richaud de Minzi, 2012; Hughes & Ensor, 2009; Mezzacappa, 2004; Noble et al., 2005; Noble et al., 2007; Sarsour et al., 2011). In this present research one SES component has been researched, namely parental educational degree. Parental educational degree is seen as one of the most significant parts of SES (Ardila et al., 2005). Research shows that children of parents with a higher educational degree show an improved performance on EF tasks (Ardila et al., 2005; Klenberg et al., 2010; Noble et al., 2005; Noble et al., 2007). Research from Arán-Filippetti and Richaud de Minzi (2012) shows an association between the educational degree of Argentinian mothers and the EF of their toddlers. An even more pronounced association was found between the educational degrees of both parents combined (Arán-Filippetti & Richaud de Minzi, 2012; Klenberg et al., 2010).

Another important influence on EF is bilingualism. Bilingual speakers have better EF compared to monolingual speakers (Bialystok, 2011; Barac & Bialystok, 2012; Kroll & Bialystok, 2013). This is also found throughout the entire life span

(Adesope, Lavin, Thompson, & Ungerleider, 2010; Bialystok, 2011). An explanation for the bilingual advantage in EF is that the experience of managing more than one language at the same time trains EF that are needed to resolve conflict between competing language systems (Adesope et al., 2010; Engel de Abreu et al., 2012). Research has found that both languages of a bilingual speaker are constantly active to some degree when bilinguals are using one of them (Bialystok, 2011; Carlson & Meltzoff, 2008; Kroll & Bialystok, 2013). This even happens in strong monolingual contexts and if bilinguals are exceedingly experienced in both languages (Bialystok, 2011; Kroll & Bialystok, 2013; Morales, Gómez-Ariza, & Bajo, 2013). If both languages of a bilingual speaker are constantly active, the bilingual speaker has to select between these two competing languages so that one language can be processed fluently without interference of the other (Bialystok, 2011; Kroll & Bialystok, 2013). This constant need for language control increases the ability to ignore irrelevant information and develop efficient EF (Engel de Abreu et al., 2012; Morales et al., 2013).

Following Bialystok (2001; Craik & Bialystok, 2006) Engel de Abreu and colleagues (2012) made a distinction between two types of EF namely ‘Representation’ and ‘Attentional Control’. Representation is the process of encoding and structuring knowledge in a manner that permits retrieval, logical inference, and access to relational information, also known as working memory. Attentional control included the following EF’s: selective attention, inhibition and cognitive flexibility, which are needed to deal with conflicting information (Engel de Abreu et al., 2012). They found that the bilingual children outperformed the monolingual children on the control factor, but that both groups performed equally on the representation factor. Engel de Abreu and colleagues (2012) therefore found that bilingualism does not simply lead to a domain-increase in EF but instead selectively influences the ability to deal with conflict. Other research supports these findings, showing a bilingual advantage in cognitive flexibility (Barac & Bialystok, 2012) and inhibition during conflict tasks (Adesope et al., 2010; Bialystok 2011; Carlson & Meltzoff, 2008) but not for working memory tasks based on verbal recall (Bialystok, 2009).

Most of the studies reporting a bilingual advantage have been conducted with children in middle-class environments (Calvo & Bialystok, 2014). It may be that the bilingual advantages in EF emerges only for children in higher SES classes but produce no positive effects for children with a lower SES (Engel de Abreu et al., 2012). According to the statistics from the Centraal Bureau voor de Statistiek (CBS, 2013), there are a total of 3,543,081 immigrants in the Netherlands among which 395,302 people are of Turkish descent and 368,838 people are of Moroccan descent. Most of these immigrants want to maintain their link with their own culture and language (Vedder & Virta, 2005) leading to an upbringing in which both their own language and the Dutch language are represented. Looking at the literature about bilingualism above, it could be assumed that the Turkish and Moroccan immigrants have exceedingly better EF. However, people from immigrant families generally have a low SES (Stronks, Ravelli, & Reijneveld, 2001). Looking at the literature above about SES, it could be assumed that the Turkish and Moroccan immigrants show lower EFs. The question now is which of the two statements above is the most suitable when looking at Turkish and Moroccan immigrants in the Netherlands.

Engel de Abreu and colleagues (2012) tried to answer a similar question. They examined bilingual and monolingual children of comparable low SES situations from the same cultural group in Luxembourg and Portugal. Results suggest that bilingual children have better developed attentional control skills compared to their monolingual counterparts. Bilingualism might provide protection against the negative impact of a low SES on EF (Engel de Abreu, et al., 2012).

