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Lexical-semantic production and executive functions in bilingual (German-English) children

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1. ABSTRACT

When testing bilingual children, as a speech and language therapist, one often encounters problems. A field which is especially challenging to test is lexical-semantic production. The aim was to shed more light on bilingual children's inhibitory and switching ability during picture-naming and related non-verbal tests and which factors must be taken into consideration when evaluating these results.

The present study explored the effects of age and cognitive processing within a timed picture-naming task and a non-verbal switching task and also examined a possible relation between these tasks. 22 children participated in the study, which were divided into two groups (Group 1: 5-6 years; Group 2: 7-12 years). All had learnt German from birth at home. English was either introduced as a second language later or was also learnt from birth at home. The testing of language switching and inhibition was conducted through a cued timed picture-naming task. Picture naming was tested in three different conditions, two conditions where only one language was tested (blocked English and blocked German) and one mixed condition (switching between English and German). A non-verbal switching and inhibition test was conducted using the Wisconsin Card Sorting Test (WCST) for the older group and the Dimensional Change Card Sorting (DCCS) for the younger group.

Results revealed unequal error rates and differences in response time, with the older children producing fewer errors and lower response times in all three conditions. The study showed no statistical relationship between non-verbal and verbal switching and inhibition tasks. Results from the verbal switching task, support earlier findings of a shift towards becoming more dominant in L2 (in this case English) with increased age (and equivalent years of language experience) and that the developments of cognitive functions play a big role in the control of the switching and inhibition abilities.

Keywords: bilingualism, lexical-semantic production, executive functions, picture-naming

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2. INTRODUCTION

Bilingualism is a phenomenon that more and more emphasis is placed on. It is present everywhere and is nowadays seen as enrichment by most people. Even though bilingualism is more common than uncommon there is not much focus put on this area during most speech and language therapists' education. This leads to an uncertainty when it comes to testing bilingual children and assessing their speech and language difficulties. An area which is particularly challenging to test is lexical-semantic production. This is due to unawareness on how both languages influence each other during production. Specific questions I have tried to answer are:

- Does competition between the two languages lead to consequences during picture naming?
- Can bilingual children inhibit the non-target language?
- Will balanced bilinguals (who are equally strong in both their languages) get different results than unbalanced bilinguals (who are more dominant in one language)?
- Is it possible to test both languages at the same time?

Another area of interest is executive functions. There is a lot of evidence suggesting that bilinguals perform better in executive functions tasks due to their superior inhibitory control that may have developed as a result of their bilingual experience. Previous studies using picture naming tasks have shown that the switching process in bilinguals contribute to slower response times in picture naming tasks but increases the performance of inhibitory control. Questions I have looked closer at are:

- Do bilingual children have better executive functions?
- Is there a connection between non-verbal and verbal switching and inhibition abilities?

To understand more about both bilingualism and executive functions and how these two abilities are related, related literature is discussed in the background.

3. BACKGROUND

BILINGUALISM

To understand what bilingualism is and who can be defined as bilingual, I have looked at previous studies to find a definition for what the term bilingualism means and what criteria there are for being bilingual.

3.1 Definition of bilingualism

Defining bilingualism is not an easy task. Bilingualism is present in every country in the world, in all socioeconomic groups and in all age groups. It is a worldwide phenomenon. There are different ways a child can become bilingual or in some cases even multilingual.

In many families nowadays, there is often another language that is being used. This language differs from that of the other residents of the country. The extended families can have two or more languages which their children may or may not learn through interaction. In other cases parents deliberately choose to speak to the child in different languages which also creates a bilingual home (Bialystok, 2003). In some parts of the world, bilingualism is expected

(Grosjean, 1982). Mostly these are old colonial countries, where the language of the colonial master has become a second language next to the native language (Bialystok, 2003).

One could call these forms of language acquisition, which are mentioned above, Bilingual First Language Acquisition (BFLA) (De Houwer, 2009) or early simultaneous bilingualism (de Groot 2011; Kapa 2010). These terms implicate that the child develops two languages from birth. They learn to understand two languages simultaneously and when they start speaking they often use words and sentences in both languages (De Houwer, 2009; De Groot, 2011).

The terms *Simultaneous* and *sequential* bilingualism are used (de Groot, 2011) to distinguish between those children acquiring L1 and L2 from birth and those exposed to the L2 only after the L1 is completely acquired, respectively; the divide is set at about three years of age (Genesee *et al.*, 2004).

Early Second Language Acquisition (ESLA) or sequential bilingualism is when a monolingual child's language environment changes in such way that they start to hear a second language with some regularity over and above their L1 (Kapa, 2010; De Groot, 2011). This often happens in day care or preschool. ESLA children learn to understand one language and start speaking in one language only. Subsequently they learn to understand a second language, their L2 (De Houwer, 2009).

The learning situation of children who grow up with one language is called Monolingual First Language Acquisition (MFLA) and means that the child will only learn to speak and understand one language from birth (De Houwer, 2009).

I have decided to define bilingualism as when a child develops two languages before the age of three.

3.2 Who is bilingual?

Researchers in the area have proposed different definitions of bilingualism. Fluency in both languages has often been an important criterion. Grosjean (1982) however reasons that too much attention is put on fluency and other values like regularity of the use of the languages, the dominance of use and factors like reading and writing skills should be focused on more. A broad definition is that a bilingual is an individual who lives in a non-monolingual environment and interacts regularly to at least two languages (Salameh, 2003). As one may notice, in this definition there are no requirements for a certain level of linguistic competence. Most of the researchers have decided to highlight the use of the two languages instead of the fluency. According to Grosjean (1989) a bilingual is someone who can function in both languages according to given needs. Both Weinreich (1968) and Grosjean (1982) define bilingualism as the alternate use of two (or more) languages.

The fact that BFLA children hear two languages from birth does not necessarily mean that they will actually learn to speak these languages (De Houwer, 2009). Results from Flanders survey study shows that even though the children heard two languages at home, many children do not actively speak both languages (De Houwer, 2009). This result is also shown in De Houwers study (2009), where all children spoke the majority language but only 71% also spoke the other language. Grosjean (1996) also noted that bilinguals rarely developed equal

fluency in both languages. Altaribbas (1992) results show that early Spanish-English bilinguals who receive the majority of their education in English will become more sufficient in English than in Spanish, which suggests that bilinguals show effect of language dominance. Currently there are no tests or accepted standards to “measure” the degree of bilingualism. Therefore it is not possible to classify the degree of bilingualism on some absolute scale (Bialystok, 2003).

There is a difference in how bilingual children develop and use their lexical and semantic skills compared to their monolingual peers. In the next section I will look closer at bilingual lexical and semantic development and skills and how these skills can affect picture naming tasks, which are often used to study lexical-semantic knowledge.

4. LEXICAL-SEMANTIC SKILLS

4.1 Bilingual lexical and semantic skills

The general developmental patterns of bilingual language acquisition are identical to monolingual children’s language acquisition (De Houwer, 2009). This shows the robust nature of early language acquisition. The timeframe in which major developmental steps take place are also similar. There is a wide variation in the ages at which children reach important milestones (De Houwer, 2009), which exists in both mono- and bilinguals. As long as the child has no major problems such as hearing loss, neurological disorder or lack of human interaction he or she will learn to speak well by the time it is five, independently of whether one or more languages are present (De Houwer, 2009).

Bilingual children must learn to detect and take in the regularities of the two languages at the same time. Both languages have to be differentiated whilst the child also has to recognize both languages as native languages. Rhythm is one source of information that is used to discriminate between the two languages (Mehler, Dupoux, Nazzi & Dehaene-Lambertz, 1996). Newborn infants who were exposed to only a single language prenatally show greater interest in their native language than in an unfamiliar language from a different rhythmic class (Mehler *et al.*, 1988; Moon, Cooper, & Fifer, 1993). Rhythm is in these cases defined as a component of prosody.

An example for lexical retrieval is if you ask a bilingual child to name a picture of a dog in one of its two languages, it will sooner or later come up with an answer. This mental process makes the connection between the “idea” of dog and the word dog (Costa, 2005). In most language production models, two selection processes are assumed. In the first process, the relevant conceptual information is selected and in the second one word from the set of activated representations is selected (Costa, 2005). As one can see, this selection process is a complex mechanism. Because lexical access involves many executive functions like semantic memory, the representation of words and selective attention, we will probably know a lot more about cognition in general if we understand lexical access (Costa, 2005).

