Language production and cognitive abilities in child heritage speakers

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Contents

Chapter 1

General Introduction

There can be several causes for why children grow up bilingually. It is possible that a child's parents are native speakers of two different languages and want their child to acquire both these languages. Apart from that, many children grow up in families that have a background of migration. In those families, children are exposed to the language spoken in the country that the family migrated from and used by the parents, grandparents or other family members at home. In addition, they are exposed to the main language of the country they currently reside in, the majority language. As the name indicates, this language is spoken by the majority of the inhabitants of that country. In both of these situations, acquisition of the two languages can either happen simultaneously or sequentially, although in the first case (one language per parent) languages are usually learned simultaneously. This dissertation focuses on the language abilities of 5-8-year-old children in the Netherlands whose parents or grandparents emigrated to the Netherlands from Turkey or Morocco. More generally, these children are referred to as bilingual children. Other terms that have been used in the literature for children in this situation are migrant children, language minority children, (child) heritage speakers/language learners or second language learners, depending on which aspects of their bilingual experience is being focused on. Throughout this dissertation, the studied populations are either referred to as bilingual children or child heritage speakers. The term *heritage language* has been used to describe the languages spoken by immigrants and indigenous groups (Wiley, 2001) or the language of someone who grows up in a family where a minority language is spoken and who is to some extent proficient in this language (Valdés, 2000). The term child heritage speakers thus describes children who learn the language of their family's migration background at home and learn the main language of their country of residence outside the home.

The following general introduction to this dissertation will first introduce the characteristics of child heritage language learners in general and more specifically Turkish-Dutch and Moroccan-Dutch child heritage speakers in the Netherlands, the population studied in this dissertation. As this dissertation focuses specifically on language production in child heritage speakers, we will introduce some theoretical models that have been used to describe the different processes involved in language production. We then introduce the different aspects of language production studied in this dissertation, namely lexical access, accuracy, fluency and language switching. We will explain what these concepts are and why these concepts are studied in relation to bilingual children. The order of this general introduction reflects the order of the separate studies that are reported in chapters 2-3, where chapter 2 focuses on lexical access in child heritage speakers in the Netherlands, chapter 3 on the accuracy and fluency of these children's majority language speech and chapter 4 on language switching between their heritage language and the majority language Dutch.

Child heritage speakers

The study of heritage language learners is a fairly recent area in bilingualism research (Benmamoun et al., 2013) and yields some findings that are specific to this type of bilingual experience. At the point of entering the education system, many child heritage speakers show delays in their majority language development (Hammer et al., 2014), while at the same time also showing low proficiency in their heritage language (Scheele et al., 2010). Low skills in the majority language can have detrimental consequences for them, as education is usually provided in the majority language and strong majority language skills are required in order to succeed in the education system (Han 2012). Low proficiency in the heritage language can lead to difficulties in the communication with family members or heritage speakers who are not proficient in the majority language, with potential consequences for family relationships and academic achievements (Schofield et al., 2012). Furthermore, child heritage speakers often come from families with low socio-economic status (SES). Some studies have found that children growing up in families with lower SES might be exposed to a lower quantity and/or quality of language input important for language learning (Golinkoff et al., 2019; Hart & Risley, 1995; Hoff & Naigles, 2002), whereas families with a higher SES engage their children more often in home literacy activities (Hindman & Morrison, 2012) and are more likely to use the majority language (Dixon et al., 2012; Prevoo et al., 2014).

After they enter the education system, child heritage speakers tend to become more dominant in the majority language – which often has a more prestigious status in society. As a result, many of these children avoid the use of the heritage language and show a preference for the majority language in their home environment (De Houwer, 2007). Situations like these can account for patterns in which bilingual children show comparable receptive skills in both of their languages but better productive skills in the majority language (Hoff, 2018). Even though the heritage language is often acquired first, this so-called dominance switch to the majority language can result in incomplete acquisition of the heritage language (Benmamoun et al., 2013). In fact, a core characteristic of child heritage speakers is the enormous amount of variation with regard to heritage language proficiency. While some children show only receptive skills, others reach full native-like proficiency in the heritage language (Polinsky & Kagan, 2007). In many cases, the listening and speaking abilities are better developed in child heritage speakers than reading or writing skills (if present at all), due to the fact that education is usually offered exclusively in the majority language (Rothman, 2007). Becoming literate in the heritage language is an important factor with regard to the retention and maintenance of the language (Pires & Rothman, 2009; Rothman, 2007).

Child heritage speakers in the Netherlands

The research for this dissertation was carried out in the Netherlands, where two of the largest populations with a migration background come from Turkey and Morocco (CBS Jaarrapport Integratie, 2020). The children growing up in these families are often born to parents who were already born in the Netherlands themselves. In the 1960s, many Turkish and Moroccan people moved to the Netherlands in the context of labor migration. Later, migration was often motivated by reasons of family reunification. Nowadays, family reunification is still among the most prominent reasons for Turkish and Moroccan people to migrate to the Netherlands. However, work and higher education are becoming more important reasons for migration within these groups (CBS, 2020).

Even if their parents were already born in the Netherlands, many children from Turkish and Moroccan descent are still exposed to a heritage language in their home environment. In families of Turkish descent this language is predominantly Turkish (there is also a smaller group of Kurdish speaking Turks, who have not been included in this study). In the families of Moroccan descent, the heritage language is either Moroccan Arabic or Riffian Berber, also named Tarifit, a language that gained official status in 2011, but does not have a history of being a scripted language[1]. Throughout this dissertation, we will refer to the language as Berber. The children in this study either speak Turkish or Berber as their heritage language. Arabic-speaking children from Moroccan descent were excluded from this dissertation research for reasons of focus. The focus was on Berber because in the Netherlands, the majority of immigrants from Moroccan descent speak a Berber language (Kossmann & Grigore, 2016). The Turkish-Dutch and Berber-Dutch families share similar backgrounds in terms of their migration history and socioeconomic status, but differ with regard to the level of prestige of their heritage language and the opportunities of language maintenance (Scheele et al., 2010). Children in the Turkish families usually receive more heritage language input than the children in the Moroccan families (Scheele et al., 2010). There are also more opportunities for exposure to the minority language in the Turkish families, as they have access to Turkish language books, media and TV programs (Backus, 2005), which is often not the case for the Moroccan children, as language resources for the maintenance of Berber are still very limited at this point.

Despite these differences in minority language input in these two groups, both Turkish-Dutch and Berber-Dutch children are found to show disadvantages in their language development in the majority language Dutch. At the end of elementary school (age 11-13), they still score lower on the Dutch language section of a national standardized test, compared to monolingual Dutch children, but also compared to children from other migration backgrounds (Centraal Bureau voor de Statistiek [CBS], 2016). This finding might be related to the fact that Turkish and Moroccan families are more likely to speak a different language than Dutch at home than families from, for example, Surinam or the Netherlands Antilles (Hartgers, 2012). Finally, Turkish and Moroccan families also have the highest rate of families where both partners have a migration background (Centraal Bureau voor de Statistiek [CBS], 2016), which increases the probability of heritage language use at home, as opposed to families in which one parent is of Dutch origin.

The large numbers of Turkish-Dutch and Moroccan-Dutch children in Dutch schools is one of the reasons why researchers have been interested in studying different aspects of the language development of these children at different ages. Previous research has shown that before entering elementary school at age 4, the Turkish vocabulary size of child heritage speakers of Turkish is comparable to the Dutch vocabulary size in monolingual Dutch children, but their Dutch vocabulary is smaller than that of monolingual Dutch children. However, the Dutch vocabulary of these children grows significantly after they have started elementary school (Leseman, 2000). A similar pattern is found for grammar skills, such as reflexives and relative clauses in school-aged Turkish-Dutch bilingual children, who show relatively stronger grammar skills in their heritage language at younger ages but after age 8,

[1] A book describing the grammar of the Berber language was recently published by two researchers in the Netherlands (Mourigh & Kossmann, 2020).

their Dutch grammar skills are at the same level as their Turkish grammar skills (Aarssen, 1998). Other studies report delays in majority language development in Turkish-Dutch and Moroccan-Dutch children – compared to their monolingual peers – for reading comprehension, oral language skills (Droop & Verhoeven, 2003), the use of tense during narrative production (Bos, 2001) and grammatical gender agreement (Cornips et al., 2006). Furthermore, some studies have been able to show language transfer effects between the heritage language and the majority language Dutch (Verhoeven, 1994, 2007), which suggests that language development in the two languages is interrelated. In line with this, high vocabulary skills in the heritage language of 10-year-old Turkish-Dutch and Moroccan-Dutch children have been found to benefit their reading comprehension in Dutch (Raudszus et al., 2018).

One factor that significantly affects bilingual proficiency and explains differences in proficiency between the heritage language and the majority language in these children is the amount of language input they receive in their home environment. Generally, the amount of input bilingual children receive in each of their languages is directly related to the development of language skills, such as vocabulary growth (Gathercole & Thomas, 2009; Pearson et al., 1997; Place & Hoff, 2011; Scheele et al., 2010) and development of grammar (Gathercole & Thomas, 2009; Paradis, 2010; Unsworth, 2013). Turkish-Dutch and Berber-Dutch child heritage speakers in the Netherlands have been found to receive less overall language input in the form of shared book reading or other oral language activities compared to monolingual children (Scheele et al., 2010) and low majority language input quantity in 2-3-year-old Turkish-Dutch children has been linked to slower grammatical development in Dutch (Blom, 2010).

Although Turkish-Dutch and Berber-Dutch children have often been studied together as one group of bilingual children in the Netherlands, with regard to language use, there are differences between these two groups. As mentioned before, the Turkish families usually show relatively more heritage language use than the Moroccan families, whereas relatively more Dutch is used in the Moroccan families. It was found that at 2-3 years old, this difference in language use affects the vocabulary development of Dutch, with the Berber-Dutch children having better Dutch vocabulary than the Turkish-Dutch children (Scheele et al., 2010). In school-aged children the difference in heritage language input affects the vocabulary development in the heritage language. Whereas Turkish vocabulary was found to continue to improve in the Turkish-Dutch children between age 5 and 8, the Berber vocabulary of children from Moroccan descent stagnates at some point within this age range (Blom, 2019).

The main purpose of this dissertation is to study different aspects of language production in this group of bilingual children and gain a better understanding of bilingual language production in relation to general cognition. Previous research on this population has either focused on performance in relation to language norms and factors that influence linguistic development (Altinkamis & Simon, 2020; Scheele et al., 2010), development of literacy (Aarts & Verhoeven, 1999) or cognitive development (Blom et al., 2014), but language production has not been a main focus when studying Turkish and Moroccan child heritage speakers. The following sections of this introduction will introduce theoretical approaches of language production and provide more insight into the different aspects of language production studied in this research.

An overarching model of language production

This dissertation focuses on different aspects of language production in bilingual Turkish-Dutch and Berber-Dutch child heritage speakers in the Netherlands. We focused on language production rather than comprehension, as production is usually considered to follow comprehension (Clark, 1995), and whereas child heritage speakers often have relatively well-developed receptive skills, they show great variation in their productive skills (Polinsky & Kagan, 2007). To better understand this variation in language production skills, we focused on different aspects of production, namely lexical access (chapter 2), accuracy and fluency (chapter 3) and language switching (chapter 4).