The present study tries to make a contribution to the current literature by examining the effects of bilingualism and SES on EF in five and six year old Dutch preschool children. Following the research of Engel de Abreu and colleagues (2012) this study will look at the attentional control factor of EF. The representation factor will not be investigated due to the fact that no significant effects of bilingualism were found (Engel de Abreu et al., 2012). Unfortunately, in the present study it is not possible to compare children form the same cultural group. Therefore Dutch monolingual and bilingual children will be matched according to their age and the effect of SES will be controlled for. Based on the literature researched above, the next hypotheses were formulated:

1. Bilingualism selectively affects the ability to resolve conflict, and this difference emerges in carefully matched monolingual and bilingual children from the same age and SES group.

2. Bilingual children outperform monolingual children on the Flanker Task measuring interference suppression.
3. Bilingual children outperform monolingual children on the Sky Search Task measuring selective attention.

Method

Participants

The children were recruited through a selective sample consisting of elementary schools, mosques and neighborhood children from Amersfoort, Gouda, Leiden and Utrecht. The sample consisted of 66 children between 59 and 83 months old (M= 69.4, SD 6.7) of whom 33 children were boys (50%) and 33 children were girls (50%). The monolingual group (N=33) consisted of 22 girls and 11 boys (M=69.5 months, SD 6.8). The bilingual group (N=33) consisted of 11 girls and 22 boys (M=69.2 months, SD 6.7).

The children within the monolingual group only spoke Dutch. The children from the bilingual group spoke Turkish (N=2), Berber (N=22), Spanish (N=1), Somalian (N=3), Chinese (N=1), Polish (N=1), Italian (N=1), Javanese (N=1) or English (N=1) as their first language and Dutch as their second language.

Procedures and Tasks

Current research used a non-experimental comparative research design using data from the 'Flanker Task' (Engel de Abreu et al., 2012) and the 'Sky Search Task' (Manly, Robertson, Anderson, & Nimmo-Smith, 1998). These tasks were part of a larger battery from the 'Cognitive Development in Emerging Bilingualism' ((CoDEmBi) Blom, Boerma, Timmermeister, Wijnen, Leseman, n.d.) pilotstudy at Utrecht University. The entire battery consisted of the 'Peabody Picture Vocabulary Test Nederlands' ((PPVT-NL) Dunn & Dunn, 2007), the 'Continuous Performance Task' ((CPT) Rosvold, Mirsky, Sarason, Bransome & Beck, 1956), 'TAK woordvorming' and 'TAK zinsvorming' (Verhoeven & Vermeer, 2001), the 'Sky Search Task' and the 'Flanker Task'. Prior to testing parents had to give a written consent along with a filled out survey concerning their highest obtained educational degree. All tasks were administered in Dutch. At the beginning of every task a couple of practice exercises were completed to ensure that the children understood the tasks. These exercises were excluded from the data-analysis. The tasks were administered in a fixed order. This order was chosen to ensure that there was enough variability to keep the children interested during the testing sessions. The data of the participating children were given a specific code to safeguard their anonymity. The children were tested individually in a quiet room. Completion of the entire battery lasted approximately 45 minutes. The children were given a sticker as a reward after the completion of the entire session. Per child a personal log was kept including the duration of the tasks, if the child was capable enough to understand and execute the tasks and if the child needed extra explanations. All the data was put into Excel files.

Following Engel de Abreu and colleagues (2012) the 'Sky Search Task' and the 'Flanker Task' were used to measure attentional control.

Flanker Task: Interference suppression was assessed using the Flanker Task from Engel de Abreu and colleagues (2012). The Flanker Task looks at the ability to ignore irrelevant information. The test is administered on a computer. In each trial a horizontal row of five equally spaced, yellow fish is showed. The children have to indicate the direction the central fish is swimming to, by pressing the corresponding left of right response button as quickly as possible. The trials consist of congruent and incongruent conditions. In the congruent conditions (50% of the trials) the flanking fish are swimming in the same direction as the center fish. In the incongruent conditions (50% of the trials) the flanking fishes are swimming in the opposite direction. The congruent and incongruent trials are represented in a randomized order.