Previous studies have shown that bilingual children often score lower on expressive vocabulary test than monolingual children (Junker & Stockmann, 2002). However, if one added up the two vocabulary scores of both languages it has been found that the Total

Conceptual Vocabulary (TCV) is actually the same or even bigger than monolinguals (Pearson, 1998; Junker & Stockman, 2002). “Conceptual vocabulary is defined as the number of different semantic concepts for which the child has a lexical representation. A bilingual child may associate two labels, one in each language, with a single conceptual referent, and the conceptual vocabulary may therefore differ from the number of lexical forms” (Junker & Stockman, 2002). Researchers (Yan & Nicoladis, 2009; Costa, 2005) have often assumed that expressive and receptive vocabulary share a semantic store but there is an extra step involved in the expressive vocabulary and this is the motoric representation. This means that producing words is harder than understanding them. The lower scores in expressive vocabulary tests in bilinguals could therefore be due to difficulties in lexical access for the purposes of production (Yan & Nicoladis, 2009). There may be two steps involved for bilinguals: recognition of a familiar pattern plus identification, these steps are combined in monolinguals (Sorace, 2013).

4.2 Picture Naming

Picture naming is a task often used to investigate lexical-semantic knowledge. Picture naming consists of recognizing the meaning of an item and then finding the correct verbal label for it in the mental lexicon (Glaser, 1992). There are two different ways to perform this test; one can measure vocabulary knowledge of the person by measuring the grade of correctly named items when the items are graded in difficulty, or you can measure the amount of correct named items during timed variants of the picture naming task. By using the response time instead of the overall accuracy score you can qualify performance based on speed of information processing (Kohnert, 1999).

In monolingual studies a number of factors have been identified which can affect the results of the picture-naming performance. Frequencies of occurrence of the pictures name, their familiarity, the degree of image agreement (e.g. how well does the picture match with the person’s own image of the item) are a few factors which are relevant (Snodgrass & Yuditsky, 1996). The length of the word has, in monolingual studies, not shown to be a factor which affects the accuracy and timing of the picture naming performance (Snodgrass & Yuditsky, 1996). This factor can be significant in tests with bilinguals because the length of the word can vary across their languages (Kohnert, 1999).

4.3 Previous Picture-naming studies with bilingual children

Two studies, written by Kohnert et al. (1999 and 2002) looked at lexical-semantic skills by using picture-naming tasks. In these studies, lexical-semantic production and cognitive processing in children learning Spanish and English were investigated.

In Kohnert’s study from 1999, there were 100 participants, 20 at each different age group (5-7, 8-10, 11-13, 14-16 years and young adults). They had all learnt Spanish as a first language L1 at home and at 5 years they received formal English experience at school L2. The study showed that in the young children there was a cross-over from Spanish which is their dominant language. In the children in the two middle groups, the two languages were relatively balanced and the adolescents and young adults were dominant in English. All the

groups had slower response times in the mixed-language condition than in the blocked conditions (in the blocked conditions, only one language at a time was tested), but the older the children became, the better the speed-accuracy was. This can be interpreted as an improvement in the children's ability to resist cognitive interference during production. In their follow up study in 2002, a subgroup of the original study participants were tested 1 year later using the same method. This study showed that the gains were greater in English than in Spanish and in the mixed-language task than the blocked language tasks at Time 1. These findings reinforce the results found in 1999, children get better in English the older they get (and the more language experience they gain) as well as that there is a cognitive development which is important for the control of the language system that manages both languages, a dual-language system (De Groot, 2011). There was also an overall pattern of increasing speed, accuracy and control of the dual-language system.

The findings of these studies indicate that there is a change in the dominance of the two languages and that switching between the languages get easier, the older the child gets.

5. EXECUTIVE FUNCTIONS AND EXECUTIVE CONTROL

5.1 Definition of executive functions and executive control

Executive functions, like bilingualism, is a hard term to summarize. It is an umbrella concept that includes different abilities. Gilbert and Burgess (2008) state that "executive functions are a high-level cognitive function that facilitate new ways of behaving, and optimises one's approach to unfamiliar circumstances." (p.110). Planning, flexibility, error correction/detection, multitasking, reasoning and problem solving are examples of features that are included in the concept of executive functions. (Lezak, 1995; Stuss, 2011)

Executive functions are often grouped into what they are (1) and what they do (2):

1. Processes that organize and control cognitive functions and that control lower level processes such as thoughts and actions (Roca, 2010; Gilbert & Burgess, 2008).
2. They help us to behave flexibly when new situations occur and facilitate individual behaviour (Gilbert & Burgess, 2008; Lezak, 1995)

There are many different theories as to what should be included in the term executive functions. If you narrow it down you will find three key points (Diamond, 2006). :

1. Inhibition is the ability to ignore distraction and stay focused and resist making one response and instead making another.
2. Working memory is the ability to hold information in mind and manipulate it.
3. Cognitive flexibility is the ability to flexibly switch perspectives, focus of attention, or response mappings.

Executive functions are active regulating processes like forth initiation, modulation and inhibition of on-going mental attention, necessary for task performance (Dempster, 1992). According to Diamond (2006), the ability to resist the strongest response tendency (i.e., to inhibit responding) "provides us with extraordinary flexibility and the freedom to choose and

control our actions". Deficits in inhibitory control can lead to the incorrect performance of tasks, resulting in that a response will be executed, rather than inhibited which could be more appropriate in that situation (Schachar & Logan, 1990; Schachar, Tannock & Logan, 1993).

Harnishfeger and Bjorklund (1993) suggested the growth of an inhibition mechanism, "a mechanism for suppressing behaviour that characterizes the development of executive functions". With Luria (1961) being one of the first numerous authors have suggested that the growth of an inhibition mechanism occurs in parallel with the growth of the prefrontal cortex. It is definite that lexical access is more difficult for bilinguals because both languages are active and compete with each other during speech. Some type of selection or attention has to be made. One of the essential cognitive abilities underlying all these skills is executive functions in particular inhibition and switching processes. (Bialystok, 2009)

5.2 Task Switching

Task Switching can be seen as a part of the executive control mechanism. Already in the beginning of the last century task switching was investigated. Jersild (1927) participants were asked to perform one task or to switch between other tasks. Even though his study is from the beginning of the 20th century, both his results and method are still relevant. The study investigated the processing time to process whole lists, so all the stimuli were on a single sheet of paper. He found that some tasks resulted in longer switching times.

Allport and colleagues (1994) found that participants showed more interference when having to switch between within-dimension switches (switch between naming colours and words on a Stroop task (Stroop, 1935)) than in-between-dimension switching (naming colours and numerical values). The phenomenon in which participants suffer from interference of previously activated tasks is called task set inertia. The more an alternative task command is active the larger the switching costs. Rogers and Monsell (1995) looked at reaction times to a set of letter-number pairs in which the digit had to be classified as even or odd and the letter had to be classified as consonant or vowel. When the interval between the pairs was increased, the switching time was faster. The stimulus cues the switch which leads to no additional switching costs, which contradicts the findings of Allport *et al.* (1994). They proposed that participants should become slower beyond the first trial as the task set inertia dissipates. Both task set inertia, and Roger and Monsells stimulus-cued switch, predict that non-switches are faster than switches.

Studies have shown that task switching, results in the extension of central executive processing and that bilingualism also has a positive effect on the central executive processes (Hahn *et al.*, 1998; Bialystok, 2009).

This would lead to the implication that if executive processing skills are enhanced when doing switching tasks, proficient bilinguals should have improved executive processing skills and older bilingual children should be better than younger bilingual children in executive processing. Their advantage over younger children has both to do with them improving in the switching but also because of the fact that they are older, and so have improved executive function skills.

5.3 Bilingualism and Language Switching

The idea that bilinguals have a switching mechanism that mediates between the two languages is found in the neurophysiological literature. The separation of two languages is executed by an automatic switch at the neurophysiological level (Penfield & Roberts, 1959). Using magnetic resonance imaging, an increased activation in the dorsolateral prefrontal cortex during language switching has been found (Hernandez *et. al.* 1998). MacNamara (1968) found that language switching affects the processing speed.

An advantage for bilingual children over their monolingual peers in inhibition and switching tasks has been shown in various studies. (Kapa, 2010; Poarch & van Hell, 2012; Bialystok, 2011; Festman *et. al.* 2010; Van Hell & Dijkstra, 2002). In these studies several different tasks and diverse language pairs have been used. This suggests that the advantage is neither task nor language specific (Bialystok, 2009). It must be taken into account that unbalanced bilinguals (bilinguals who are more dominant in one language) show more interference when switching from their non-dominant language to their dominant. The interference when switching from the non-dominant to the dominant language, could not be found in balanced bilinguals (bilinguals who are equally good in both languages).

5.4 Bilingualism and Inhibition

There is considerable evidence that when bilinguals speak, both their languages are activated (Costa, 2005; Jared & Kroll, 2001). There are two different explanations to how the cross-language interaction affects the language production. Costa and colleagues (Costa *et al.*, 2005, 2006) have stated that when both languages are active, this dual activity benefits the language management and that the non-target language is not inhibited but helps facilitating the lexical access. When the child is searching for a word, the simultaneous activation can lead to both enablement and interference depending on how the words are related (Costa, 2005). Meuter and Allport (1999) as well as Rivera (2008) support the statement that inhibition of the non-target language occurs and that an inhibitory control is necessary to use the correct language, suited for the situation. There is a lot of evidence proposing that one language has to be inhibited and according to Green (1998) this should also effects the control mechanisms of attention and inhibition positively, as bilinguals practice inhibition from a very young age, when suppressing the non-target language.