Different models of language production have been put forward in the past (e.g., Dell, 1986; Fromkin, 1973; Levelt, 1989). As the aim is not to test these models but rather to provide a general theoretical background for the different chapters in this dissertation, we will focus here on the architectural features that most of these models have in common, instead of delving into the differences between these models. Although several decades have passed since these models were first introduced, they are still widely referred to in more recent linguistic literature (e.g., de Jong et al., 2015; Georgiadou & Roehr-Brackin, 2017; Michel, 2017). Generally, language production is assumed to start at the conceptualization stage. According to Levelt's (1989) model, speech starts in the *conceptualizer* where the speaker's intentions for an utterance are formed and prepared to be turned into actual language. The output of this stage is the so-called *preverbal message*. Conceptualization is followed by the stage of sentence formulation, which includes lexicalization (selecting the right words to convey the message) and syntactic structuring (selecting the right order and grammatical rules that apply to the selected words). The selection of lexical items from the mental lexicon is also called *lexical access*. Levelt (1989) refers to this production stage as the *formulator*, in which lemmas are chosen from the mental lexicon and are grammatically and phonetically encoded, resulting in a phonetic plan that is converted into actual speech output at the next stage, referred to as the *articulator*. The articulation stage describes the execution of motor movements that are needed to produce the sound structure of the sentence. Some accounts posit that syntactic structure is decided on prior to lexical selection (e.g., Fromkin, 1973). In contrast to other accounts (e.g., Fromkin 1973), Levelt's (1989) model includes a specific system that checks the speech output and makes sure that no mistakes were made. As language production happens very fast, these mechanisms are all active in parallel and require a certain level of cognitive monitoring to ensure that the produced output corresponds with the intended message. In general, language production models are useful to distinguish the different processes involved in language production and they also serve as theoretical explanations for common speech errors. In this dissertation, language production models provide the theoretical framework for the different aspects of language production being studied: lexical access, accuracy, fluency and language switching. These aspects will be discussed in more detail in the following sections.

Lexical access

Bilingualism researchers are faced with the question how speech production models developed originally for monolingual speakers would apply to speakers who speak more than one language. Although there is no reason to assume that bilinguals make use of fundamentally different mechanisms when producing speech than monolinguals, knowing and using multiple languages will automatically affect the speech production processes involved (De Bot, 1992). Typical questions that arise and have been addressed by bilingualism researchers are, for example: How are words from two languages stored in the long-term memory and do they share representations in the mental lexicon? Aside from that, how are bilinguals able to select words from one of their languages without experiencing constant interference from their other language? Some accounts suggest that language selection takes place at the conceptual level as part of the preverbal message (Bloem et al., 2004) and that lexical representations in the non-target language are simply not activated. However, ample evidence from lexical access studies (e.g., picture naming) shows that both languages are co-activated in the bilingual mind (Bialystok et al., 2009; Green, 1998; Kroll et al., 2006), even in very proficient bilingual speakers and in situations where only one language is being used. These results support a non-language-selective model of lexical access, meaning that language selection takes place at the lexical level and not at the conceptual level. Finally, cross-language effects are found in both directions, meaning that knowing a second language influences speech production in the first language and vice versa (Jarvis, 2003; Pavlenko & Jarvis, 2002). All in all, the fact that two languages are co-activated during bilingual language production is likely to result in differences between language production in bilinguals as compared to monolinguals.

When comparing language production in bilingual and monolingual adult speakers, many studies have reported disadvantages for bilinguals. Bilinguals have been found to be slower and less accurate in picture naming tasks than monolinguals (Gollan et al., 2005), produce fewer items in category fluency tasks (Bialystok et al., 2008; Gollan et al., 2002; Sandoval et al., 2010) and experience more tip-of-the-tongue occurrences than monolinguals (Gollan & Acenas, 2004; Gollan & Silverberg, 2001). This phenomenon has been explained by two different theoretical accounts, which attribute this bilingual disadvantage in lexical access to different causes that are nevertheless said to be mutually compatible (Kroll et al., 2014). The first account is called the Frequency-lag or Weaker Links hypothesis (Gollan, et al., 2008; Gollan et al., 2005; Gollan et al., 2011), which proposes that bilinguals are slower in language production as a result of the lower frequency with which they use each of their languages as compared to monolingual speakers who speak only one language at all times. This explanation is in line with effects in monolinguals who experience more difficulty producing low-frequency words than words with high frequency (Murray & Forster, 2004) and is therefore not specific to bilingual language use. Also, in bilinguals, frequency effects are strongest for low-frequency words, and bilingual disadvantages in lexical access can even disappear for high frequency words (Kroll et al. 2014).

The Competition-for-Selection hypothesis states that bilinguals might experience disadvantages in their lexical access as compared to monolinguals because of competition effects. This account hypothesizes that lexical access in bilinguals is slower because there are lexical items from both languages that compete for selection, even in a single-language mode (Kroll et al., 2006), and the word from the non-target language needs to be inhibited. For example, when an English-Spanish bilingual wants to access the English word *apple*, its Spanish equivalent *manzana* will also be activated and needs to inhibited, resulting in a processing cost that slows down production. In Green's inhibitory control model (ICM) (Green, 1998), it is hypothesized that words are selected based on activation level, meaning that words with a high activation level are more easily accessible. Consequently, words from the non-target language with high activation levels will cause more interference and will be more difficult to be inhibited during selection than words with a low activation level. Furthermore, the Competition-for-Selection hypothesis can explain why bilingual disadvantages seem to be more robust in language production than in language comprehension (Gollan et al., 2011), as competition and inhibition of the non-target language are less relevant during language comprehension than during language production.

Because of the great variation in both language input and language proficiency, child heritage language learners are a relevant group of bilingual speakers when studying lexical access. As mentioned before, Turkish and Moroccan child heritage speakers in the Netherlands both learn Dutch as their majority language and also as the language of their education system. However, they have been found to differ in their amount of language input in their heritage language (Scheele et al., 2010). It is thus important to study whether this difference in heritage language input affects their lexical access in the majority language Dutch. Children with less input in the heritage language are likely to experience less competition from their heritage language. Apart from that, following the Frequency-lag hypothesis, less input in the majority language Dutch may lead to slower lexical access in Dutch caused by lower frequency of use of that language.

Another aspect that is special about child heritage language learners is the shift in language dominance they often experience. After being more dominant in their heritage language at first, they become more dominant in the majority language at some point in their lives. To study this dominance shift with regard to language production or lexical access more specifically, it is important to have measures of lexical access in both of the children's languages. Apart from that, to get a better understanding of the developmental trajectory of their language production in the two languages, it is essential to test children more than once. To that end, the current study collected language production data from the same children at multiple points in time.

Accuracy and fluency

Chapter 3 of this dissertation focuses on accuracy and fluency of spoken language in bilingual Turkish-Dutch and Berber-Dutch children. Accuracy and fluency have been extensively studied in the field of second language (L2) acquisition by using the so-called CAF (C=complexity, A=accuracy, F=fluency) framework for measuring L2 proficiency (Housen & Kuiken, 2009). Complexity refers to the use of varied structures and vocabulary in an L2, accuracy to the ability to produce error-free and target-like language (according to a certain language norm), and fluency to the ability to use an L2 with native-like rapidity, pausing, hesitation, or reformulation (Housen et al., 2012). For the purpose of this dissertation, we were only interested in the accuracy and fluency of the children's spoken language, as the relationships we wanted to study referred to these two measures. We will not further address the construct of complexity.

Whereas fluency is mainly a measure of spoken language, accuracy can be measured for spoken as well as for written language. Our focus was on accuracy as a measure of spoken language. Moreover, accuracy can be relevant at the phonological, lexical, morphological, syntactic or socio-pragmatic level, whereas fluency is mainly a phonological phenomenon (Housen et al., 2012). We measured accuracy by the number of errors (deviations of what is considered to be grammatically correct) a speaker makes within a certain unit of (semi-) spontaneous speech. In that sense, accuracy is related to the level of syntactic and morphological encoding in Levelt's (1989) model of speech production, as discussed in section 1.2. A major challenge when operationalizing accuracy concerns the language norm to be used and how to weigh deviations from this norm. It has to be decided whether deviations should be considered only to standard prescriptive target language norms or also to non-standard or even non-native usages that are nevertheless acceptable in everyday language use (Pallotti, 2009). This can be particularly challenging in populations of child heritage speakers. On the one hand, the language input they receive in their minority language often deviates from the standard variety spoken in the country of origin of their families. There is evidence, for example, that the Turkish spoken by Turkish-Dutch speakers in the Netherlands has undergone language change and may deviate from the Turkish spoken in Turkey (Doğruöz & Gries, 2012; Sevinç, 2014). On the other hand, the parents or other family members of child heritage speakers are often (late) second language learners of the majority language. For that reason, also some of the children's input in the majority language might deviate from the standard variety of that language.

Fluency is a multidimensional construct that comprises three subdimensions: speed fluency (e.g., speech rate), breakdown fluency (e.g., number and length of pauses) and repair fluency (e.g., false starts, repetitions and reformulations) (Skehan 2003, 2009). With regard to language processing, accuracy is thought to depend mainly on linguistic knowledge (Housen et al., 2012). Speed fluency has been associated with proceduralized knowledge, breakdown fluency with planning and conceptualization, and repair fluency with monitoring processes (Michel, 2017). As we were mainly interested in the effects of linguistic knowledge and monitoring processes on language production, we focused on measures of accuracy and repair fluency in the majority language production of our bilingual participants.

The reason why it is relevant to study which factors affect speech production in a second language is that L2 speech production is considered to be less automatized and more effortful than language production in a first language and therefore requires more attention (O'Brien et al., 2007; Segalowitz & Hulstijn, 2005). With regard to bilingual children, there is evidence for higher error rates in the spontaneous oral language production in the L2 compared to monolingual norms of that language (Paradis, 2005). For fluency, there is both evidence for more disfluencies in the speech of bilingual children (Fiestas et al., 2005), as well as absence of evidence for difference in fluency between bilingual and monolingual children (Bedore et al., 2006).

Besides studying the effects of linguistic knowledge on the accuracy and fluency of producing speech in an L2, there has also been interest in understanding which cognitive control processes affect language production. When formulating a sentence, the preverbal message has to be temporarily stored and kept active during the planning and encoding stages of language production, and the speech-comprehension system checks the speech output and makes sure that no mistakes were made (Levelt, 1989). These monitoring processes have been thought to involve both phonological short-term memory (PSTM) (O'Brien et al., 2007) as well as verbal working memory (VWM) (Mizera, 2006). PSTM is the ability to temporarily store phonological information in the mind and reproduce it, whereas VWM describes not only the storage and reproduction of verbal information but also includes the manipulation of this verbal information. To better understand majority language production of Turkish-Dutch and Berber-Dutch child heritage speakers, we wanted to study to what extent both linguistic knowledge (e.g., vocabulary knowledge or grammar skills) and verbal processing skills (e.g., PSTM and VWM) affect the accuracy and fluency when producing their L2 Dutch. Finding evidence for a positive relationship between verbal processing skills and language production in bilingual children could be used as motivation to specifically train these skills in child heritage speakers to counterbalance potential deficits in majority language production caused by lower linguistic knowledge in that language.

Language switching

With regard to language production, one aspect that distinguishes bilingual speakers from monolinguals is that most bilinguals frequently switch between languages. In linguistics, this phenomenon is usually referred to as code-switching (Green, 2018) and can take place consciously or intentionally or unintended or unconsciously (Gollan et al., 2014; Green, 2018). Unintended code-switching can also be referred to as language interference or language intrusion (Gollan et al., 2014). As mentioned before, there is ample evidence that both languages of a bilingual speaker are always active, even when only one language is being used (Kroll et al., 2006). Moreover, the process of switching from one language to the other has been shown to involve a processing cost (Declerck & Philipp, 2015). The ability of bilinguals to switch from one language to the other has been extensively studied by using the language switching paradigm (cf. Declerck & Philipp, 2015, for a review), which is also how we study language switching in child heritage speakers in the current study (see chapter 4).

In order to successfully manage their two languages, such as switching from one language to the other or controlling the interference from the non-target language, bilinguals are thought to make use of general cognitive control mechanisms, also called executive functions. Executive functions are commonly divided into three closely related domains: set shifting, inhibition of irrelevant information and working memory updating (Miyake et al., 2000). They are cognitive processes that control behavior and are developed in childhood, usually peak in young adulthood and decline in older age, but can change and be trained throughout a person's life (Diamond, 2013). To test the hypothesis that bilingual language control draws on general cognitive control, researchers have for example used brain imaging studies for within-group analyses and have indeed found evidence for shared neural mechanisms used during bilingual language switching and general cognitive control (Abutalebi & Green, 2008; Abutalebi et al. 2012; Green & Abutalebi, 2016). Within-group analyses of this kind are very rare in bilingual children or child heritage speakers, which is why we study this potential relationship between language switching and non-verbal switching in child heritage speakers in this dissertation (see chapter 4).