Sky Search Task: The Sky Search Task from the Test of Everyday Attention for Children (Manly, Robertson, Anderson, & Nimmo-Smith, 1998) is administered as a measure of selective attention. The children have to circle 20 identical spacecraft pairs. These are located on a A3 sheet of paper containing 128 paired spacecrafts. The main goal of this task is to find the 20 identical pairs as quickly as possible without being distracted by the other spacecrafts. Subsequently, the children are given a motor-control version of the task on which only the 20 identical pairs are depicted. Again, they have to circle the pairs as quickly as possible. The total number of correctly found pairs and the total duration (in seconds) of both tasks were registered. The attention score was calculated on the basis of the following formula: (duration time in seconds task one/total correctly found pairs task one) – (duration in seconds motor control task/correctly found pairs motor control task). Research from Manly, Nimmo-Smith, Watson, Anderson, Turner and Robertson (2001) showed a .90 test-retest reliability for the Sky Search task.

Parental education: Parental education was measured via a short survey. Parents had to choose one out of nine categories, corresponding to their highest obtained educational degree. The Dutch version of the survey can be found in appendix 1.

Reliability and validity

To ensure the reliability and validity of the current research all researchers had to attend a short course. After the course each researcher had to practice with the battery on an experimental subject. This session was filmed and feedback was given on their performance. The battery was administered in a fixed order and a standardized manual was used.

Data analysis

First all the data from the Excel files was put into a SPSS data file including the subject code, age in months and gender of the participating children. Bilingualism and SES (parental educational level) were used as independent variables and the reaction times from the Flanker Task and attention scores on the Sky Search Task were used as dependent variables.

The participants were divided into two groups, i.e. monolingual (Dutch native speakers) and bilingual children. The children were matched on chronological age and parental educational level. The matching procedure tried to ensure that there was no confound with age or parental educational level in the group structure, so performance differences between the monolingual and bilingual group could be attributed to bilingualism (Engel de Abreu et al., 2012). An independent Samples T-test was performed to ensure there were no significant differences between both groups.

Parental educational degree was used to define children's SES. It has been selected because parental educational degree is a major component of SES (Ardila et al., 2005). Also, parental educational degree is seen as a reliable variable, as it is accurately reported (Roberts, Bornstein, Slater, & Barrett, 1999). Questions about yearly income were avoided due to the fact that most parents are less inclined to talk about their actual income (Noble et al., 2007). Parental educational degree was divided into four groups, i.e. lowest, low, medium and high according to the classification of educational degree in the Netherlands ("indeling van het opleidingsniveau in Nederland") obtained from the Rijksinstituut voor Volksgezondheid en Milieu ((RIVM) Verweij, 2008). Following the research of Aarnoudse-Moens (2013) the highest rated educational level out of father and mother was chosen to define parental education. Both mother's and father's educational level were used because there is no reliable evidence that the effect of mother's educational level dominates that of father's educational level (Hauser, 1994).

Selective attention was measured using children's attention scores from the 'Sky Search task'. A low attention score signifies that the child uses less time to find the targets compared to the other children and therefore possesses better-developed selective attention skills.

Interference suppression was measured using the 'Flanker task'. Following Engel de Abreu and colleagues (2012) incorrect responses, reaction times below 200 milliseconds and reaction times above three standard deviations of children's individual means were excluded from the analysis (<2% of trials). Children's individual means and standard deviations were calculated using both the correct responses on the congruent and incongruent trials after all the reaction times below 200 milliseconds were deleted. Only the incongruent data was used for the analysis to measure interference suppression on the Flanker task. A low reaction time signifies that the child uses less time to press the corresponding button and therefore possesses better-developed interference suppression.

When looking at the data, both the results form the monolingual and bilingual group on the Sky Search and Flanker Task are positively skewed instead of normally distributed.

The first hypothesis was tested using a Multivariate Analysis of Covariance (MANCOVA). The second and third hypotheses were tested using an Analysis of Covariance (ANCOVA), even though the assumptions (homogeneity of variance in each experimental condition, normal distribution, independence of the covariate and treatment effect and homogeneity of regression slopes) could not be met (Field, 2009). Even so, the MANCOVA and ANCOVA were chosen because the independent variable Parental Education needed to be included as a covariate. It is important to keep in mind that results from this current research need to be interpreted carefully due to the limitations of this thesis' sample (i.e. positively skewed dataset and significant differences between the monolingual and bilingual group).