6. THE PRESENT STUDY

In this study I aimed to look at the connection between switching, inhibition and picture naming, measuring response time and accuracy when naming stimuli in three different language conditions; blocked German, blocked English and mixed German and English. In this task the participants will have to use both their inhibitory and switching abilities to name the stimulus in the target language. I have partly replicated Kohnert's study from 1999, by using the same design for the verbal switching test and have, as far as possible, used her evaluation system. To investigate a possible connection between verbal and non-verbal inhibition and switching tasks, non-verbal inhibition and switching abilities were measured with the DCCS, for the children under 7 years, and WCST for the children over 7 years.

To find out more about the children's language background, I used questions from the Utrecht Bilingual Language Exposure Calculator (UBILEC) for a questionnaire in German. This questionnaire was filled in by the parents.

6.1 Hypotheses

1. Bilinguals must experience more competition during word recognition and word production which should lead to consequences in their performance (De Groot 2011).
2. The increased demands in the switching task will lead to longer response times and more inaccurate answers than in the blocked condition. I anticipate that there will be differences between the two age groups but the differences will be smaller in the blocked condition results.
3. I anticipate a difference in results depending on the individual UBILEC statements given by the parents. More unbalanced bilinguals should have longer response times than balanced bilinguals.
4. The accuracy of answers will vary between age groups and balanced/unbalanced bilinguals.

6.2 Questions I sought to answer

1. How do bilinguals handle the competition between the two languages? Can they switch off the non-target language? If the latter is true, it implies that bilinguals possess an effective control system to inhibit one language whilst speaking the other. They should have high scores on inhibition and switching tasks.
2. Will balanced bilinguals (who are equally strong in both their languages) get different results than unbalanced bilinguals (who are more dominant in one language)?
3. Is it possible to test both languages at the same time?
4. Do bilingual children have better executive functions?
5. Is there a connection between non-verbal and verbal switching and inhibition abilities?

7. METHOD

7.1 Participants

A total of 22 German-English bilingual children participated in the study. Due to time restrictions, I did not have the possibility to test more participants. These children were recruited at a German Saturday school in Edinburgh. They attended a regular communal Scottish school during the week and went to the German Saturday School once a week. During the Saturday School all education was held in German. None of the participants had any neuropsychiatric diagnoses or had been in contact with a speech and language therapist before. The mean age of the group was 7,14 years with the youngest being 5:0 and the oldest 12:4. The participants were divided into two groups depending on their age, 5-6 and 7-12 years. This division was made based upon which executive function test the children did (DCCS for 5-6 and WCST for 7-12). The age range for the WCST was 6,5 to 89 years of age and for the DCCS the range was 3 to 6 years of age. Both these test are based on monolingual

norms and results. There were 8 children in group 1 and 14 children in group 2. The unequally sized groups are due to irregular numbers of participants from each age. With the group of 7 years old being the biggest (8 participants) it was not possible to divide the groups in to similarly big groups. If the group of 7 years old had been excluded, the number of participant had only been 14.

Group 1 (5-6 years)	Group 2 (7-12 years)
8	14

A survey based on questions from UBILEC was sent to the parents via Email or were filled out at the occasion of the testing. The survey included questions about their child’s languages, language acquisition and use of language.

All participants had learned German as L1 from birth. English was introduced between 0 and 3 years of age (mean age = 0.5). Participants lived in Edinburgh and surroundings and were from different socioeconomic backgrounds with the majority of an academic background.

7.2 Design and materials

The children were tested with a picture-naming task and an executive function task. For children under 7:0 years, Zelazo’s Dimensional Change Card Sorting (DCCS) was used and for children over 7:0 years, Wisconsin Card Sorting Test (WCST) was used. These tests both focus on inhibition and switching.

The program used for the picture-naming task was E-prime. All pictures were edited and presented as black-on-white line drawings. The picture stimuli were presented on a 16 inch laptop screen. A microphone-headset was used to record the children’s answers. A separate standing microphone was connected to an SR button box which recorded the timing of responses. The 84 picture test stimuli were arranged into three different test conditions: (1) blocked English, (2) blocked German and (3) mixed English and German. 20 pictures were used for each of the blocked conditions with 4 practice trials each and 30 for the mixed condition with 5 practice trials. No practice or test pictures were repeated within or across conditions for any participant. Pictures were rotated so that each picture appeared in a random order in every test condition. The pictures were taken from the Snodgrass and Vanderwart (1980) material and it was double checked with a group of parents if the children would know the items in both languages. The children were prompted by auditory cues which were recorded by a male adult. When the cue was “say” the children were supposed to name the picture in English and when it was “sag”, in German. In the mixed condition, the auditory cues were randomised. This required the participants to switch languages to name the pictured stimuli in the target language. Language cues were randomized throughout the set, so that the participant could not anticipate the next target language. Participants were given 5 seconds to respond. Once the 5 seconds had elapsed, the experiment advanced to the next picture. The change to the next picture was done automatically after 5 seconds.

A well-known and often used test to examine executive functions is the WCST (Wisconsin Card Sorting Test). This test was originally developed to assess abstract reasoning ability and the ability to shift cognitive strategies in response to a changing environment. This test requires strategic planning, organized searching, using environmental feedback to find the right cognitive sets, directing behaviour towards achieving a goal and modulating impulsive responses (Chelune & Bear, 1986). The WCST has been standardized and normed for use with children, adolescents and adults from 6 ½ through 89 years of age. The WCST consists of four stimulus cards and 128 response cards that portray different forms (crosses, circles, triangles and stars), colors (red, blue, green and yellow), and number of objects (one, two, three or four). The total number of trials administered, total number of correct, total number of errors and percentage errors are written into the scoring booklet and is then matched to existing normative data to derive a standard score, T score and percentile score.

For the younger participants of this study, the DCCS (Dimensional Change Card Sort) was used. This test was originally created by Zelazo and his colleagues (Zelazo *et al.*, 2006) to assess executive functions in young children. The standard version is for children between 3 and 5 years of age and a more challenging border-version for children up to 7 years. The DCCS consists of two trays, two target cards and fourteen standard test cards for use in the standard version. These are identical in style to the target cards, but half of them show a red cat and half show a blue bus. Two of these cards are used in the demonstration phase. In the border version, for children over 5 years of age, seven cards which are identical to the standard test cards but have a black border around them. Four of these cards depict a red cat and three depict a blue bus. In this test you can either pass or not pass. Monolingual children over 36 months of age usually sort correctly on all six pre-switch trials. A child needs to sort at least five out of six post-switch trials correctly in order to pass. Performance on the border version is scored as the number correct out of 12. Children should be able to sort nine or more cards correctly out of 12 trials to pass. It is between 3-4 years of age that children start to pass both the standard tests. At 5 years, approximately half pass the border tests. If the participant fails the pre-switching phase of the test, they get the score of 0. If they pass the pre-switch phase but fail the post-switch phase, they get a score of 1. If they pass both the pre- and post-switch phase but fail the border version, they are assigned a score of 2. A score of 3 is assigned if they pass all the versions.

7.3 Procedures

All children were tested individually either on Saturdays during their Saturday school or in their homes. The testing lasted for 40 minutes and included an introduction to the tests and the conduction of the tests. Participants were fitted with a microphone, a set of bilateral earphones and seated in front of the computer screen. They were instructed in German to name the pictured item as fast as possible in the language which was indicated by an auditory cue (eg. “say” or “sag”). All instructions of all three tests were given in German, for one reason that my German is more fluent. Another reason was that since English was the dominant language of all children, giving instructions in German would put the children into a German language mode and this might compensate for their unequal language skills.

In the WCST the four stimulus cards are placed in front of the participant. The participant is then handed the deck of response cards and is instructed to match each card with a stimulus card. The correct sorting principle is never told, only whether each response is right or wrong. Once 10 cards are sorted correctly, the sorting principle is changed, without warning the participant and he or she now has to develop a new strategy. There are three different sorting strategies; form, colour and number. The test proceeds in this manner until the participant either has successfully completed six categories or until both decks of response cards have been used.

In the DCCS there are two dimensions; colour and shape. Usually colour is chosen to be relevant during the pre-switch phase. First a demonstration is held by placing the sorting trays side by side in front of the participant. The target cards are affixed to the display behind the trays. The participant is told what is on the target cards, "Here is a red cat and here is a blue bus". The first dimension is the colour game. The child has to sort all the blue cards into the tray with the blue bus and all the red cards into the tray with the red cat. Two cards are used for the demonstration and the child has to sort six cards themselves. Next is the post-switch trial where the relevant dimension is shape. The participant is told to sort all the cards with a cat into the tray with the red cat and all the buses into the tray with a blue bus. Children who pass the post-switch trial may proceed to the border version. If there is a border the participant has to play the colour game, if the card has no border the participant has to play the shape game.