Based on the assumption that bilinguals make use of general cognitive processes when managing two languages, it has further been hypothesized that having to switch between languages on a regular basis can be considered an intensive training of bilinguals' cognitive control functions. This would result in enhanced executive functions in bilinguals as compared to monolinguals, who do not engage in this additional cognitive exercise. This line of reasoning is supported by similar transfer effects that have been reported for other activities that are cognitively engaging, such as playing computer games (Merzenich et al. 1996) or playing a musical instrument (Musacchia et al. 2007). Starting in the late 90s, this question initiated an extensive line of research in which bilingual groups are compared to monolingual control groups in their performance on various experimental tasks, tapping into the different executive function domains. Numerous research groups worldwide have tried to answer this question by studying bilingual groups varying with regard to age, language combinations, age of onset of bilingualism, language dominance or language use (see e.g., Antoniou, 2019; Laine & Lehtonen, 2018, for recent reviews of the topic).

In the early years of this research, many studies reported a so-called bilingual advantage in executive functions, both for studies testing children (e.g., Barac et al., 2014; Bialystok, 1999; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008; Morales et al. 2013; Poarch & van Hell, 2012), as well as adults (Adesope et al., 2010; Bialystok et al. 2009). With regard to children, studies report bilingual advantages for shifting (Bialystok & Viswanathan, 2009; Bonifacci et al., 2011), inhibition (Bialystok, 1999; Bialystok & Viswanathan, 2009) and working memory (Blom et al., 2014; Morales et al., 2013). However, in recent years, numerous studies have been published that were unable to replicate this finding and did not report any differences in cognitive control between bilinguals and monolinguals (e.g., Duñabeitia et al., 2014; Hilchey & Klein, 2011; Lehtonen et al., 2018; Morton & Harper, 2007; Paap & Greenberg, 2013; Paap et al., 2014). This has caused a considerable amount of controversy in the field and cast doubt on the robustness of a bilingual effect on executive functions. Moreover, attention has been drawn to a potential publication bias within the field (De Bruin et al., 2015). The current study was set out to contribute to this field by studying potential bilingual cognitive advantages in child heritage speakers from a low socio-economic background, which is a group not yet extensively studied in this context.

Regarding the use of monolingual control groups in studying bilinguals, a common point of criticism is the problem of finding monolingual speakers who have not been previously exposed to a second language. This issue might be less problematic, however, when studying young children who have not been systematically exposed to a second language, which is the case for the monolingual Dutch children in the current study. Finally, studies have often disregarded differences in bilingual experience of the bilingual participants, such as information about their language switching behavior, distribution of language use of the two languages or the linguistic distance of the two languages.

The reason why using heterogeneous groups of bilinguals who vary in their bilingual experience might be problematic, is that the amount of cognitive control needed for bilingual language use might be specific to the language situation. This idea has informed the adaptive control hypothesis (Green & Abutalebi, 2013), which distinguishes between three different language contexts: a single language context, in which one language is used in one situation and the other in another situation, a dual language context, where both languages are being used but with different speakers and code-switching is limited, and a dense code-switching context, in which switching from one language to the other occurs frequently. The idea is that these different contexts draw on different aspects of cognitive control to different degrees, with the dual language context demanding the most cognitive control processes (e.g., Verhagen et al., 2017).

In a similar line of thinking, others have hypothesized that cognitive control might only be needed during the beginning stages of L2 acquisition, when interference is the strongest and that cognitive control might be less drawn upon in highly proficient bilingual speakers (Paap, 2018). With regard to child heritage speakers, it is therefore relevant to know whether they use the minority and majority languages only in different situations (single language context) or also in the same situation but with different speakers (dual language context). This would likely affect the level of cognitive control required in these language situations.

This dissertation

The research for this dissertation was carried out within the research program 'Cognitive development in the context of emerging bilingualism: Cultural minority children in the Netherlands'[2] at Utrecht University. Data was collected in three consecutive years between 2014 and 2016. In the first year the data collection started with 45 monolingual Dutch children and 74 bilingual children ($N_{\text{Turkish-Dutch}} = 24$; $N_{\text{Moroccan-Dutch}} = 50$). For the second and third year, data from 8 Turkish-Dutch children were added to the sample. The drop-out rate was very low ($N_{\text{monolingual}} = 1$; $N_{\text{bilingual}} = 3$). The program also included data collection from additional children who were diagnosed with a language impairment (Boerma, 2017). However, these data were irrelevant with regard to this dissertation.

The different studies in the following chapters were designed to first look at language production at a micro-level by studying the retrieval of single lexical items and then study bilingual language production at a macro-level by analyzing the production of spontaneous

[2] This research program was financed by a VIDI-grant awarded to prof. dr. Elma Blom by the Netherlands Organization for Scientific Research (NWO).

speech. Finally, we focus on the interplay between bilingual language control and general cognitive control. For each of the different studies, we used data from different subsets of children, depending on the specific research question of the individual study. The following outline provides an overview of the three different studies carried out for this dissertation.

Chapter 2 focuses on lexical access in bilingual and monolingual children. Questions addressed in this chapter are the following: 1) Are child heritage speakers in the Netherlands at a lexical access disadvantage compared to their monolingual peers? 2) How does the fact that these children receive input in their heritage language at home affect their lexical access skills in the majority language Dutch and finally, does the amount of language input in the home environment affect their lexical access skills in the majority language?

Chapter 3 focuses on the accuracy and fluency of Dutch in bilingual and monolingual children. It addresses the questions 1) Do child heritage speakers in the Netherlands show lower accuracy and fluency when speaking Dutch than their monolingual peers? 2) Are accuracy and fluency in the children's speech related to general cognitive skills and if so, is this relationship the same for bilingual and monolingual children? Cognitive skills, such as working memory or PSTM may play an essential role during language production (Mizera, 2006; O'Brien et al., 2007), as they are needed to monitor speech output. Assuming that bilingual language use draws on these general cognitive skills during language production, the question arises whether these skills affect language production in bilinguals to a different degree than they do in monolingual children.

Chapter 4 discusses the potential relationship between bilingual language control and general cognitive control. It addressed the questions: 1) Can we find evidence for related cognitive mechanisms of bilingual language control and general cognitive control in child heritage speakers? And 2) If so, do we also find bilingual advantages in cognitive control in the same group of children? Finally, Chapter 5 provides a general discussion of the individual studies and connects their main findings within a wider context of bilingual language production. It further addresses the limitations and implications of this dissertation and discusses ideas for future research within the field of bilingualism.

Chapter 2

Lexical access in Turkish and Moroccan child heritage speakers in the Netherlands

Author contributions: Mona Timmermeister and Elma Blom conceptualized the research, M.T. collected the data, M.T. and E.B. analyzed the data, M.T. wrote the paper, E.B. supervised the writing process. Paul Leseman, Frank Wijnen & E.B. critically reviewed the research.

Abstract

In this study, we investigated the development of lexical access in child heritage speakers. We compared lexical access of bilingual Turkish-Dutch and Berber-Dutch children in the Netherlands to that of monolingual Dutch children. All children were tested again after one year. The bilingual groups differed significantly in their amount of heritage language use. Data were collected with a picture naming task. The bilingual children were tested in both languages as well as in a mixed language condition. Reponses were scored for both accuracy and response times. Both bilingual groups showed a majority language dominance. Productive skills in the heritage language of the Berber-Dutch children were limited. Results from the Turkish-Dutch children confirmed negative effects of language mixing on lexical access in bilingual children. Comparisons with monolinguals showed that while the Berber-Dutch children had native-like Dutch lexical access, the Turkish-Dutch children were outperformed by their monolingual peers. The findings of the study indicate that including measures of language use as well as having more than one time of measurement can be valuable when studying language abilities of child heritage speakers.

Introduction

As a consequence of migration, many children worldwide grow up as bilinguals by learning both the native language of their parents or grandparents (heritage language), and the main language of the country in which they currently live (majority language). Although child heritage speakers are often dominant in the majority language (Benmamoun et al., 2013), they can nevertheless be disadvantaged in their majority language skills when compared to their monolingual peers. One aspect of language that might be vulnerable to such disadvantages is lexical access, the ability to activate and retrieve lexical items from the mental lexicon (Gollan et al., 2005b). For instance, adult bilinguals have more tip of the tongue occurrences than monolinguals (Gollan et al., 2005a), are slower in picture naming tasks and name fewer pictures correctly than monolinguals (Gollan et al., 2005b).

In this study, we investigate whether the lexical access of Turkish and Moroccan child heritage speakers is influenced by their bilingualism, as it has been found for adults, and if lexical access is hampered when both languages are active. Both groups of child heritage speakers were compared to monolingual Dutch children. All children were tested again after one year to gain insight into the developmental patterns of lexical access.

Lexical access, language dominance and language mixing in child heritage speakers

Already during childhood many heritage language speakers shift from being dominant in the heritage language to being dominant in the majority language (Benmamoun et al., 2013), a pattern observed in various studies that looked at lexical access. A cross-sectional study with different age groups of Spanish-English bilingual children in the U.S. showed that while 5–7-year-old children were still better at naming pictures in their first language (L1) Spanish, 8–10-year-old children showed equal skills in both of their languages and children in older groups (14-16 years old) were significantly faster and more accurate in their second language (L2) English (Kohnert et al., 1999). The authors confirmed this dominance shift in a longitudinal study with a subset of the original participants (Kohnert, 2002). Faster response times for the majority language as compared to the heritage language were also found in 6- to 11-year-old German-Swedish bilingual children, after they had been in the majority language environment for several years (Mägiste, 1992). In a study with Hmong-English child heritage speakers, better lexical access in the majority language was already observed for children between 3 and 5 years of age (Kan & Kohnert, 2005).

One factor that influences lexical access and that may interact with dominance is the extent to which bilinguals mix their languages. When bilinguals execute tasks involving lexical access, such as picture naming, words from both languages are activated and compete for selection (Colomé, 2001; Hermans et al., 1998). Although cross-language competition has been demonstrated for situations in which bilinguals only use one of their languages (Costa et al., 2000), cross-language competition is more likely in situations where both languages are highly active (Costa et al., 1999), such as picture naming experiments with a mixed language condition, in which bilinguals have to name pictures in both of their languages with the target language changing repeatedly after several trials (either initiated by a cue or a fixed number of trials). Results of studies with bilingual adults (Prior & Gollan,

2011) confirm this prediction and show, moreover, that the slowing effects of language mixing are stronger for the dominant language than for the non-dominant language (Christoffels et al., 2007; Prior & Gollan, 2011). The reason could be that the dominant language needs to be strongly inhibited during mixed language naming to facilitate lexical access in the weaker language, leading to larger slowing effects for the dominant language than for the non-dominant language (Christoffels et al., 2007).

However, a similar effect of language dominance on mixing was not observed in a study with bilingual child heritage speakers (Kohnert et al., 1999). Moreover, studies with child heritage speakers report divergent results about the developmental trajectories of both languages, necessitating further research with different groups of child heritage language speakers. For instance, whereas one study finds age-related gains in lexical access for both languages, with a higher increase for the majority language (Kohnert et al., 1999), other studies report growth of lexical access skills in the majority language, but stabilization in the heritage language (Kan & Kohnert, 2005), or even signs of decline in the heritage language (Kohnert, 2002).