Results

Table 1 shows the highest obtained educational level of parents from the monolingual and bilingual group. There was a significant difference in parental education between the monolingual and bilingual group t (64) = 2.07; p < .01; d = 0.52. Therefore, parental education was included into the MANCOVA and ANCOVA as a covariate. No significant age difference was found between the monolingual and bilingual group t (64) = -0.13; p = .420.

Table 1

Highest Obtained Educational Level Parents of the Monolingual and Bilingual Children

Highest obtained Educational Level	Monolingual children		Bilingual children	
	Frequency	Percentage	Frequency	Percentage
Lowest	0	0	5	15.2
Low	1	3	4	12.1
Medium	13	39.4	7	21.2
High	19	57.6	17	51.5
Total	33	100	33	100

Table 2 shows the means, standard deviations, minimum and maximum scores for both the monolingual and bilingual group on the Flanker Task and Sky Search Task.

Table 2

Descriptive Statistics Flanker Task (reaction times measured in milliseconds) and Sky Search Task (attention score) of the Monolingual and Bilingual Groups

Task	Group	N	*M*	*Sd*	Min	Max
Flanker Task	Monolingual	33	1574.5	521.6	883.3	3142.9
	Bilingual	33	2409.1	1002.0	788.2	4270.8
Sky Search Task	Monolingual	33	8.7	5.5	3	25.0
	Bilingual	33	11.7	6.3	3.8	30.6

First, the hypothesis ‘Bilingualism selectively affects the ability to resolve conflict, and this difference emerges in carefully matched monolingual and bilingual children from the same age and SES group’ was tested. There was a significant effect of bilingualism on attentional control after controlling for the effect of parental education, $F(2, 62) = 12.71$, $p < .001$. The monolingual children outperformed the bilingual children on attentional control.

Second, the hypothesis 'Bilingual children outperform monolingual children on the Flanker Task measuring interference suppression' was tested. There was a significant effect of bilingualism on the child's performance on the Flanker Task after controlling for the effect of parental education, $F(1, 63) = 25.75$, $p < .001$, *partial* $\eta^2 = .29$. Compared to the monolingual children, the bilingual children needed more time to accurately response to incongruent trials.

Third, the hypothesis 'Bilingual children outperform monolingual children on the Sky Search Task measuring selective attention' was tested. There was a significant effect of bilingualism on the child's performance on the Sky Search Task after controlling for the effect of parental education, $F(1, 63) = 4.75$, $p = .03$, *partial* $\eta^2 = .07$. Compared to the monolingual children, the bilingual children needed more time to find and select a target.

Discussion

The purpose of the present study was to investigate if bilingualism selectively affects the ability to resolve conflict, and if a difference between monolingual and bilingual children emerges in carefully matched children from the same age when the effect of SES was controlled for. Five and six year old monolingual and bilingual children performed tasks measuring selective attention and interference suppression. It is important to keep in mind that results from this current research need to be interpreted carefully whilst MANCOVA and ANCOVA analyses were executed even though the assumptions were violated.

There were three findings of this study. First, the analysis revealed a significant difference between the monolingual and bilingual children on attentional control, even after controlling for the effect of parental education. The monolingual children outperformed the bilingual children on attentional control.

Second, there was a significant difference in test scores from the Flanker Task between the monolingual and bilingual children measuring interference suppression, even after controlling for the effect of parental education. Bilingualism negatively affected the performance of the bilingual children. Compared to the monolingual children, the bilingual children needed more time to select and press the correct button during the incongruent trials.

Third, bilingualism negatively affected the child's performance on the Sky Search Task, measuring selective attention. Yet again, parental education was controlled for. Compared to the monolingual children, the bilingual children needed more time to find and select a target.

The data are inconsistent with previous research stating that the constant use of executive control to resolve language conflicts strengthens EF and therefore makes bilinguals more proficient than monolinguals in tasks measuring EF (Bialystok, 2001). Moreover, it is contradictory to the research of Engel de Abreu and colleagues (2012) in which they found a significant, positive effect of bilingualism on attentional control.