The statistical calculations were implemented using Microsoft Excel 2010 and SPSS 19. As the groups were not normally distributed but the sample sizes of the different variables were big enough, the t-test was used for comparison within and between the groups. 0.05 was used as significance level. Descriptive statistics were prepared with the t-test and using the descriptive function in SPSS. Correlation calculations were made with Pearson's and Spearman's correlation tests. Both calculations within and between the groups were made.

Response times (in milliseconds) were analysed only for those items that were accurately named. A response was counted as correct if:

1. It was produced without noticeable hesitation in the target language
2. If it was the correct name of the picture or was an appropriate synonym/dialectal variation of the item (e.g., in English, "plane" was accepted for "airplane")

Items scored as incorrect and therefore eliminated from subsequent response time analysis included:

1. "No responses" within the pre-set five-second response window
2. Audible hesitations (such as "uh", "um" causing a false trigger of the voice key)
3. Translation errors (e.g., a picture named in German that was cued in English)
4. "Within-language" errors, such as superordinate names (e.g., "furniture" instead of "bed") and naming the picture incorrectly.

8. RESULTS

There were three primary aims of this study. The first was to investigate if there were any developmental changes in lexical-semantic encoding skills in both L1 and L2 in early bilinguals (during language-blocked picture naming) and also to compare results within the group. The second was to explore the effects of inhibition and switching abilities on the lexicon in these normally developing bilinguals (during language-mixed picture naming). The third was to see if there is a correlation between inhibition and switching abilities in verbal task and non-verbal tests.

Results relevant to these three purposes are presented first looking at response times, then accuracy and correlation between the non-verbal and verbal task at the end.

8.1 Response Times

In table 1 the response times in milliseconds for the different groups are reported. The response times for the different categories as well as the mean of all three conditions are shown.

Group 1 (5-6 years)			Group 2 (7-12 years)		
Condition 1	Condition 2	Condition 3	Condition 1	Condition 2	Condition 3
1676.12ms	1811.43ms	2254.42ms	1389.10ms	1505.78ms	1894.72ms
Mean of all 3 Conditions			Mean of all 3 Conditions		
1913.99ms			1596.53ms		

Table 1: Mean of response times (in milliseconds) for each group and condition.

Condition 1: English, Condition 2: German, Condition 3: Mixed

In this table we can see, that group 1 had a higher response time in general but also in each one of the three conditions compared to the older children in group 2. Both groups had higher response times in condition 3 compared to both condition 1 and 2.

8.1.1 Response Times: Comparison within groups using t-test

Figure 1 and 2 show the mean of the response times achieved in the different categories. Figure 1 demonstrates the response times of group 1, figure 2 shows the response times for group 2.

Group 1

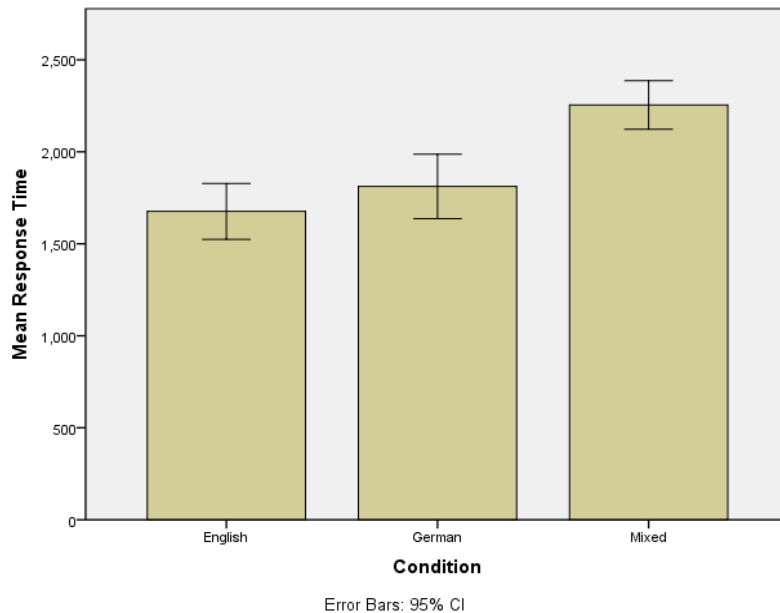


Figure 1.

t-test showed a significant statistical difference when comparing the mean response times of condition 1 and 3 ($t(302) = -5.698, p < 0.05$), 2 and 3 ($t(281) = -4.063, p < 0.05$) but not in 1 and 2 ($t(246) = -1.161, p > 0.05$) within group 1.

Group 2

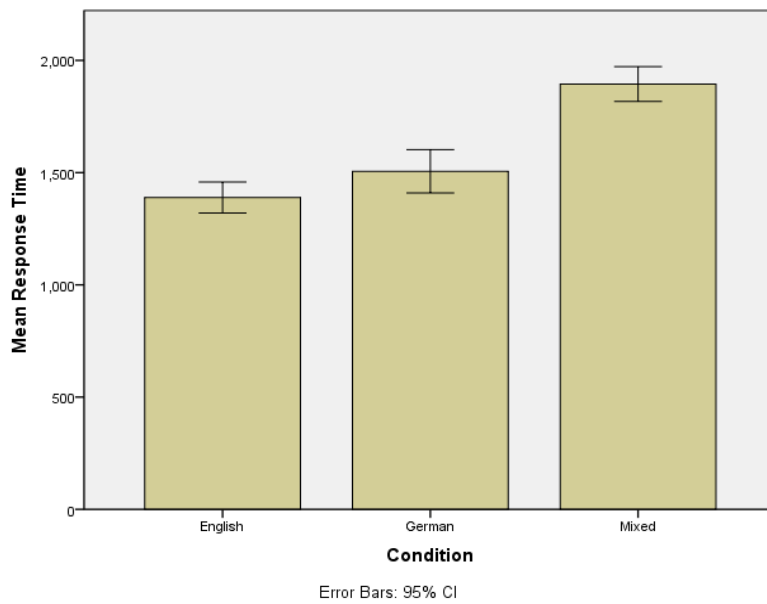


Figure 2.

The t-test showed a statistical significant difference between the response times of condition 1 and 3 ($t(615.39) = -9.57, p < 0.05$), of condition 2 and 3 in group 2 ($t(595) = -6.209, p > 0.05$). On the contrary, no statistical significant difference was found when comparing the response times as well as when comparing condition 1 and 2 ($t(444.09) = -1.937, p > 0.05$).

8.1.2 Response Times: Comparison of groups using t-test

The t-test was used to compare the response times between the two groups for each condition. Figure 3 shows the results for category 1 (English), Figure 4 for category 2 (German) and Figure 4 displays the results for the mixed category.

Condition 1:English

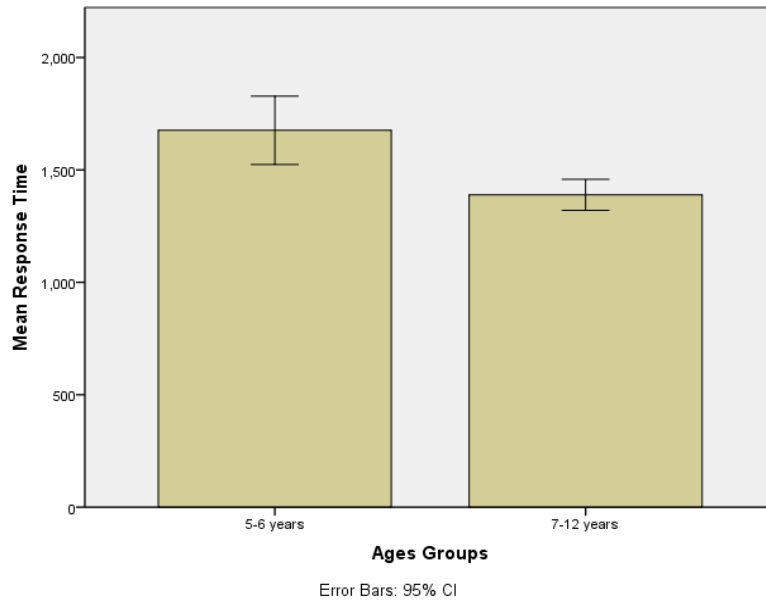


Figure 3.