Comparing lexical access across groups of child learners

One factor that is considered to influence lexical access is the frequency of use of a language: the more often a speaker uses words from a certain language the easier it is to access these words again later (‘weaker links’ account, e.g., Gollan, et al., 2008). As bilinguals generally use each of their languages less frequently than monolinguals, lower frequency of language use should lead to slower and less accurate lexical access in bilingual speakers compared to monolingual speakers, as evidenced in, for instance, picture naming tasks with adults (Gollan et al., 2005b). Several studies indeed provide evidence for frequency effects in lexical access (Forster & Chambers, 1973; Gollan et al., 2005b; Gollan et al., 2008) and even suggest that repeated activation of lexical items can improve lexical access to a point that differences in lexical access between bilinguals and monolinguals disappear (Gollan et al., 2005b). Another reason why bilinguals might be disadvantaged in lexical access tasks when compared to monolinguals could be the cross-language competition mentioned earlier. When bilinguals activate lexical items in their mental lexicon, translation equivalents in the other language are also activated and need to be inhibited during language production (Green, 1998). Resolving this interference is assumed to entail a processing cost, leading to slower and less accurate lexical access in bilinguals than in monolinguals.

Whereas differences in lexical access between bilinguals and monolinguals have often been studied in adults, few studies on this topic have included children (Bialystok & Feng, 2011; Poulin-Dubois et al., 2013) and so far, none of them report bilingual disadvantages of lexical access in children. Apart from that, to our knowledge there are no lexical access studies with child heritage speakers in particular that have included comparisons with a monolingual control group. This calls for further research. For instance, if cross-language competition attenuates lexical access, more heritage language use may have negative effects on lexical access in the majority language. Moreover, if more frequent language use is indeed associated with better lexical access (Gollan et al., 2005b), we may ask if it is possible for child heritage speakers to reach native-like lexical processing in the majority language.

The present study

This study focuses on Turkish and Moroccan children in the Netherlands. In this context, the majority language is Dutch, a language which all children learn when starting the kindergarten department of elementary school at age 4, but often already before that age at daycare or preschool. Both Turkish and Moroccan children predominantly come from families with lower socio-economic status (SES). The Turkish population highly values maintenance of the heritage language (Backus, 2005) and Turkish heritage speakers in the Netherlands have full access to Turkish media, such as television and newspapers. Many Moroccans speak a Berber language, which is a non-scripted language and not used in official communication or public media in Morocco. As a consequence, there are fewer opportunities for the Moroccan group to use their heritage language in formal or literate situations than for the Turkish group. As a result, many Moroccan children receive more input in Dutch, whereas the Turkish children receive more input in the heritage language (Scheele et al., 2010).

Language dominance. We expected that the Turkish children would use less Dutch and more Turkish at home as compared to the Moroccan children who are likely to use more Dutch at home than the heritage language. Since all the children in this study spend the larger part of their daily lives in a school environment where Dutch is the only language of communication, overall frequency of use of Dutch was assumed to be higher than the overall use of the heritage language for both groups of child heritage speakers. Therefore, both groups may show better lexical access in Dutch than in their heritage language. Similar to earlier studies (Kan & Kohnert, 2005; Kohnert et al., 1999; Kohnert, 2002), we expected improvement of lexical access in Dutch as a function of time since first exposure. Lexical access in the heritage language may improve (Kohnert et al., 1999), stabilize (Kan & Kohnert, 2005) or decline (Kohnert, 2002),

Language mixing. Language mixing is expected to have a negative effect on lexical access as reflected by longer response times and more errors. This effect may be similar for both languages, in line with another study that investigated effects of language mixing across the two languages in bilingual children (Kohnert et al., 1999). This would confirm that a difference exists between the effect of dominance on lexical access between children and adults. Adults have been found to show stronger effects of language mixing for the dominant language (Christoffels et al., 2007; Prior & Gollan, 2011). For effects of time, we expect improvement of lexical access during language mixing (Kohnert et al., 1999; Kohnert, 2002).

Between-group comparisons. Regarding between-group comparisons, different outcomes for lexical access in Dutch are envisaged. It is possible that child heritage speakers are outperformed by their monolingual peers, because the child heritage speakers might experience cross-language interference when accessing words in Dutch. In addition, more heritage language use goes hand in hand with less use of Dutch, which could have negative effects on lexical access in Dutch. However, because the children use the majority language frequently, the amount of majority language use among the child heritage speakers could also be sufficient to allow for performance at monolingual levels (Gollan et al., 2005b). Native-like lexical access in Dutch is more likely in the Moroccan children than in the Turkish children, due to more use of Dutch in the Moroccan families and more cross-language interference in the Turkish sample (as an effect of more use of the heritage language in the Turkish families). As far as developmental trajectories are concerned, we expect all groups of children to have better lexical access in Dutch when tested one year later. If the magnitude of gains in lexical access is larger for child heritage speakers than for monolingual children, this may be indicative of catching up effects.

Method

Participants

Data were collected from 60 children divided into one group of monolinguals and two groups of bilingual children in the Netherlands. At the first time of measurement, all children were between 4.5 and 7.0 years old (mean age = 5.8 years). The three groups of children were matched as much as possible (on a subject-by-subject basis) for age, nonverbal IQ, and socio-economic status (SES) (see Table 1). Nonverbal IQ was measured with the short version of the Wechsler Nonverbal-NL (Wechsler & Naglieri, 2008). SES was indexed by the average educational level of both parents of the child, based on the Questionnaire for Parents of Bilingual Children (PaBiQ; Tuller, 2015).

Table 1

Number of children, mean age in months, mean nonverbal IQ and mean socio-economic status (SES) in the three groups

	N	Age (*SD*)	IQ (*SD*)	SES (*SD*)
Monolinguals	20	70.3 (6.0)	101.5 (15.1)	6.8 (1.9)
Turkish	20	70.5 (7.0)	99.7 (11.6)	4.6 (2.2)
Moroccan	20	68.4 (6.4)	97.3 (12.5)	5.1 (2.2)

A child was assigned to the bilingual group when at least one of the child's parents spoke Turkish or Tarifit-Berber in the home environment most of the time. All children had attended kindergarten departments of Dutch elementary schools, where Dutch had been the only language of instruction, for at least half a year at the first time of testing. There were no significant age differences between the groups ($F(2,57) = .65$, $p = .53$, $\eta_p^2 = .02$) and no significant differences between the three groups for nonverbal IQ ($F(2,57) = .5$, $p = .6$, $\eta_p^2 = .02$). SES did differ significantly across the groups ($F(2,57) = 5.6$, $p < .01$, $\eta_p^2 = .16$), reflecting the often lower socioeconomic position of Turkish and Moroccan immigrant families in the Netherlands as compared to native Dutch monolingual families, but no significant SES difference between the two bilingual groups.

Measurements

Lexical access. Lexical access was measured with a picture naming task that was developed with the software package E-Prime 2.0 Standard (Psychology Software Tools, Pittsburgh, PA). The task included 32 different colored pictures of objects, selected from a picture database (Rossion & Pourtois, 2004). Pictures were chosen to refer to highly frequent Dutch concrete nouns (based on SUBTLEX-NL; Keuleers et al., 2010) that were all included in a list of words that children in the Netherlands are expected to be familiar with in kindergarten (Basiswoordenlijst Amsterdamse Kleuters (BAK); Mulder et al., 2009). This was done so that the task would test the children's ability to rapidly access words and not their knowledge of words. To ensure that the level of difficulty of naming these words in Turkish and Berber was comparable to naming these words in Dutch, only pictures rated by native speakers of these languages as 'very easy' were included. Pictures that referred to words that were cognates in any of the languages used in the task were not included.

Three different versions of the task were constructed with one version per language group. All items in the task were divided into lists by first creating pairs of words that were from the same semantic category, e.g., 'animal', and were comparable with regard to word frequency and word length, and then assigning the two words of each pair to different lists. For example, the word 'cat' in list A would be matched with the word 'dog' in list B. This resulted in two comparable word lists with 14 different items each for each language. The Dutch-only version of the task consisted of two practice trials followed by two blocks with 28 trials in each block. The 28 trials per block had a fixed order, namely two consecutive cycles of each of the two word lists. Thus, every target item was presented twice during the task, to increase the total number of trials.

The versions for bilingual children consisted of two single language blocks and a mixed language block. Each of the single language blocks consisted of two practice trials and 28 test trials. The bilingual children either started with the Dutch language block, which was followed by a block in the heritage language or the other way around. The order of the two languages was counterbalanced. The order of the two word lists remained the same for the single language blocks so that those children who started with Dutch named the pictures from word list A in Dutch followed by word list B in the heritage language and those children who started with the heritage language, named the pictures from word list A in Turkish/Berber and word list B in Dutch. The mixed language block consisted of four practice trials and 56 test trials which consisted of 28 trials per language. The target language was cued by a language cue as will be described below. The order of the trials was fixed. The target language changed every 2 to 5 trials. The target language stayed the same as in the previous trials for about 75% of the trials and changed to the other language for about 25% of the trials.

Language use at home. Information on language use at home was gathered by using a parental questionnaire based on the PaBiQ (Tuller, 2015). Dutch language use was measured as the amount of time a child was addressed in Dutch in the home environment. This information was collected for the mother, father, other caregivers and siblings on a five-point scale ranging from 0 = *never* to 4 = *always*. The same measure was applied for use of the heritage language. Information regarding other caregivers was only included when these individuals were present in the home environment at least several times per week.

Procedures

A trained assistant tested all children in a quiet room at their school. The tasks reported on in this study were part of a larger test battery that was administered in several test sessions. Monolingual children were tested in two sessions by a native speaker of Dutch. Because of additional tasks for the bilingual group, the bilingual children were tested in three sessions. The picture naming task was part of the first test session, which was conducted by a test assistant who was a native speaker of the respective heritage language of the child. In this session, the heritage language was the only language of communication between the test assistant and the child. This was done to ensure that the children would feel comfortable speaking the heritage language in a school environment where Dutch is usually the only language they use.

<u>Lexical access.</u> The picture naming task was presented on a 15-inch laptop screen. Instructions were given via prerecorded audio files. For monolingual children, all instructions were given in Dutch accompanied by a drawing of a girl's face. For the bilingual children, instructions were given in the language of the corresponding test condition. The same girl as in the monolingual version explained the task for the Dutch language condition. For the language block in the heritage language the face of a boy was introduced as a speaker of Turkish/Berber and instructions were given in the heritage language. The instructions for the mixed language condition were explained both in Dutch (by the girl) and in the heritage language (by the boy).

The purpose of introducing the two faces was to cue the language of the test condition during the task. The picture of the girl was the language cue for naming in Dutch and the picture of the boy was the language cue for naming in the heritage language. Thus, the bilingual children were familiarized with the language cues during the single language blocks, where the cues were the same for all trials within a block. In the mixed language condition, they had to answer in either Dutch or the heritage language, depending on the face shown at the top of the screen, above the target item. By introducing two potential interlocutors that differed in their languages in which they had to be addressed, the task was assumed to resemble a real-life mixed language situation more than when arbitrary cues, e.g., colors, would have been used. In each trial the participants saw a language cue for 650ms, then a fixation mark for 350ms, then a blank screen for 150ms, and then the target picture. The target picture would remain on the screen until a response was given. After the child's response the test assistant clicked the mouse to move on to the following item. The cue remained on the screen until the end of the trial. There was a time limit of 7,000ms for the child to respond.

Children's spoken responses were picked up by a microphone connected to a PST serial response box with a voice key function. Responses were also recorded via an external USB microphone for offline scoring of accuracy. Children were instructed to name pictures as fast as possible and to only name the word corresponding to the picture (e.g., *apple*, without using any additional words, e.g., determiners '*an apple'*). All children were tested again on the exact same task after approximately one year.

Language use at home. The parental questionnaire was administered during a telephone interview with one of the child's parents. The interview was conducted by bilingual assistants who were proficient in both Dutch and the heritage language of the child, and could therefore be carried out in the preferred language of the parent. Per language the percentage of language use in the home environment was calculated. SES was measured by level of education on a nine-point scale for both the mother and the father of the child. Averages of both parents were calculated and used for the analyses as a covariate.