The current study has some limitations, which could explain the differences between this study and previous research. Firstly, the current study had a small, non-random sample due to the matching procedure of the monolingual and bilingual children. Therefore, generalizing these results to the entire Dutch five and six year old population isn't possible. Also, the tasks in the current study were still in an experimental phase. It could be possible that the tasks didn't measure what they were supposed to do. Additionally, Engel de Abreu et al. (2012) researched the difference between two groups from the same culture and who had the same SES. The current study used children from multiple cultures and compared them to Dutch monolingual children from the same SES group (i.e. parental educational level). It is possible that unmeasured cultural factors influenced the results. Furthermore, the data were not normally distributed. The monolingual group consisted mostly out of medium of highly educated parents whilst the parental educational levels from the bilingual group were more equally spread over the four groups. In the study by Engel de Abreu et al. (2012) the children had a low SES. They argued that regular use of more than one language is a mentally stimulating activity, which provides the opportunity to strengthen control mechanisms that build a defense to counteract the negative impact of a low SES. Because the dataset of the current study mostly consisted of children from higher educated parents, it was not possible to research this statement. Without the negative impact of SES, the bilingual children should outperform monolingual children on EF-tasks since they had extensive practice with attentional control (Carlson & Meltzoff, 2008). Remarkably, in contrast to the literature, the bilingual children from the current study performed worse than the monolingual children.

These contradictory findings could be explained by another limitation from the current study: there was no data collection concerning the quality of both the first (L1) and second (L2) language skills of the bilingual children. Carlson and Meltzoff (2008) argued that the outcomes on cognitive performance tasks are dependent on the extent to which an individual is bilingual. They found that only native bilinguals, who had early and extensive exposure to more than one language, showed benefits in the development in EF. Children who learned their second language later on didn't show the same benefits. Research from Blumenfeld and Marian (2013) showed that bilinguals who are more proficient in their L2 perform better on conflicting task measuring attentional control than bilinguals who are less proficient in their L2. Bilingualism therefore must be of a sufficiently high level to find detectable advantages in cognitive tasks (Carlson & Meltzoff, 2008). It could be possible that the bilingual children in the current study were no native bilinguals and that they were less proficient in their Dutch language compared to the children from the study of Engel de Abreu et al. (2012). This may also have had an effect on the children's task comprehension as the tasks were explained in Dutch. Research shows that bilingual children have a smaller vocabulary in their second language than monolingual children in their first language (Bialystok, 2011).

In sum, this study found that bilingualism was significantly related to children's selective attention, interference suppression and attentional control. Contradictory to the findings of Engel de Abreu et al. (2012) this study demonstrated that bilingual children performed significantly poorer than their monolingual peers on interference suppression, selective attention and attentional control. Further studies should examine this issue due to limitations from the current study.

References

Aarnoudse-Moens, C. S. H., Weisglas-Kuperus, N., Duivenvoorden, H. J., Oosterlaan, J., & Van Goudoever, J. B. (2013). Neonatal and parental predictors of executive function in very preterm children. *Acta Paediatrica, 102,* 282-286. doi:10.1111/apa.12101

Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A systematic review and meta-analysis of the cognitive correlates of bilingualism. *Review of Educational Research, 80,* 207-245. doi:10.3102/0034654310368803

Arán-Filippetti, V., & Richaud de Minzi, M. C. (2012). A structural analysis of executive functions and socioeconomic status in school-age children: Cognitive factors as effect mediators. *The Journal of Genetic Psychology, 173,* 393-416. doi:10.1080/00221325.2011.602374

Ardila, A., Rosselli, M., Matute, E., & Guajardo, S. (2005). The influence of the parents' educational level on the development of executive functions. *Developmental Neuropsychology, 28,* 539–560. doi:10.1207/s15326942dn2801_5

Barac, R., & Bialystok, E. (2012). Bilingual effects on cognitive and linguistic development: Role of language, cultural background, and education. *Child Development, 83,* 413-422. doi:10.1111/j.1467-8624.2011.01707.x

Best, J. R., Miller, P. H., & Jones, L. L. (2009). Executive functions after age 5: Changes and correlates. *Developmental Review, 29,* 180-200. doi:10.1016/j.dr.2009.05.002

Bialystok, E. (2001). *Bilingualism in development: Language, literacy, and cognition.* New York, NY: Cambridge University Press.

Bialystok, E. (2009). Bilingualism: The good, the bad and the indifferent. *Bilingualism: Language and Cognition, 12,* 3-11. doi:10.1017/S1366728908003477

Bialystok, E. (2011). Reshaping the mind: The benefits of bilingualism. *Canadian Journal of Experimental Psychology, 65,* 229-235. doi:10.1037/a0025406

Blom, E., Boerma, T., Timmermeister, M., Wijnen, F., & Leseman, P. (n.d.) *Cognitive development in emerging bilingualism (CoDEmBi), 28 May,* Retrieved from: www.uu.nl/codembi

Blumenfeld, H., & Marian, V. (2013). Parallel language activation and cognitive control during spoken word recognition in bilinguals. *Journal of Cognitive Psychology, 25,* 547-567.