The t-test shows that there is a statistical significant difference between the response times of group 1 and group 2 in Condition 1, $t(192.85)=3.399$, $p<0.05$

Condition 2: German

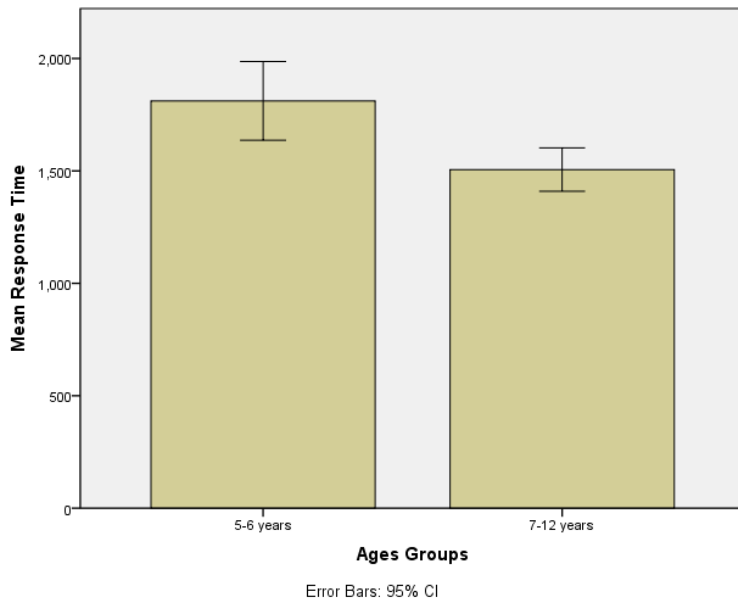


Figure 4.

The t-test shows that there is a statistical significant difference between the response times of group 1 and group 2 in Condition 2, $t(186.40)=3.024$, $p<0.05$

Condition 3: mixed

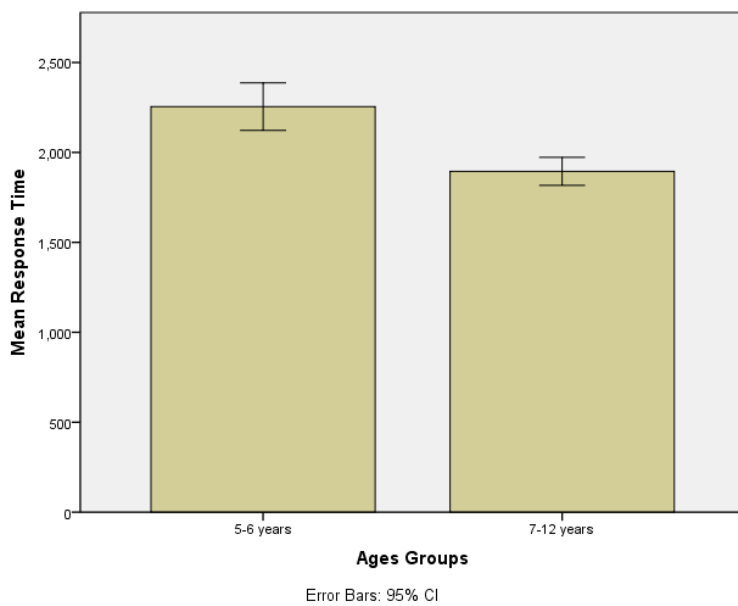


Figure 5.

The t-test shows that there is a statistical significant difference between the response times of group 1 and group 2 in Condition 3, $t(287.32)=4.63$, $p<0.05$

8.2 Accuracy

In table 2 the percentage of errors made in the different groups are reported. The percentage of errors for the different categories as well as the mean of all three conditions are shown.

Group 1 (5-6 years)			Group 2 (7-12 years)		
Condition1	Condition 2	Condition 3	Condition 1	Condition 2	Condition 3
11.25%	27.5%	28.71%	5.35%	12.14%	14.48%
Mean of Errors (%) made in all Conditions			Mean of Errors (%) made in all Conditions		
22.49%			10.66%		

Table 2. Mean of Errors made (in %)

Condition 1: English, Condition 2: German, Condition 3: Mixed

Group 1 had 11.25% errors (listed in data analysis part) in Condition 1 (English), compared with Group 2 who had a lower percentage of errors 5.35%.

Also in Condition 2 we can see a difference between the groups with group 1 making 27.5% errors and group 2 12.14%.

In Condition 3 we correspondingly see a difference between the groups. Group 1 made 28.71% errors and group 2 made 14.48% errors.

We can also see that the mean the errors made in all conditions was almost double as high in group 1 (22.49%) compared to group 2 (10.66%).

8.2.1 Accuracy: Comparison within groups using t-test

The t-test was used to compare the errors made in every condition by each group. Figure 6 illustrates group 1 results and figure 7 shows group 2 results.

Group 1

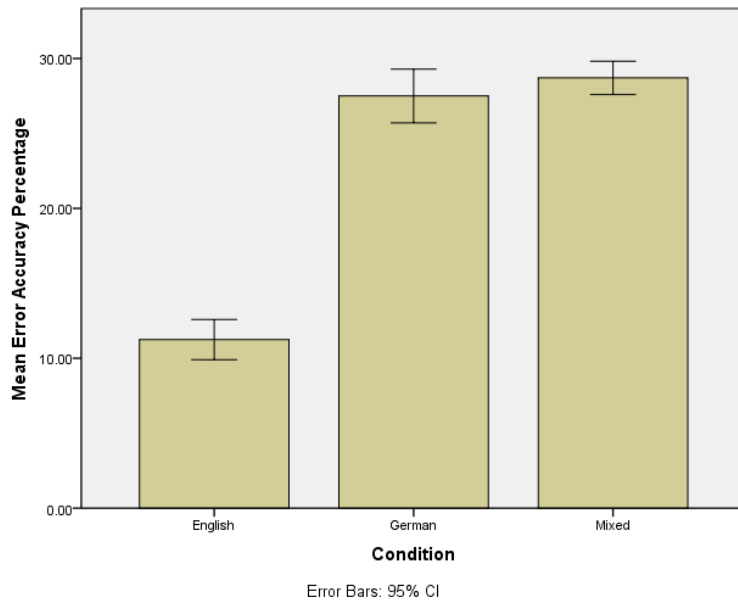


Figure 6

The t-test shows a statistical significant difference in the errors made between conditions 1 and 3 in group 1 ($t(345.22) = -19.749, p < 0.05$) and condition 1 and 2 ($t(294.50) = -14.322, p < 0.05$). On the other hand there is no statistical significant difference between and conditions 2 and 3 ($t(278.216) = -1.130, p > 0.05$).

Group 2

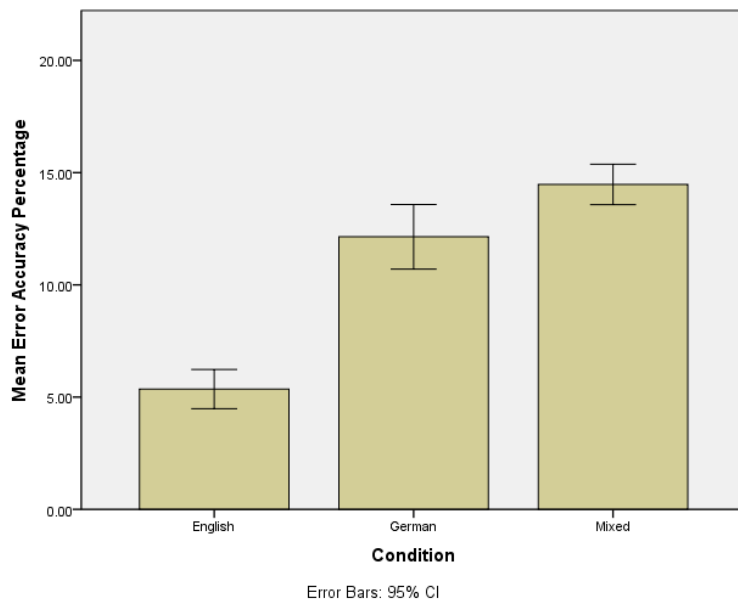


Figure 7

The t-test showed statistical significant difference in the errors made between conditions 1 and 3 in group 2 ($t(677.468) = -14.274, p < 0.05$), between conditions 2 and 3 ($t(491.214) = -2.705, p < 0.05$) as well as between conditions 1 and 2 ($t(460.867) = -7.932, p < 0.05$).

8.2.2 Accuracy: Comparison between groups using t-test

A t-test was also used to compare the percentage of errors made between the two groups for every condition. Figure 8 shows the results when comparing group 1 and 2 in the English condition. Figure 9 demonstrates the same group comparison, however for the German condition and figure 10 illustrates the percentage of errors made in the mixed condition when comparing group 1 and 2.

Condition 1: English

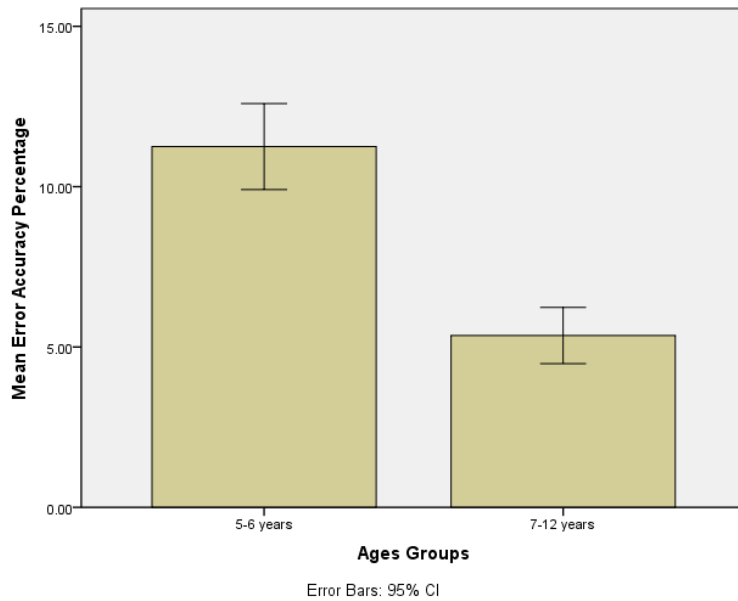


Figure 8

The t-test shows that there is a statistical significant difference when looking at the mean of errors made between group 1 and 2 during condition 1 ($t(293.749) = 7.255$, $p < 0.05$).