Data preparation

Lexical access. For accuracy on the picture naming task, the percentages of correct answers were calculated per language and per condition (single vs. mixed) using the audio recordings. For calculations of mean response times (RTs), only accurate trials were used (91.2 % of all trials). For 18 out of the 60 children RTs were not recorded due to microphone malfunction. For these children, response times were measured manually in the free audio editor software Audacity 2.1.0. Response latencies were measured as the interval between picture presentation onset and onset of the expected target response, disregarding all audible noise or filled pauses preceding the response. Trials in which a child stuttered or said something else before the target word were excluded. All RTs smaller than 200ms were excluded and all RTs smaller than 500ms were checked and measured manually to determine e.g., if the voice key had been triggered accidentally by other sounds than the child's spoken response, e.g., background noise. We computed means and standard deviations per child, and for the bilingual children also per language and test condition. All RTs that were 2.5 standard deviations above the mean were excluded. These measures led to the exclusion of 0.7% of the total number of correct trials. In order to measure potential costs for response times in a mixed language condition, for each child and per language we calculated mixing costs by subtracting response times of the single language conditions from those of the mixed language condition.

Results

Language dominance

Before analyzing measures of lexical access, we compared the two bilingual groups with regard to their language use in the home environment. A one-way ANOVA was carried out with bilingual group (Turkish /Moroccan) as independent variable and majority language use and heritage language use as dependent variables. The mean percentages and standard deviations for language use are presented in Table 2.

Table 2

Language use (in %) in the home environment for the two bilingual groups

	Dutch language use	Heritage language use
	Mean (*SD*)	Mean (*SD*)
Turkish	43.7 (11.6)	56.3 (11.6)
Moroccan	60.6 (13.4)	39.4 (13.4)

The Moroccan group made more use of the majority language Dutch at home than the Turkish group (F(1,37) = 17.0, $p < .01$, $\eta_p^2 = .32$). The Turkish group made significantly more use of the heritage language at home than the Moroccan children (F(1,37) = 17.0, $p < .01$, $\eta_p^2 = .32$). Because of these differences, the Turkish and the Moroccan children were treated as separate groups in the analyses. In the Turkish group, occasionally, a third language was used, which is why the percentages of Dutch and Turkish combined do not reach 100%.

Accuracy and response times

Due to high numbers of non-response in the heritage language condition for the Moroccan children (at time 1: 17 out of the 20 children had less than 25% accuracy in the Berber single language condition and 14 of them had 0% accuracy, at time 2: 19 children less than 40% accuracy and 10 of them had 0% accuracy), it was not possible to analyze lexical access data in the heritage language for the Moroccan children. Therefore, for comparing lexical access in both languages, we analyzed only data from the Turkish children (*N*=20). An overview of their lexical access data is given in table 3.

Table 3

Mean accuracy scores (SD). mean response times (SD) and mixing costs (SD) of Turkish group for picture naming in Dutch and Turkish in single language and mixed language conditions at time 1 and time 2.

	Dutch		Turkish	
	Time 1	Time 2	Time 1	Time 2
Accuracy (%)				
single block	93.6 (8.4)	97.3 (4.2)	83.4 (10.7)	86.8 (14.3)
mixed block	88.9 (15.3)	96.5 (7.1)	77.3 (16.0)	82.1 (14.0)
Response times (ms)				
single block	1166.1 (299.5)	1160.7 (189.4)	1334.8 (304.5)	1440.0 (311.6)
mixed block	1411.2 (386.3)	1530.3 (349.7)	1623.2 (490.5)	1690.1 (370.1)
Mixing costs (ms)	242.9 (250.0)	331.8 (257.4)	375.3 (402.2)	256.0 (305.8)

A repeated-measures ANOVA with language (Turkish/Dutch) and time (year 1/2) as within-subject factors and accuracy and response times as dependent measures was carried out. There were significant main effects of language on accuracy (F(1,19) = 18.1, $p < .01$, η_p^2 =

.49) and response times ($F(1,19) = 10.7$, $p < .01$, $\eta_p^2 = .36$) reflecting higher accuracy and faster responses in the majority language Dutch than in the heritage language. While time did not affect response times, there was a trend for accuracy, indicating slightly higher overall accuracy scores at time 2 ($F(1,19) = 3.2$, $p = .09$, $\eta_p^2 = .14$). No interaction effects were found.

Language mixing

A repeated-measures ANOVA, with language (Turkish/Dutch), condition (single/mixed) and time (year 1/2) as within-subject factors and accuracy and response times as dependent measures were carried out. Accuracy was higher for Dutch than for Turkish ($F(1,19) = 29.1$, $p < .01$, $\eta_p^2 = .61$) and response times were also faster for Dutch than for Turkish ($F(1,19) = 16.5$, $p < .01$, $\eta_p^2 = .47$). The Turkish children were significantly less accurate ($F(1,19) = 8.6$, $p < .01$, $\eta_p^2 = .31$) and slower ($F(1,19) = 42.6$, $p < .01$, $\eta_p^2 = .69$) when naming pictures in a mixed language condition compared to single language conditions. No interaction effects emerged.To compare the magnitude of slowing effects of language mixing between the two languages and across time, we carried out a repeated-measures ANOVA with language and time as within-subject factors and mixing costs as dependent measures. The interaction effect between language and time showed a trend suggesting an increase of mixing costs in Dutch but not in Turkish ($F(1,19) = 4.0$, $p = .06$, $\eta_p^2 = .17$). No main effects of language or time were observed.

Comparing child heritage language learners to monolingual children

To compare lexical access in the majority language Dutch between child heritage language learners and monolingual Dutch children across the two time points, we conducted two mixed-design ANCOVAs with language group (Dutch/Turkish/Moroccan) as between-subject factor, time as within-subject factor, accuracy and response times as dependent measures and age, IQ and SES as covariates. Table 4 gives an overview of the Dutch lexical access data for all language groups.

Table 4

Mean accuracy scores (SD) and mean response times (SD) in Dutch picture naming for the three language groups measured at time 1 and time 2.

	Accuracy Dutch (%)		Response times (RTs) Dutch (ms)	
	Time 1	Time 2	Time 1	Time 2
Monolingual	98.2 (2.7)	99.6 (1.1)	993.2 (155.1)	901.5 (187.7)
Turkish	93.6 (8.4)	97.3 (4.2)	1166.1 (299.5)	1160.7 (189.4)
Moroccan	97.3 (2.8)	98.2 (2.7)	1005.2 (205.5)	932.0 (181.7)

<u>*Accuracy.*</u> Accuracy scores in Dutch were not normally distributed. We report the results from the parametric tests, because these did not differ from those of a non-parametric equivalent. There was a significant effect of language group on accuracy scores: $F(2,54) =$

4.1, $p < .05$, $\eta_p^2 = .13$. Post-hoc analyses (Games-Howell) indicated that the monolinguals outperformed the Turkish children. No significant effect of time emerged.
Response times. There was a significant effect of language group on response times ($F(2,54) = 7.5$, $p < .01$, $\eta_p^2 = .22$). At time 1, the Turkish children tend to be slower than the monolingual children ($p = .07$) while at time 2, the Turkish children are significantly slower at Dutch naming than both the monolingual children ($p < .01$) and the Moroccan children ($p < .01$). The Moroccan children do not differ from the monolingual Dutch children, neither at time 1 nor at time 2. Finally, there was a significant positive effect of time on response times in Dutch ($F(1,54) = 5.9$, $p < .05$, $\eta_p^2 = .1$), meaning that response times decreased over time. There was no interaction effect between time and language group.

Discussion

With this study we wanted to determine 1) whether child heritage speakers in the Netherlands are dominant in the majority language Dutch with regard to their lexical access, 2) if lexical access of these children is hampered in situations where they need to use both of their languages, e.g., during language mixing, and 3) if child heritage speakers are at a disadvantage for lexical access in the majority language when compared to monolingual children. By retesting the same children after a year, we could evaluate whether variation within children regarding language dominance and language mixing as well as between-group patterns changed over time. By including Turkish and Moroccan child heritage language children, we were able to compare different groups of child heritage language learners that vary in heritage language status and use.
First of all, the heritage language (Turkish or Berber) was used more often in the home environment of the Turkish children than the Moroccan children. In contrast, the Moroccan children made more use of Dutch at home than the Turkish children, in line with previous research (Scheele, et al., 2010). Due to the fact that the only language of instruction at school is Dutch for all of these children and that most of them also use (at least some) Dutch inside the home environment, we expected children to have better lexical access in Dutch than in the heritage language. This pattern was particularly striking for the Moroccan children in our study who were unable to name more than a few pictures in their heritage language Berber, despite use of Berber by parents, siblings and other caretakers in the home environment of these children.

Nevertheless, the heritage language skills for many of the Moroccan children appeared to be limited to receptive skills, which is not uncommon for heritage speakers (Polinsky & Kagan, 2007). The Turkish children did show productive heritage language skills, but their lexical access patterns also demonstrated majority language dominance: they were more accurate and faster at lexical access in Dutch than in Turkish at both times of measurements, similar to the child heritage language learners studied by Mägiste (1992) and the 8–10-year-old group studied by Kohnert et al. (1999).

Due to higher cross-language interference (Costa et al., 1999), we hypothesized that lexical access should be more effortful in a mixed language condition, where both languages are highly active, than in single language conditions. Unfortunately, due to low response in the Moroccan group, we were only able to analyze language mixing in the Turkish group (see p. 44). The Turkish children had indeed lower accuracy and longer response times in the mixed language condition than in the single language conditions at both times of testing (Kohnert et al., 1999; Jia et al., 2006; Prior & Gollan, 2011). No evidence was found for a stronger negative effect of language mixing on lexical access for the dominant language, as was found for bilingual adults (Christoffels et al., 2007; Prior & Gollan, 2011). This pattern resembles the results of Kohnert et al. (1999) who found that for the 5–7-year-old children in their study, language mixing effects were not different for the two languages. Contrary to our expectations and findings in previous research (Kohnert et al., 1999; Kohnert, 2002), mixing costs did not decrease between time 1 and time 2. This might be related to lower frequency of language mixing in Turkish child heritage speakers as compared to, for example, Spanish-English heritage speakers, but needs to be further investigated in future research.

Research with bilingual adults has repeatedly demonstrated that bilinguals are disadvantaged in lexical access tasks when compared to monolingual speakers (Gollan et al., 2005b; Michael & Gollan, 2005; Portocarrero et al., 2007). Therefore, we investigated whether child heritage speakers – even when they are dominant in the majority language – are at a risk of being less accurate and slower at accessing words in the majority language than their monolingual peers. All three groups of children were highly accurate, which is not surprising, because frequent items were selected to focus on lexical access and rule out effects of lexical knowledge. The Moroccan children were as fast at naming pictures in Dutch as their Dutch monolingual peers. The native-like performance of the Moroccan children can be attributed to their language use of Dutch, suggesting that these children make sufficient use of the majority language Dutch to access lexical items as fast as monolingual children. Moreover, the fact that these children have limited productive skills in their heritage language implies that they will hardly suffer from cross-language interference. The Turkish children showed a different pattern. In particular at time 2 they were significantly slower than both the monolingual and the Moroccan children. This finding could be related to lower frequency of use of Dutch at home, but also to effects of cross-language competition from Turkish. For effects of time, we found evidence for faster lexical access at time 2 in all groups, confirming gains in Dutch response times for all groups of children.