Calvo, A., & Bialystok, E. (2014). Independent effects of bilingualism and socioeconomic status on language ability and executive functioning. *Cognition, 130,* 278-288. doi:10.1016/j.cognition.2013.11.015

Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science, 11,* 282-298. doi:10.1111/j.1467-7687.2008.00675.x

Centraal bureau voor de Statistiek. (2013). *Bevolking: Generatie, geslacht, leeftijd en* *herkomstgroepering, 1 January.* Retrieved from: http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=37325&D1=0&D2=a&D3=0&D4=0&D5=2-4,11,38,46,95-96,137,152,178,182,199,220,237&D6=0,4,8,12,16-17&HD=130613-1224&HDR=T,G2,G3,G5&STB=G1,G4

Craik, F. L. M., & Bialystok, E. (2006). Cognition through the lifespan: Mechanisms of change. *Trends in Cognitive Sciences, 10,* 131-138.

Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test*. Minneapolis, MN: Pearson.

Engel de Abreu, P. M. J., Cruz-Santos, A., Tourinho, C. J., Martin, R., & Bialystok, E. (2012). Bilingualism enriches the poor: Enhanced cognitive control in low-income minority children. *Psychological Science, 23,* 1364-1371. doi:10.1177/0956797612443836

Field, A. (2009). *Discovering Statistics using SPSS.* London: SAGE Publications Ltd.

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive functions in preschoolers: A review using an integrative framework. *Psychological Bulletin, 134,* 31-60. doi:10.1037/0033-2909.134.1.31

Hauser, R.M. (1994). Measuring socio-economic status in studies of child development. *Child Development, 65,* 1541–1545.

Hughes, C. H., & Ensor, R. A. (2009). How do families help or hinder te emergence of early executive function? In C. Lewis & J. I. M. Carpendale (Eds.), Social interction and development of executive function. *New Directions in Child and Adolescent Development, 123,* 35-50. doi:10.1002/cd.234

Klenberg, L., Korkman, M., & Lahti-Nuuttila, P. (2001). Differential development of attention and executive functions in 3- to 12-year-old Finnish children. *Developmental Neuropsychology, 20,* 407-428. doi:10.1207/S15326942DN2001_6

Kroll, J. F., & Bialystok, E. (2013). Understanding the consequences of bilingualism for language processing and cognition. *Journal of Cognitive Psychology, 25,* 497-514. doi:10.1080/20445911.2013.799170

Manly, T., Nimmo-Smith, I., Watson, P., Anderson, V., Turner, A., & Robertson, I. H. (2001). The differential assessment of children's attention: The Test of

Everyday Attention for Children (TEA-Ch), Normative sample and ADHD performance. *Journal of Child Psychology and Psychiatry*, *42*, 1065-1087.

Manly, T., Robertson, I. H., Anderson, V., & Nimmo-Smith, I. (1998). *Test of Everyday Attention for Children*. London, England: Pearson Assessment.

Mezzacappa, E. (2004). Alerting, orienting, and executive attention: Developmental properties and sociodemographic correlates in an epidemiological sample of young, urban children. *Child Development, 75,* 1373–1386. doi:10.1111/j.1467-8624.2004.00746.x

Morales, J., Gómez-Ariza, C. J., & Bajo, M. T. (2013). Dual mechanisms of cognitive control in bilinguals and monolinguals. *Journal of Cognitive Psychology, 25,* 531-546. doi:10.1080/20445911.2013.807812

Noble, K.G., McCandliss, B.D., & Farah, M.J. (2007). Socioeconomic gradients predict individual differences in neurocognitive abilities. *Developmental Science, 10,* 464–480. doi:10.1111/j.1467-7687.2007.00600.x

Noble, K.G., Norman, M.F., & Farah, M.J. (2005). Neurocognitive correlates of socioeconomic status in kindergarten children. *Developmental Science, 8,* 74–87. doi:10.1111/j.1467-7687.2005.00394.x

Poulin-Dubois, D., Blaye, A., Coutya, J., & Bialystok, E. (2011). The effects of bilingualism on toddlers' executive functioning. *Journal of Experimental Child Psychology, 108,* 567-579. doi:10.1016/j.jecp.2010.10.009

Roberts, E., Bornstein, M. H., Slater, A. M., & Barett, J. (1999). Early cognitive development and parental education. *Infant and Child Development, 8,* 49-62. doi:10.1002/(SICI)1522-7219(199903)8:1<49::AID-ICD188>3.0.CO;2-1

Rosvold, H., Mirsky, A., Sarason, I., Bransome, E., & Beck, L. (1956). A continuous performance test of brain damage. *Journal of Consulling Psychology, 20,* 343-350.