Condition 2: German

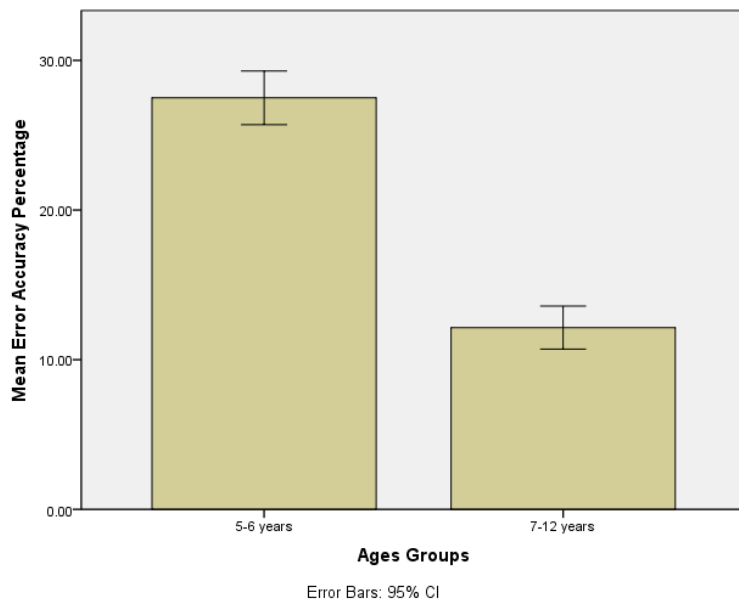


Figure 9

The t-test shows that there is a statistical significant difference when looking at the means of error made during condition 2 ($t(438) = 12.950, p < 0.05$).

Condition 3: mixed

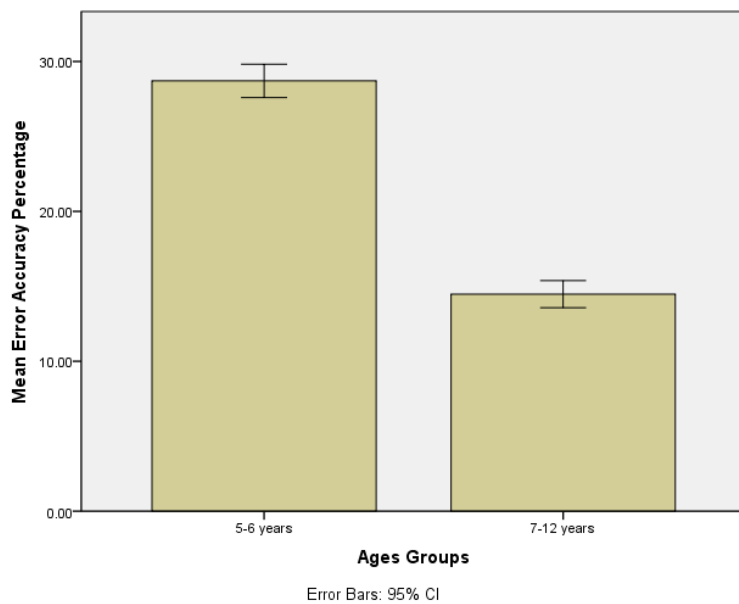


Figure 10

The t-test shows that there is a statistical significant difference between group 1 and 2 in condition 2 ($t(658) = 19.182, p < 0.05$).

8.3 Further results

8.3.1 Picture Naming: Age and Response Times

A calculation of the relationship (Pearson correlation) between age and response time was made. There was a significant relationship between age and response times, $r(1540) = -0.244$, $p < 0.01$. The older you get, the lower response times.

8.3.2 Mean Percentile Score WCST of group 2

Participants WCST scores
93
88
0
97
96
82
96
99
79
95
77
42
97
0

The mean percentile score was 74.357. This means that the children were better or as good as 74% of the participants in the same age ranges who have conducted this test.

8.3.3 Correlation WCST and Picture Naming in mixed condition in group 2

Pearson's correlation test shows that the WCST results and response times of condition 3 are not significantly correlated, $r(420) = -0.44$, $p > 0.05$

8.3.4 Mean Score DCCS of group 1

Participants DCCS scores
3
3
3
3
2
2
2
3

The mean Score of the DCCS test was 2.625, with 3 being the highest score achievable in this test.

8.3.5 Correlation DCCS and Picture Naming in mixed condition in group 1

Spearman's correlation test shows that the response times of condition 3 are not significantly related to the results of the DCCS, $r(240) = -0.105$, $p > 0.05$

9. Discussion

9.1 Method considerations

Despite time limitations and the low number of bilingual German-English families in Edinburgh, the number of participants was satisfying. Initially I wanted to compare the results from balanced and unbalanced bilinguals, to see if there were any differences regarding both response times and accuracy of answers. If there had been more participants available it could have been taken into consideration to have spent more time on searching for balanced bilinguals.

E-prime which was used for the picture naming task required a lot of time to programme and had not been possible without technical support. Even though the preparations were time consuming, this programme worked very well and reduced the workload during the testing.

Initially I had intended to use the Tea-Ch test (test of Everyday Attention for Children), for testing non-verbal switching and inhibition abilities, because this test would have covered all age groups. Due to unavailability of the test, I was not able to get a hold of it, as originally planned. Therefore I chose to use the Wisconsin Card Sorting Test and Dimensional Card

Change Sort. These tests assess the same abilities as Tea-Ch and were suitable for the age groups that participated. Both tests were easily administrated and did not take more than 30 minute to implement. It was important that the test time did not exceed 50 minutes, as the youngest children had to be able to complete both tests during one test time. A disadvantage with using two different tests was that the results were not directly comparable.

The questionnaire I used had some initial problems due to one questions being imprecise and could therefore be misinterpreted. Since I was present during the time that the parents filled in the questionnaire, I was able to explain what was initially meant and also change this questions after a few parents had raised the same concerns regarding this particular question. If I, as originally planned, had sent out the questionnaire via email the answers could have become unreliable.

9.2 Result discussion

The results from this study did not reveal numerous new findings, however confirmed previous results from other studies and also support most of my hypothesis. The younger group showed disadvantages compared with the older group regarding both response time and accuracy. Group 1 was almost one-third slower in the overall response time of all three conditions compared to group 2 (see table 1). Group 1 was slower in every single condition, compared to the children in group 2 (see table 1). Even though the answers from the parent's questionnaire revealed very different levels of competence in the different languages distributed over the two groups, group 1 was, as previously mentioned, slower in every condition which shows the impact of age on picture naming and lexical retrieval. In both groups the response times increased when answering in German (see table 1). This underlines the fact that English was specified by the parents as being the dominant language of almost all children in this study. The response times increased even more when answering in the mixed condition. Group 1 was one-third slower in condition 3 compared with condition 1, which is a statistically significant difference (see Figure 1). Group 2 was also slower in condition 3 then in condition 1, though not as significant as group 1, nevertheless the difference was also a statistically significantly different (see Figure 2). If one compares all the response times of every condition between the groups, there is in every instance a statistical significant difference (see Figures 3,4 and 5) which supports my hypothesis that the younger children would have more difficulties with the picture-naming test.

There is a significant relationship between age and response times which means that the older you get, the lower your response times are (see 7.3.1). Older bilinguals are able to access their lexicon very quickly during a picture naming task when responses are required in a single language (i.e., English or German) (see Figure 3 and 4). The younger children's ability to alternate between languages in response to an auditory cue is impaired compared to the older children's group (see Figure 5).

It was likely that the task of switching in condition 3 would result in a decrease in response time. But not only the response times were effected, the errors made also increased. Both group 1 and 2 made over double as many errors in condition 3 compared to condition 1 (see table 2). Both groups also made more than double as many errors in condition 2 compared to condition 1 (see table 2). This confirmed the parents' statements that English was the dominant language of nearly all children. We can also see that group 1 made twice as many errors in all conditions compared with group 2 (Table 2). If we look at Figures 8 to 10 there is

an overall outcome of statistical significant difference between the errors made in group 1 and group 2, with group 1 being the group which made more mistakes. This is also no surprise, as we can assume that the vocabulary of the younger children is not as developed as in the older children. These outcomes confirm my hypothesis that there would be differences between the two age groups, and that less errors would be made in the blocked conditions. Both results showing that the response times were higher and the errors increased in the mixed condition, supports the theory that bilinguals experience more competition during word recognition and production and this leads to consequences in their performance.