This study has shown that Turkish and Moroccan child heritage speakers in the Netherlands are better at accessing words in the majority language Dutch than in their heritage language after being in the Dutch school system for at least a year. After approximately two years at school, their lexical access in Dutch had further improved. A comparison of the two languages in the Turkish sample demonstrated that child heritage speakers are slower at naming pictures when the heritage language (Turkish) and majority language (Dutch) were mixed, confirming effects of cross-language competition and interference in bilingual children's mental lexicon, also when the two languages are clearly unbalanced as is the case for many heritage language children. Importantly, marked differences were found between two different heritage language groups that vary in heritage versus majority language use. The Moroccan children had clearly more limited productive heritage language skills than the Turkish children, but performed at a monolingual level for lexical access in the majority language. The latter observation implies that learning a heritage language only leads to disadvantages in lexical access in the majority language if the amount of heritage language use exceeds a certain threshold, as was apparently the case for the Turkish children. However, if the amount of heritage language use is below a certain threshold, heritage language proficiency will be low, as was apparently the case for the Moroccan children. A major limitation of our study is the fact that we were not able to study lexical access in the heritage language of the Berber-Dutch children and compare it to their lexical access in Dutch. To gain a better understanding of the lexical processing in groups of children with low heritage language proficiency, it might thus be more insightful to also include tasks testing the children's comprehension rather than production, for example, by using lexical decision tasks.

Chapter 3

Accuracy and fluency in the language production of monolingual and bilingual children: effects of bilingualism, language proficiency and memory

Author contributions: Mona Timmermeister and Elma Blom conceptualized the research, M.T. collected the data, M.T. and E.B. analyzed the data, M.T. wrote the paper, E.B. supervised the writing process. Paul Leseman, Frank Wijnen & E.B. critically reviewed the research.

Abstract

This study compared the language production of 5- to-7-year-old monolingual and bilingual children with regard to their accuracy and fluency. We investigated whether and how linguistic resources (vocabulary and grammar) and processing resources (phonological short-term and working memory) affected children's language production. Forty bilingual children (Turkish-Dutch, Berber-Dutch) and forty monolingual Dutch children participated. Dutch speech samples were used to calculate accuracy and fluency rates. Linguistic and processing resources were measured using Dutch vocabulary and grammar tests, and non-word repetition and backward digit span tests. The bilingual children had lower accuracy and fluency than the monolingual children. Bilingual children's larger number of production errors was partly explained by their more limited linguistic resources. Phonological short-term memory was linked to fluency in the bilingual children. When phonological short-term memory was controlled for, disfluency rates of both groups did not differ. Bilingual children with lower language knowledge are at risk for errors in language production while bilingual children with lower phonological short-term memory are at risk for disfluencies.

Introduction

Learning to express oneself through language is a major accomplishment of early childhood. The ability to produce language fluently and accurately is at the core of successful human communication. Deficits in oral language skills have negative effects on children's (psycho)social and academic development (Snow et al., 1998) directly and indirectly, as these deficits may also impact the acquisition of other language abilities, such as reading (Miller et al., 2006). It is therefore important to determine which children are at risk for language production difficulties and to understand why they experience these difficulties. The primary aim of this study was to compare the spoken language production of monolingual and bilingual children with regard to their accuracy and fluency and to determine if bilingual children make more errors and produce more disfluencies than their monolingual peers.

Two cognitive resources that are critical for fluent and accurate language production are linguistic knowledge (grammar, vocabulary) (Gilabert & Muñoz, 2010; Hilton, 2008) and working memory (WM) (Mota, 2003). As bilingualism has been found to affect linguistic knowledge (Bialystok et al., 2010) as well as WM (Blom et al., 2014; Delcenserie & Genesee, 2016; Morales et al., 2013), bilinguals can be expected to differ from monolinguals as regards fluent and accurate language production. Importantly, whereas bilingual children are often at a disadvantage for linguistic skills in the second language (L2) when compared to monolingual children (Bialystok, 2009, Paradis, 2005, Rispens & De Bree, 2015), they have been found to be at an advantage for WM skills (Blom et al., 2014). It is therefore difficult to predict how the combined effect of these skills will pan out. Moreover, language production might be less automatized in bilingual children who are second language (L2) learners of a particular language compared to monolingual children (Gilabert & Muñoz, 2010). Production could therefore be more dependent on nonlinguistic skills, such as WM in order to successfully deal with the processing load necessary for language production. However, studies investigating potential effects of WM on language production in children are scarce and little is known about relations between linguistic knowledge, memory skills and language production in bilingual children, warranting research into the language production of this group of language learners. Therefore, the secondary goal of this study was to obtain a better understanding of how both linguistic resources (vocabulary, grammar), as well as processing resources (WM including phonological short-term memory (PSTM)) affect language production in monolingual and bilingual children.

The role of vocabulary and grammar in language production

Two language production measures that have been studied in relation to language acquisition are accuracy and fluency (Housen & Kuiken, 2009). Accuracy is the more straightforward of these dimensions and is mostly measured by the number of errors (deviations from what is considered to be grammatically correct) a speaker makes within a certain unit of (semi–) spontaneous speech. Fluency is a more complex dimension that has been operationalized through different measures, such as speech rate, length of pauses, the number of (filled) pauses or the frequency of repetitions and revisions. That better language proficiency – as measured by standardized tests of vocabulary or grammar – leads to higher accuracy and fluency in oral language production seems obvious, and is supported by research on native speakers and adult L2 learners (Gilabert & Muñoz, 2010; Hilton, 2008).[3] In order to better understand which mechanisms underlie these relations, it is relevant to consider the different stages involved in language production more closely.

Levelt and Meyer (2000) argue that in order to produce a spoken utterance, the following processing steps are to be taken: conceptualization, lexical selection, grammatical encoding, morpho-phonological encoding, phonetic encoding, and articulation. There is abundant evidence that speakers monitor this process as it unfolds. Speed and fluency are thought to result from the overlap in time of these component processes, which entails that articulation can begin before the preceding steps have been completed (Levelt, 1989). A pivotal step is lexical selection, i.e., the selection of a word from the mental lexicon on the basis of a preverbal message (conceptual structure). A large vocabulary will have positive effects on fluency, because a person who knows more words has better chances of selecting a lexical item that captures the concept of the intended message (Chambers, 1997). Difficulty in retrieving a lexical item may result in disfluency, i.e., an unintentional interruption of the speech stream. Adult L2 learners, for example, experience difficulties in lexical access due to cross-language competition, which in turn leads to increased disfluency (Bergmann et al., 2015). Grammatical knowledge is relevant for language production because the selected lexical items need to be arranged in a grammatical structure, according to the morphological and syntactic rules of a language (Levelt, 1989). As grammatical encoding is thought to be less automatized in young or beginning language learners than mature language users (O'Brien et al., 2007; Wijnen, 1990), difficulties with grammatical structures that are not yet fully mastered are likely to become visible during language production in the form of erroneous or disfluent speech.

The role of phonological short-term memory and working memory in language production

Next to language knowledge, PSTM and WM are likely to play a key role in language production. WM is a domain-general cognitive function used for the temporary storage and manipulation of information in the mind (Diamond, 2013). The amount of information that can be held in WM is limited and develops with increasing age (Davidson et al., 2006). In Baddeley's multicomponent WM model, PSTM is viewed as a subsystem of WM that is used for temporarily storing and reproducing specifically phonological information (Baddeley, 2003). Whereas WM capacity is often measured using more complex tasks such as dual tasks or tasks in which information has to be manipulated, PSTM is measured using simple span tasks in which participants repeat or recall words, digits or non-words.

Both PSTM and WM have been studied in relation to measures of spontaneous speech in adult L2 learners (Gilabert & Muñoz, 2010; Guara-Tavares, 2009; Mizera, 2006; Mota, 2003; O'Brien et al., 2007; Trebits & Kormos, 2008). With regard to language production in

[3] However, it has also been argued that the relationship between linguistic factors and, for example, fluency should not be expected to be a perfect one, as other factors such as speaking rate, time pressure, content or topic are also likely to affect how fluent a speaker's speech is (Yaruss et al., 1999).

bilingual children, most studies focus on PSTM (Adams & Gathercole, 1995, 1996, 2000; Verhagen et al., 2015) and only few also include WM (Blom et al., 2021). PSTM measured by non-word repetition performance correlates positively with MLU, number of different words (types), and syntactic complexity in the speech of monolingual children (Adams & Gathercole, 2000). Note that these measures are not measures of accuracy or fluency, as a sentence can be syntactically complex but still contain errors or disfluencies. The study by Verhagen and colleagues (2015) reports a positive relation between PSTM and accuracy for one specific linguistic feature, namely subject-verb agreement. Blom et al. (2021) found that PSTM (but not WM) predicted accuracy of inflectional morphology in both monolingual and bilingual children. Research with adult L2 learners has indicated that a larger PSTM is related to higher oral fluency (O'Brien et al., 2007), but none of the studies with children has investigated the relations between PSTM and fluency.

Effects of PSTM on children's language production have usually been interpreted in the context of vocabulary and grammar acquisition. In those studies, it is argued that PSTM is involved in children's acquisition of new words as it helps the creation of stable phonological representations in long-term memory (Gathercole & Baddeley, 1990; Gupta et al., 2003; Masoura & Gathercole, 2005). Moreover, PSTM is involved in the acquisition of grammar (Blom et al., 2021; Daneman & Case, 1981; French & O'Brien, 2008; Verhagen et al., 2015). Children are thought to make use of PSTM to temporarily store and repeat grammatical constructions they encounter in the input before they store them as templates in long-term memory. With those stored grammatical patterns in long-term memory, these constructions can easily be used during spontaneous speech, decreasing the processing demands (Speidel & Herreshoff, 1989; Speidel, 1993).

These explanations suggest an indirect connection between PSTM and language production, but there may also be direct relations between PSTM and WM, on the one hand, and accuracy and fluency during language production, on the other hand. PSTM and WM might be important for monitoring language production (Mizera, 2006), as well as during grammatical encoding (Mota, 2003). In order to produce a sentence accurately and fluently, the preverbal message and the selected lexical items needs to be temporarily stored and kept active during the planning and encoding processes of language production. The intended message and the selected lexical items have to be held in mind while executing grammatical encoding, e.g., marking words for number, case, tense. Speakers who are less successful at temporarily storing verbal information or who have problems performing a dual task might be more likely to lose track of their intended utterance, which could lead to disfluencies and errors. These effects may be more prominent in speakers whose language production processes are less automatized because less automatized language production may require more cognitive resources than more automatized language production. For this reason, the effects of WM on language production have been particularly studied in the field of L2 acquisition (Gilabert & Muñoz, 2010).

There is evidence for effects of WM on measures of accuracy and fluency in the oral language production of adult L2 learners, although the findings are not fully consistent. Whereas some studies find that WM capacity is related to both accuracy and fluency

(Daneman, 1991; Fortkamp, 1999; Guara-Tavares, 2009; Mizera, 2006; Mota, 2003), others report correlations between WM and fluency but not accuracy (Gilabert & Muñoz, 2010). A potential problem of many of these studies is that WM was assessed with tasks such as the speaking span task (Daneman & Green, 1986), in which participants are presented with a sequence of words and have to form grammatical sentences with each of the target words in the same order as they were presented. As these tasks are strongly dependent on language knowledge, it is possible that results reflect effects of language proficiency rather than WM (Gilabert & Muñoz, 2010). That the observed relationships are not fully attributable to the role of language knowledge is shown by Trebits and Kormos (2008), who find relationships between fluency and WM in 17–18-year-old L2 learners using a backward digit span task. Digit span tasks measure WM while making limited use of language knowledge, in contrast to speaking span tasks.

Language production in bilingual children

For the purpose of the current research, we compared the language production of bilingual children to that of monolinguals. There is evidence for higher error rates in the spontaneous oral language production of bilingual children compared to monolingual norms (Paradis, 2005). For example, children learning an L2 have problems with tense and agreement markers (Blom & Baayen, 2013; Ionin & Wexler, 2002; Prévost, 2003; Verhoeven et al., 2011). One question that arises is whether these language production errors are mainly caused by incomplete or difficult-to-access linguistic knowledge or are also related to limited processing resources, such as PSTM or WM. For instance, the argument that WM is more likely to affect language production when language abilities are not yet automatized has been made for adult L2 learners but could also be made for young children, especially for children who are L2 learners of a language (Prévost, 2003).