Sarsour, K., Sheridan, M., Jutte, D., Nuru-Jeter, A., Hinshaw, S., & Boyces, W. T. (2011). Family socioeconomic status and child executive functions: The roles of language, home environment, and single parenthood. *Journal of the International Neuropsychological Society, 17,* 120–132. doi:10.1017/S1355617710001335

Stronks, K., Ravelli, A. C. J., & Reijneveld, S. A. (2001). Immigrants in the Netherlands: Equal acces for equal needs? *Journal of Epidemiol Community*

Health, 55, 701-707. doi:10.1136/jech.55.10.701

Vedder, P., & Virta, E. (2005). Language, ethnic identity, and the adaptation of Turkish immigrant youth in the Netherlands and Sweden. *International Journal of Intercultural Relations, 29,* 317-337. doi:10.1016/j.ijintrel.2005.05.006

Verhoeven, L., Vermeer, A. (2001). *Taaltoets Alle Kinderen, handleiding.* Arnhem, Citogroep.

Verweij, A. (2008). Scholing en opleiding: Indeling opleidingsniveau. Verkregen van http://www.nationaalkompas.nl/bevolking/scholing-en-opleiding/indeling-opleidingsniveau/

Verweij A. (2010). *Wat is sociaaleconomische status?* Retrieved from http://www.nationaalkompas.nl/bevolking/segv/wat-is-sociaaleconomische-status/

Appendix 1: Dutch Version of the Survey

Aanvullende Vragenlijst

Universiteit Utrecht

1. Vader: Wat is de hoogste opleiding die u heeft afgemaakt?
   - o Geen opleiding (lager onderwijs: niet afgemaakt)
   - o Lager onderwijs (lagere school, basisschool, speciaal basisonderwijs)
   - o Lager of voorbereidend beroepsonderwijs (zoals huishoudschool, vbo, lbo, lts, leao, lhno, vmbo)
   - o Middelbaar algemeen voortgezet onderwijs (zoals mavo, (m)ulo, ivo, mbo-kort, vmbo-t)
   - o Middelbaar beroepsonderwijs en beroepsbegeleidend onderwijs (zoals mbo-lang, mts, meao, mhno, bol, bbl, in(t)as)
   - o Hoger algemeen en voorbereidend wetenschappelijk onderwijs (zoals havo, vwo, atheneum, gymnasium, hbs, mms)
   - o Hoger beroepsonderwijs (zoals hbo, hts, heao, hhno)
   - o Wetenschappelijk onderwijs (universiteit)
   - o Anders, namelijk: ______________________________

2. Vader: Wat is uw huidige beroep?

   ____

3. Moeder: Wat is de hoogste opleiding die u heeft afgemaakt?
   - o Geen opleiding (lager onderwijs: niet afgemaakt)
   - o Lager onderwijs (lagere school, basisschool, speciaal basisonderwijs)
   - o Lager of voorbereidend beroepsonderwijs (zoals huishoudschool, vbo, lbo, lts, leao, lhno, vmbo)
   - o Middelbaar algemeen voortgezet onderwijs (zoals mavo, (m)ulo, ivo, mbo-kort, vmbo-t)
   - o Middelbaar beroepsonderwijs en beroepsbegeleidend onderwijs (zoals mbo-lang, mts, meao, mhno, bol, bbl, in(t)as)
   - o Hoger algemeen en voorbereidend wetenschappelijk onderwijs (zoals havo, vwo, atheneum, gymnasium, hbs, mms)
   - o Hoger beroepsonderwijs (zoals hbo, hts, heao, hhno)
   - o Wetenschappelijk onderwijs (universiteit)
   - o Anders, namelijk: ______________________________

4. Moeder: Wat is uw huidige beroep?

   ____