The additional part of my study using non-verbal switching tests did not confirm my hypotheses as I had hoped. After conducting correlation tests to see if there is a connection between the non-verbal switching tests (WCST and DCCS) and the verbal switching test (Mixed condition of picture-naming test) I found no correlation, neither when comparing DCCS with the Picture naming test, nor when comparing WCST with the picture naming test. These results may be due to the sample not being big enough to prove that there is a relationship.

An interesting discovery was that the participants who did the Wisconsin Card Sorting Test had very high percentile scores. Of the 14 children who performed this test, two did not complete it. After giving the instructions, one is not allowed to answer any questions. Due to two of the children not understanding that the sorting principles were changing, these two children were not able to complete the test and therefore received a percentile of 0. Despite this, the mean score of the test was still 74,357. This means that the children were better than, or as good as 74% of the participants in the same age ranges who have taken the test. This supports previous findings that bilinguals have a higher inhibition and switching ability in non-verbal tests. The mean score of the DCCS test was 2.625, with 3 being the highest and 1 being the lowest score achievable in this test. This also gives us an indication of young bilingual's ability to perform well in switching-tasks.

The few errors the children made were mostly not naming the picture, which led to that no response time was measured. The other error that occurred was naming the picture in the wrong language, though these errors were only encountered in 7.12% of all conditions when looking at both groups. No code-switching occurred in the mixed conditions, even in the children who self-described their German as not being very strong. This shows the robust inhibition-system that prevents us from choosing the non-target language in a specific situation.

After reviewing the questionnaires I found that, even though 8 out of the 22 participants had parents who were both German, the dominant language stated by the parents were in almost all cases English. Most of these children also spoke English with their siblings. All the children who had one English and one German parent were dominant in English.

As English is one of the world's most spoken languages and much of the media and information we perceive is in English, it is no surprise that most of the children were dominant in English as they are surrounded by this language every day.

It would be interesting to see if the country's language also would be the dominant language in other bilingual children outside the UK. For example, by testing Swedish-German children of one Swedish and one German parent or both German parents in Sweden. This study's findings would imply that Swedish would be the dominant language of most of the children even though they might speak German, or mostly German at home.

9.3 Conclusion

In summary, current findings confirmed most of my hypotheses. Children can switch off the non-target language but this also has effects on their performance of response time and accuracy. There must be an effective control system that can inhibit the non-target language, which gets more precise when the child gets older. The older children performed better in all conditions both regarding Response time and accuracy of naming.

The hypothesis that did not prove to be correct is that I assumed there would be a correlation between non-verbal and verbal switching tasks. Even though they are not statistically related, we can see that the children who had a high WCST score, are above average when comparing with the normative data. Current findings support previous findings (e.g Kohnert 2002) of a shift towards becoming more dominant in L2 (in this case English) with increased age (and equivalent years of language experience) and that the development of cognitive functions plays a big role in the control of these two languages.

As part of this study I also wanted to look at differences and similarities of balanced and unbalanced bilinguals. Unfortunately there were not enough balanced bilinguals participating in my study to compare the results of balanced and unbalanced bilinguals with each other. This could be something to investigate in future studies. Another point to study more closely would be to find out if there is correlation between WCST/DCCS and the picture naming task if the number of participants was larger.

The findings in the study can help speech and language therapists when assessing speech-delays and impairments in bilinguals. It is vital to talk with the parents about the different strengths and weaknesses of both languages when assessing the child. It is also important to understand that it is useful to test the child in both languages to get a full picture of the child's problems. A weakness in one language does not necessarily mean a weakness in the other language. This study clearly shows the disadvantages the children have, when having to name pictures in their non-dominant language. On the other hand, it also shows how well bilinguals can switch between languages and how this ability translates into other cognitive areas, especially when the children get older. It also shows that assessing only one language is, if at all, only possible when the child is not too young and even then one will have to take consideration of slower responses or lower accuracy due to having to inhibit another language.

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11. REFERENCES

- Altarriba, J. (1992). The representation of translation equivalents in bilingual memory. In R. J. Harris (Ed.), *Cognitive processing in bilinguals*, 83,157-174. Amsterdam: North-Holland. DOI: 10.1016/S0166-4115(08)61493-4
- Allport, A., Styles, E., & Hsieh, S. (1994). Shifting intentional set: Exploring the dynamic control of tasks. In C. Umiltà & M. Moscovitch (Eds.), *Attention and performance*, XV, 421–452. Hillsdale, NJ: Erlbaum
- Bialystok, E. (2003). *Bilingualism in Development: Language, Literacy and Cognition*. Cambridge: Cambridge University Press.
- Bialystok, E., Luk, G. & Craik, F. (2009). Cognitive Control and Lexical Access in Younger and Older Bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 2008, 34, 859–873. DOI: 10.1037/0278-7393.34.4.859
- Bialystok, E. (2011). Coordination of executive functions in monolingual and bilingual children. *Journal of Experimental Child Psychology*, 110, 461-468. DOI: 10.1016/j.jecp.2011.05.005
- Costa, A. (2005). Lexical access in bilingual production. In J. F. Kroll & A. M. B. D. Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 308–325; 251-268). New York: Oxford University Press.
- Costa, A., Roelstraete, B., & Hartsuiker, R. (2006). The lexical bias effect in bilingual speech production: Evidence for feedback between lexical and sublexical levels across languages. *Psychonomic Bulletin & Review*, 13, 612–617. DOI: 10.3758/BF03213911
- Chelune, G.J. & Bear, R.L. (1986). Developmental norms for the Wisconsin Card Sorting Test. *Journal of Clinical and Experimental Neuropsychology*, 8, 219-228. DOI: 10.1080/01688638608401314
- De Groot, A. (2011). *Language and Cognition in Bilinguals and Multilinguals*. Hove: Psychology Press.
- De Houwer, A. (2009). *Bilingual First Language Acquisition*. Channel Books.
- Dempster, F.N. (1992). The rise and fall of the inhibitory mechanism: Toward a Unified Theory of Cognitive Development and Aging. *Developmental review*, 12, 45-75. DOI: 10.1016/0273-2297(92)90003-K
- Diamond, A. (2006) The Early Development of Executive Function. *Lifespan Cognition: mechanisms of change*. Ed. Bialystok, E. and Craik, F.I.M. 70-95 UK: Oxford University Press
- Festman, J., Rodriguez-Fornells, A. & Münte, T.F. (2010). Individual differences in control of language interference in late bilinguals are mainly related to general executive abilities. *Behavioral and Brain Functions*, 6:5. Licensee BioMed Central Ltd.
- Genesee, F., Paradis, J., & Crago, M. B. (2004). *Dual language development and disorders: A handbook on bilingualism and second language learning*. Baltimore, MD: Brookes.

- Gilbert, S.J. & Burgess, P.W. (2008). Executive Functions. *Current Biology*, 18:3, 110-115.
- Glaser, W.M. (1992). Picture naming. *Cognition*, 42, 61-105. DOI: 10.1016/0010-0277(92)90040-O
- Green, D.W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition*, 1, 67–81. DOI: 10.1017/S1366728998000133
- Grosjean, F. (1982). *Life with two languages. An introduction to bilingualism*. USA: Harvard College Press. 1-2
- Grosjean, F. (1989). Neurolinguists, beware! The bilingual is not two monolinguals in one person. *Brain and Language*, 36, 3-15. DOI: 10.1016/0093-934X(89)90048-5
- Grosjean, F. (1996). Living with two languages and two cultures. In I. Parasnis, ed., *Cultural and language diversity and the deaf experience*, pp 20-37. New York: Cambridge University Press
- Hahn, S., Kramer, A., deJong, R., Gopher, D., Minear, M., & Glass, A. (1998). Aging and executive control in task switching. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 41:1, 105-109. DOI: 10.1177/107118139704100125
- Harnishfeger, K. K., & Bjorklund, D. E (1993). The ontogeny of inhibition mechanisms: A renewed approach to cognitive development. *Emerging themes in cognitive development*, 1. New York: Springer-Verlag. DOI: 10.1007/978-1-4613-9220-0_2
- Hernandez, A. E., Martinez, A., Wong, E. C., Frank, L. R., & Buxton, R. B. (1998). Neuroanatomical correlates of single- and dual-language picture naming in Spanish-English bilinguals. *Neuroimage*, 7, 190.
- Jared, D., & Kroll, J. (2001). Do bilinguals activate phonological representations in one or both of their languages when naming words? *Journal of Memory and Language*, 44, 2–31. DOI: 10.1006/jmla.2000.2747
- Jersild, A. T. (1927). *Mental set and shift*. *Archives of Psychology*, 89, 81.
- Junker, D. A. & Stockman, I. J. (2002). Expressive vocabulary of German–English bilingual toddlers. *American Journal of Speech-Language Pathology*, 11, 381–394.
- Kapa, L.L. (2010) *Executive Function in Simultaneous and Sequential Bilingual Children*. (M.A. Thesis). University of Kansas. Available from <http://hdl.handle.net/1808/6945> [last visited 23/03/2013]
- Kohnert, K. (1999). Balancing bilinguals: lexical-semantic production and cognitive processing in children learning Spanish and English. *Journal of speech, language and hearing research*. 42, 1400-1413.
- Kohnert, K. (2002). Picture Naming in early sequential bilinguals: A 1-year follow-up. *Journal of speech, language and hearing research*. 45, 759-771. DOI:10.1044/1092-4388(2002/061)
- Lezak, M.D. (1995). *Neuropsychological assessment* (4th ed.) New York: Oxford University Press