There are also reasons to expect that bilingual children might produce more disfluencies in their spontaneous language production than monolingual children. Next to lower scores on vocabulary and grammar tests, bilinguals have been shown to have disadvantages in their lexical access, that is, the activation and retrieval of lexical items in the mental lexicon (Ivanova & Costa, 2008) (see Chapter 2). As lexical access is a quintessential step in the process of language production, problems at the stage of lexical access might increase the occurrence of disfluencies. Fiestas and colleagues (2005) found that 4- to 7-year-old Spanish-English bilingual children produced almost twice as many repetitions (i.e., repetitions without a communicative goal) as functionally monolingual children, but comparable numbers of revisions and similar total numbers of disfluencies. Comparable numbers and patterns of disfluencies in bilingual and monolingual children were also found in another study (Bedore et al., 2006) and were interpreted as an indication that, although bilingual and monolingual children might differ in their linguistic knowledge, they do not necessarily have to differ in their language production skills.

Understanding the occurrence and cause of errors and disfluencies in bilingual children is crucial, as both are also used as indicators of language impairments in children (Bedore et al., 2006; Paradis et al., 2011). Inadequate interpretation of errors and disfluencies can lead to misdiagnosis of bilingual children. Moreover, studying potential effects of PSTM and WM on language production is particularly relevant in bilingual children as there is evidence that – compared to monolingual children – bilingual children show lower performance on language-specific PSTM tasks (Engel de Abreu, 2011; Kohnert et al., 2006), but higher performance on WM tasks (Blom et al., 2014; Delcenserie & Genesee, 2016; Morales et al., 2013). With regard to language production in bilingual children this means that, whereas deficits in linguistic knowledge (vocabulary, grammar) and PSTM are likely to negatively affect accuracy and fluency, enhanced WM might have positive effects on oral language production in these children. To our knowledge, effects of linguistic knowledge, PSTM and WM on language production have not been studied together however, neither in monolingual nor in bilingual children.

Aim of the present study

The present study investigated accuracy and fluency in the oral language production of monolingual and bilingual children in the Netherlands. Participants were monolingual Dutch children and bilingual children of Turkish or Moroccan descent. Next to transcribed recordings of semi-spontaneous speech, we collected measures of vocabulary and grammatical knowledge, as well as measures of PSTM and WM.

First of all, we asked whether the bilingual and monolingual children differ regarding their accuracy and fluency when producing language in Dutch. We expected that lower abilities of vocabulary and grammar in the bilingual children lead to lower accuracy in language production of bilingual as compared to monolingual children. We also expected lower Dutch language proficiency of the bilingual group to be related to a higher rate of disfluencies, although this relation was not found in previous studies (Bedore et al., 2006; Fiestas et al., 2005).

Next, this study investigated whether linguistic knowledge (vocabulary, grammar), PSTM and WM are predictors of accuracy and fluency in the language production of children, and whether predictive relationships are different for monolingual and bilingual children. We expected higher scores for vocabulary and grammar to have a positive effect on accuracy and fluency, because vocabulary and grammar knowledge may be directly or indirectly related to accuracy and fluency.

Regarding processing measures, we expected better PSTM to be related to higher accuracy, indirectly because better PSTM supports language acquisition (Adams & Gathercole, 1995, 1996, 2000), and directly because PSTM is a critical resource in planning and encoding sentences (Gilabert & Muñoz, 2010; Mizera, 2006; Mota, 2003). Based on reports of correlations between phonological short-term memory and oral fluency in adult L2 learners (O'Brien et al., 2007), we expected that PSTM might also be related to fluency in the language production of children. Considering earlier findings of weaker PSTM in bilingual children than in monolingual children (Engel de Abreu, 2011; Kohnert et al., 2006), weaker PSTM might be related to the occurrence of more disfluencies in bilingual children than in monolingual children.

Apart from effects of PSTM, this study also investigated effects of working memory on accuracy and fluency in the language production of monolingual and bilingual children. To the best of our knowledge, this relation has not been studied in children. We expected that better WM would be related to higher accuracy and fluency, for similar reasons as to why this would be expected for PSTM. However, we also reckoned with the possibility that no effects would be found, because studies with adults report mixed findings. Whereas some studies find effects of WM on both accuracy and fluency (Guara-Tavares, 2009; Mota, 2003), other studies report non-significant results (Gilabert & Muñoz, 2010; Mizera, 2006).

Method

Participants

Participants were 40 monolingual Dutch children and 40 bilingual children who learned Dutch as their L2. The bilingual group included children from Turkish (*N*=20) and Moroccan (*N*=20) descent. The bilingual and monolingual children were matched at child level for age, nonverbal intelligence, and socio-economic status (SES) (see Table 1). Nonverbal IQ was measured with the short version of the *Wechsler Nonverbal-NL* (Wechsler & Naglieri, 2008). SES was indicated by the average educational level of both parents of the child measured on a nine-point scale.

Table 1

Number of children, mean age in months, mean nonverbal intelligence scores (IQ) and mean socio-economic status (SES) in the monolingual and bilingual group.

	N	Age (*SD*)	IQ (*SD*)	SES (*SD*)
Monolinguals	40	70.4 (7.1)	104.5 (13.9)	6.5 (2.1)
Bilinguals	40	68.8 (6.8)	100.7 (11.9)	4.9 (2.1)

A child was assigned to the bilingual group when at least one of the child's parents spoke a language other than Dutch in the home environment most of the time. Information regarding language use in the home environment was gathered using a parental questionnaire, the *Questionnaire of Parents of Bilingual Children* (PaBiQ, Tuller, 2015). All children had attended kindergarten departments of Dutch elementary schools, where Dutch had been the only language of instruction, for at least half a year at time of testing. There were no significant age differences between the groups ($F(1,78) = 1.0$, $p = .31$, $\eta_p^2 = .01$) and no significant differences between the three groups for nonverbal IQ ($F(1,78) = 1.7$, $p = .2$, $\eta_p^2 = .02$). SES did differ significantly across the groups ($F(1,78) = 18.8$, $p < .01$, $\eta_p^2 = .19$) even after the matching process, reflecting the lower socioeconomic position of Turkish and Moroccan immigrant families in the Netherlands as compared to native Dutch monolingual families.

Measures

Disfluencies and errors. Disfluencies comprised repetitions and revisions in children's language samples, which were recordings of a test session in which children produced (semi)-spontaneous speech, elicited in a number of ways. During the test session, children told a story based on a coherent sequence of six colored pictures either depicting a story about young goats or young birds (Gagarina et al., 2012); they answered questions about a story told by the test assistant and about their own story, and responded to interview questions concerning a variety of topics, e.g., their preferences for games, TV programs, recent vacations, or activities at school. All children followed the same procedures. The speech samples were transcribed according to the *CHAT* transcription format (MacWhinney, 2000).

In each transcript, all utterances produced by the child were coded for repetitions and revisions. As repetitions we coded all instances where a child repeated one or multiple words without making any changes to the repeated material (e.g., 'After that *after that* the bird flew away') and without any communicative goal. As revisions we coded instances where a child made a lexical or syntactic change to (parts of) an utterance (e.g., 'After that *after eating the worm* the bird flew away'). For each child, we added the number of repetitions and revisions and divided the total number of disfluencies by the total number of produced words, multiplied by 100 to calculate the disfluency rate.

Errors included lexical (e.g., 'After that the bird **walked* away'), morphological (e.g., 'After that the bird **flied* away') and syntactic errors (e.g., 'After that the bird **away flew*') and comprised substitutions as well as omissions. Every error in an utterance was coded as a separate error. This entails that an utterance could include multiple error codes. We calculated error rates per child by dividing the total number of errors by the total number of produced words, multiplied by 100.

To calculate interrater agreement for the coding of disfluencies and errors, data from eight children (10% of the sample) were coded independently by a second person who was given the same coding guidelines as the person who coded disfluencies and errors in the entire sample. Interrater agreement was 88.4% for disfluencies and 85.0% for errors.

Language knowledge measures. Receptive vocabulary size in Dutch was assessed using the Peabody Picture Vocabulary Task (PPVT-III-NL; Schlichting, 2005). The PPVT is a standardized receptive vocabulary test designed for the age range from 2 years and 3 months to 90 years. The task contains 204 items divided over 17 sets. Each set consists of 12 items and the level of difficulty increases throughout the sets. In this task, a child heard a stimulus word and had to choose the correct referent out of four pictures. The PPVT-III-NL was administered and scored according to the manual: the starting set was determined by a child's age and the task was terminated after a child produced nine or more errors within one set. Raw scores were converted to standardized scores based on age-corrected normative scores.

Children's grammatical skills were tested with the *Taaltoets alle kinderen* (TAK: Language Test for All Children; Verhoeven & Vermeer, 2002), a standardized language assessment designed and normed for monolingual and bilingual children in the Netherlands. For the current study, the *Word formation* and *Sentence production* subtests were administered. The purpose of the Word formation test is to elicit noun plurals and past participles. To elicit noun plurals, children were presented with two pictures, one showing a single object, the other showing two or more examples of that object. Plural forms were elicited by the test assistant's prompt *'This is an X, these are two…'*. To elicit past participles, children were presented with a picture depicting a person engaged in a specific activity. The test assistant described the picture in the present tense using the target verb of the trial followed by the prompt *'yesterday he/she has also…'*, a phrase which - in Dutch - elicits only the sentence-final past participle form of the target verb. The subtest consisted of 24 items. In the Sentence production test, the child heard a complex Dutch sentence read out loud by the test assistant and had to repeat the sentence as accurately as possible. Each sentence contained a specific function word and a specific syntactic structure that had to be repeated, so that children could score two points per sentence. Although similar tests have also been used to assess phonological short-term memory this particular subtest can been used as a measure of grammatical skills as scores are not depending on exact repetition of the entire sentence but correct reproduction of function words and syntactic structures (Verhagen & Leseman, 2016). The tasks contained 20 sentences and children could obtain a total score of 40. For each child, total scores from the Word formation and Sentence production tests were added up to obtain a grammar score.

Phonological short-term memory and working memory. PSTM was measured with a non-word repetition task based on Rispens and Baker (2012). In this task, children had to repeat 24 prerecorded non-words. All items were designed based on phonological properties of Dutch, with half of the items having high and half of the items having low phonotactic probability. Items varied in syllable length from two to five syllables. Children heard each nonword once; responses were recorded by a highly sensitive microphone (Samson Go Mic) to allow for offline scoring after completion of the task (for details on items and scoring, see: Boerma et al., 2015). The recordings were transcribed and scored for the percentage of correctly repeated phonemes.

WM capacity was tested with a Dutch adaptation of the Digit Span Backward task from the *Automated Working Memory Assessment* test battery (Alloway, 2012), administered using the experimental software E-Prime 2.0 (Schneider et al., 2002). Children heard recorded sequences of digits and were asked to repeat each sequence in the reverse order starting with the last digit they had heard. The task began with a block consisting of six trials with sequences of two digits and continued six-trial blocks with sequences of increasing length, up to a maximum of seven digits. If, in a block, four trials of the same length were recalled correctly, the sequence length increased with one digit. The task was ended when a child recalled three trials of the same length incorrectly. Scores were obtained by giving six points for each completed level and adding an additional point for each completed sequence of the level at which the task was discontinued.

Procedures

The research was screened by the Standing Ethical Assessment Committee of the Faculty of Social and Behavioral Sciences at Utrecht University. Criteria were met and further verification was not deemed necessary. Parents of participating children signed informed consent forms. Children were tested individually in a quiet room at their school. The tests were administered by trained assistants following a standardized protocol. The tasks used for this study were part of a larger test battery divided into two test sessions. The first session included (among others) the backward digit span task and the sentence repetition test. The second session took place after one week and included (among others) the non-word repetition task, the vocabulary task, the word formation task and the interview/story telling episode. The only language of instruction in these two sessions was Dutch both for the monolingual and the bilingual children. The parental questionnaire was administered during a telephone interview with one of the child's parents. The interview was conducted by bilingual speakers of both Dutch and Turkish/Berber/Moroccan-Arabic and could therefore be carried out in the preferred language of the parent.