- Luria, A. R. (1961). *The role of speech in the regulation of normal and abnormal behaviour* (J. Tizard, Ed.). New York: Pergamon Press.
- MacNamara, J., Krauthammer, M., & Bolgar, M. (1968). Language switching in bilinguals as a function of stimulus and response uncertainty. *Journal of Experimental Psychology*, 78, 208-215.
- Mehler, J., Dupoux, E., Nazzi, T., & Dehaene-Lambertz, G. (1996). Coping with linguistic diversity: The infant's viewpoint. In J.L. Morgan & K. Demuth (Eds.), *Signal to syntax: Bootstrapping from speech to grammar in early acquisition* (pp. 101–116). Mahwah, NJ: Erlbaum.
- Mehler, J., Jusczyk, P., Lambertz, G. (1988). A precursor of language acquisition in young infants. *Cognition*. 29, 143–178. DOI: 10.1016/0010-0277(88)90035-2,
- Meuter, R., & Allport, A. (1999). Bilingual language switching in naming: Asymmetrical costs of language selection. *Journal of Memory and Language*, 40, 25–40. DOI:10.1006/jmla.1998.2602
- Moon, C., Cooper, R.P., & Fifer, W.P. (1993). Two-day-olds prefer their native language. *Infant Behavior and Development*, 16, 495–500. DOI: 10.1016/0163-6383(93)80007-U
- Pearson, B. Z. (1998). Assessing lexical development in bilingual babies and toddlers. *The International Journal of Bilingualism*, 2, 347–372. DOI: 10.1177/136700699800200305
- Penfield, W., & Roberts, L. (1959). *Speech and brain mechanisms*. Princeton, NJ: Princeton University Press.
- Poarch, G. J., & van Hell, J. G. (2012). Executive functions and inhibitory control in multilingual children: evidence from second-language learners, bilinguals, and trilinguals. *Journal of Experimental Child Psychology*, 113, 535-551. DOI: 10.1016/j.jecp.2012.06.013,
- Rivera, M.M, Arentoft, A., Kubo, G.K., D'Aquila, E., Scheiner, D., Pizzirusso, M., Sandoval, T.C., Gollan, T.H. (2008) Neuropsychological, cognitive, and theoretical considerations for evaluation of bilingual individuals. *Neuropsychol Rev*, 18, 255-268.
- Roca, M., Parr, A., Thompson, R., Woolgar, A., Torralva, T., Antoun, N., Manes, F. and Duncan, J. (2010). Executive function and fluid intelligence after frontal lobe lesions. *Brain*, 133, 234–247 UK: Oxford University Press. DOI: 10.1093/brain/awp269
- Rogers, R. D., & Monsell, S. (1995). Costs of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology: General*, 124, 207-231.
- Salameh, E-K. (2003). *Language impairment in Swedish bilingual children – epidemiological and linguistic studies*. Doktorsavhandling: Institution för logopedi och foniatry, Lunds universitet.
- Schachar, R.J., & Logan, G.D, (1990). Impulsivity and inhibitory control in normal development and childhood psychopathology. *Developmental Psychology*, 26. 710- 720,
- Schachar, R.J., Tannock, R., & Logan, G.D. (1993). Inhibitory control, impulsiveness, and attention deficit hyperactivity disorder. *Clinical Psychology Review*. 13, 721-739. DOI: 10.1016/S0272-7358(05)80003-0,

Snodgrass, J.G., & Yuditsky, T. (1996). Naming times for the Snodgrass and Vanderwart pictures. *Behavior Research, Methods, Instruments, & Computers*, 28:4, 516-536. DOI: 10.3758/BF03200540

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory*, 6, 174–215.

Sorace, A. (2013). *Bilingual differentiation in bilingual development*, 22/01/2013. University of Edinburgh.

Stroop, J. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*. 18, 643–662

Stuss, D.T. (2011) Functions of the Frontal Lobes: Relation to Executive Functions. *Journal of the International Neuropsychological Society*, 17, 759–765. Cambridge University Press. DOI: 10.1017/S1355617711000695

Van Hell, J. G., & Dijkstra, T. (2002). Foreign language knowledge can influence native language performance in exclusively native contexts. *Bulletin & Review*, 9, 780–789. DOI: 10.3758/BF03196335

Weinreich, U., Labov, W. & Herzog, M. I. (1968). *Empirical foundations for a theory of language change. In Directions for Historical Linguistics: A Symposium*. Edited by W. P. Lehmann. 95-195. Austin: University of Texas Press.

Yan, S. & Nicoladis, E. (2009). Finding le mot juste: Differences between bilingual and monolingual children's lexical access in comprehension and production. *Bilingualism: Language and Cognition*, 21:3, 323 -335. DOI:10.1017/S1366728909990101

Zelazo, P.D. (2006). The Dimensional Change Card Sort (DCCS): a method of assessing executive function in children. *Nature Publishing Group*. DOI: 10.1038/nprot.2006.46

12. ATTACHMENTS

QUESTIONNAIRE

Fragebogen zur Studie

Wie heißt Ihr Kind?

Geschlecht

M

W

Geburtstag ____ / ____ / ____

Geburtsort

Fragen	Antwort
1 Was ist Ihre Muttersprache?	
2 Was ist die Muttersprache Ihres Partners?	
3 Wann kam Ihr Kind nach Schottland?	
4 Hat Ihr Kind Geschwister?	Ja <input type="checkbox"/> Nein <input type="checkbox"/>
5 Wie alt sind die Geschwister?	
6 Was ist Ihre derzeitige Berufstätigkeit?	
7 Was ist die derzeitige Berufstätigkeit Ihres Partners?	
8 Wie ist Ihr Kind mit der deutschen Sprache in Kontakt gekommen?	
9 Ab welchem Alter ist Ihr Kind mit der deutschen Sprache in Kontakt gekommen?	
10 Hat Ihr Kind formalen Unterricht in Deutsch gehabt? Wenn ja wie viele Jahre und wie viele Stunden pro Woche?	
11 Wie ist Ihr Kind mit der englischen Sprache in Kontakt gekommen?	
12 Ab welchem Alter ist Ihr Kind mit der englischen Sprache in Kontakt gekommen?	

13	Hat Ihr Kind formalen Unterricht in Englisch gehabt? Wenn ja, wie viele Jahre und wie viele Stunden pro Woche?			
14	Kann Ihr Kind noch mehr Sprachen, wenn ja welche?			
15	Wie oft spricht Ihr Kind Deutsch mit Ihnen?	<input type="checkbox"/> Immer	<input type="checkbox"/> Selten	<input type="checkbox"/> Nie
16	Wie oft spricht Ihr Kind Deutsch mit Ihrem Partner?	<input type="checkbox"/> Immer	<input type="checkbox"/> Selten	<input type="checkbox"/> Nie
17	Wie oft spricht Ihr Kind mit seinen Geschwistern Deutsch?	<input type="checkbox"/> Immer	<input type="checkbox"/> Selten	<input type="checkbox"/> Nie
18	Wie oft spricht Ihr Kind Englisch mit Ihnen?	<input type="checkbox"/> Immer	<input type="checkbox"/> Selten	<input type="checkbox"/> Nie
19	Wie oft spricht Ihr Kind Englisch mit Ihrem Partner?	<input type="checkbox"/> Immer	<input type="checkbox"/> Selten	<input type="checkbox"/> Nie
20	Wie oft spricht Ihr Kind mit seinen Geschwistern Englisch?	<input type="checkbox"/> Immer	<input type="checkbox"/> Selten	<input type="checkbox"/> Nie
21	Auf welcher Sprache hat Ihr Kind Unterricht?			
22	Würden Sie sagen dass Ihr Kind in beiden Sprachen gleich stark ist? Wenn nein, was ist die stärkere Sprache?			

Kreisen Sie die passende Antwort von 1 bis 5 ein (1=schlecht, 5= sehr gut):

- Wie gut spricht Ihr Kind Ihrer Meinung nach Deutsch?

1	2	3	4	5
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- Wie gut versteht Ihr Kind Ihrer Meinung nach Deutsch?

1	2	3	4	5
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- Wie gut spricht Ihr Kind Ihrer Meinung nach Englisch?

1	2	3	4	5
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- Wie gut versteht Ihr Kind Ihrer Meinung nach Englisch?

1	2	3	4	5
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