Results

Accuracy and fluency in the language production of monolingual and bilingual children

Prior to the analyses it was checked if the data from the Turkish-Dutch and Moroccan-Dutch children could be pooled. A MANOVA run on accuracy and fluency outcomes revealed no significant differences between the two bilingual groups ($F(6,30) = 1.6$, $p = .18$). Therefore, the Turkish-Dutch and Moroccan-Dutch children were taken together as one bilingual group for all further analyses. To compare the monolingual and bilingual children with regard to their accuracy and fluency we conducted a MANCOVA with language group (bilingual/monolingual) as the independent variable, error rates and disfluency rates as dependent measures and SES as covariate. Mean scores and standard deviations for error rates and disfluency rates are presented in Table 2.

Table 2

Mean scores and standard deviations for measures of speech production (in %).

	N	Error rates	Disfluency rates
Monolinguals	40	3.4 (2.1)	3.9 (1.8)
Bilinguals	40	9.5 (4.3)	5.8 (3.5)

The MANCOVA showed significant differences between the language groups: $F(2,75) = 26.5$, $p < .01$, Wilk's $\Lambda = 5.9$, $\eta_p^2 = .41$. Post-hoc comparisons showed that the bilingual children had higher error rates: $F(1,79) = 41.6$, $p < .01$, $\eta_p^2 = .35$, as well as higher disfluency rates: $F(1,79) = 9.2$, $p < .01$, $\eta_p^2 = .11$, as compared to the monolingual children. The magnitude of the group difference was larger for the error rates than for disfluency rates, as indicated by a larger effect size for error rates. As distributions of both measures deviated from normality, we also conducted non-parametric analyses (Mann-Whitney *U*), which revealed the same patterns and confirmed the significant outcomes of the MANCOVA.

Predictors of accuracy and fluency in monolingual and bilingual children

Next, we compared the two groups with regard to vocabulary, grammar, PSTM and WM. Table 3 gives an overview of average scores for the two groups of children.

Table 3

Mean scores and standard deviations for vocabulary (PPVT), grammar (TAK), PSTM (nonword repetition) and WM (backward digit span) for both groups of children

	N	PPVT	TAK	NWRT	BWDS
Monolinguals	40	109.8 (12.9)	45.4 (10.0)	79.7 (7.2)	12.3 (3.6)
Bilinguals	40	96.2 (11.4)	30.0 (12.0)	74.1 (7.0)	11.7 (3.1)

PPVT = Peabody Picture Vocabulary Test; TAK = Taaltoets Alle Kinderen [Language test all children]; NWRT = NonWord Repetition Test, BWDS = BackWard Digit Span

A MANCOVA with language group as independent variable, SES as covariate and PPVT, TAK, non-word repetition and backward digit span as dependent measures showed a significant main effect of language group: $F(4,70) = 7.7$, $p < .01$, Wilk's $\Lambda = .70$, $\eta_p^2 = .31$. Follow-up analyses demonstrated that the monolingual children outperformed the bilingual children on vocabulary: $F(1,76) = 12.2$, $p < .01$, $\eta_p^2 = .14$, grammar: $F(1,76) = 26.4$, $p < .01$, $\eta_p^2 = .27$, and PSTM: $F(1,76) = 7.7$, $p < .01$, $\eta_p^2 = .10$, but not on WM ($p = .57$, $\eta_p^2 = .004$).

To study relations between language abilities (vocabulary and grammar) and speech production, as well as general processing abilities (PSTM and WM) and language production, we computed correlation coefficients for the two language groups (Table 4). Spearman correlations were used because the distributions of error and disfluency rates deviated from normality.

Table 4

Spearman correlation coefficients between language and processing measures and measures of accuracy and fluency in the speech of the monolingual and bilingual children.

	Monolinguals		Bilinguals	
	Error rates	Disfluency rates	Error rates	Disfluency rates
PPVT	-.37*	-.11	-.52**	-.004
TAK	-.44**	-.21	-.62**	-.11
NWRT	-.14	-.25	-.27	-.32 (*p* = .05)
BWDS	-.22	-.11	-.11	-.28

*$p < .05$; **$p < .01$; PPVT = Peabody Picture Vocabulary Test; TAK = Taaltoets Alle Kinderen [Language test all children]; NWRT = NonWord Repetition Test, BWDS = BackWard Digit Span

The correlation coefficients revealed similar patterns for monolingual and bilingual children. In both groups, the error rates showed significant negative correlations with both language measures (vocabulary – PPVT – and grammar – TAK), indicating that better language knowledge is associated with fewer errors in language production. Neither PSTM nor WM was significantly related to error rates in any of the two groups. Disfluency rates were negatively correlated with PSTM (NWRT) in the bilingual group, but this correlation was only marginally significant (p = .05). None of the other measures showed any significant correlations with disfluency rates in either of the groups.

We then entered the two language knowledge measures (vocabulary, grammar) and the two processing measures (PSTM, WM) into regression analyses to test whether they significantly predicted error and disfluency rates. With regard to error rates, regression analyses with both language measures and both processing measures as predictor variables predicted a significant amount of variation in both language groups. In the monolingual group, only grammar was a significant predictor of error rates, whereas in the bilingual group, both vocabulary and grammar significantly predicted error rates. PSTM and WM did not predict error rates in any of the groups. In the monolingual group, the regression model explained 20.3% of the variance for error rates; in the bilingual group the explained variance was 42.7%. Table 5 gives an overview of the results for error rates.

Table 5

Summary of a multiple linear regression analysis for variables predicting error rates in monolingual and bilingual children.

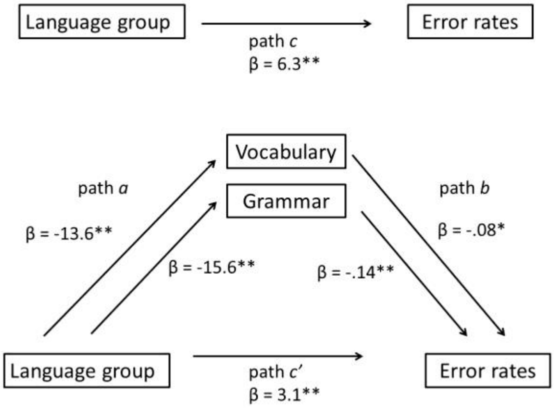
	Monolinguals				Bilinguals			
Variable	*B*	*SE B*	*β*	*p*	*B*	*SE B*	*β*	*p*
PPVT	-.02	.03	-.14	.44	-.16	.06	-.41	**.005**
TAK	-.14	.06	-.61	**.02**	-.17	.06	-.46	**.004**
NWRT	.04	.07	.14	.55	.05	.10	.08	.61
BWDS	.11	.13	.17	.42	-.14	.21	-.09	.51
R^2			.29				.49	
F			3.4*				7.9**	

*p < .05; **p < .01; PPVT = Peabody Picture Vocabulary Test; TAK = Taaltoets Alle Kinderen [Language test all children]; NWRT = NonWord Repetition Test, BWDS = BackWard Digit Span

The findings that language knowledge measures predicted error rates in the children and that the bilingual children had significantly lower language knowledge scores than the monolingual children may suggest that higher error rates in the bilingual group than in the monolingual group stem from less developed language knowledge. To investigate this interpretation, a mediation analysis was conducted in which language group (monolingual, bilingual) was entered as independent variable, vocabulary and grammar scores as mediators and error rates as outcome variable (see Figure 1). We applied a multiple mediation analysis, using the PROCESS application for SPSS (Hayes, 2013).

Figure 1

Mediation Model for Error Rates



Path *c* shows the total effect of language group on error rates in the unmediated model. Paths *a*, *b* and *c'* refer to the mediation model. Paths *a* represent the effects of language group on the mediators (vocabulary, grammar). Paths *b* show the effects of vocabulary and grammar on the dependent variable (error rates) and path *c'* shows the direct effect of language group on the dependent variable (error rates), when the mediators are held constant. All paths were significant, which satisfies the requirements for mediation (Baron & Kenny, 1986). The direct effect of language group on error rates was significant, 95% CI [1.5, 4.7]. The indirect effects of both mediator variables were also significant: vocabulary 95% CI [.14, 2.7]; grammar 95% CI [1.0, 3.5], the number of bootstraps was 5,000 (bias-corrected). Consequently, both vocabulary and grammar can account for part of the effect of language group on error rates, which is also reflected by the coefficient of *c'* being closer to 0 than that of *c*. 17% of the total effect of language group on error rates can be explained by vocabulary scores and 33.8% of the total effect can be explained by grammar skills. 49.2% of the total effect of language group on error rates is directly related to language group.

Regression analyses for disfluency rates showed non-significant models in both language groups, in line with the non-significant correlations. PSTM predicted the disfluency rates in the bilingual group, but the explained variance of the regression model in the bilingual group was low (8.9%). Table 6 gives an overview of the results for disfluency rates.

Table 6

Summary of multiple linear regression analysis for variables predicting disfluency rates in monolingual and bilingual children.

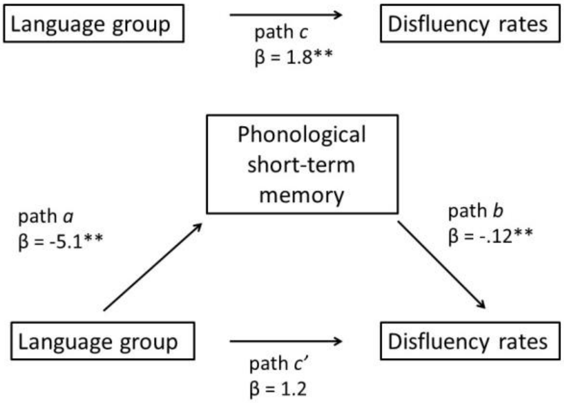
	Monolinguals				Bilinguals			
Variable	*B*	*SE B*	*β*	*p*	*B*	SE B	β	p
PPVT	-.03	.03	-.19	.33	.02	.05	.07	.69
TAK	.01	.05	.03	.90	.04	.05	.14	.46
NWRT	-.12	.06	-.48	.05	-.22	.09	-.46	**.02**
BWDS	.10	.11	.20	.38	-.05	.20	-.05	.80
R^2			.18				.19	
F			1.8				1.9	

**p* < .05; ***p* < .01; PPVT = Peabody Picture Vocabulary Test; TAK = Taaltoets Alle Kinderen [Language test all children]; NWRT = NonWord Repetition Test, BWDS = BackWard Digit Span

The effect of PSTM on disfluencies in bilingual children coupled with the observation that bilingual children produced significantly more disfluencies than the monolingual children, prompted us to conduct a mediation analysis to investigate if group differences for disfluency rates could be explained by differences in PSTM, at least in part. Language group was entered as independent variable, disfluency rates as dependent variable, and PSTM memory as mediator variable. Path *c* shows the total effect of language group on disfluency rates. Path *a* represents the effect of language group on the mediator variable PSTM (see Figure 2). Path *b* shows the effect of PSTM on the dependent variable disfluency rates and path *c'* shows the direct effect of language group on disfluency rates, when PSTM is held constant.

Figure 2

Mediation Model for Disfluency Rates



The effect of PSTM on disfluency rates was significant, 95% CI [.19, 1.4]. However, the direct effect of language group was not significant, 95% CI [-.11, 2.4], as indicated by the confidence interval which includes 0. Thus, when controlling for PSTM, the significant difference between monolingual and bilingual children for disfluency rates is no longer present; the observation that the bilingual children produced more disfluencies than their monolingual peers can be attributed to bilingual children’s lower PSTM outcomes.

Discussion

This study investigated language production in monolingual and bilingual Turkish-Dutch and Moroccan-Dutch 5- to 7-year-old children in the Netherlands. The first aim of the study was to examine whether children who learn Dutch as L2 differ in their Dutch language production from monolingual Dutch children. In particular, our question was whether Turkish-Dutch and Moroccan-Dutch children would show more errors and disfluencies in their oral language production compared to monolingual Dutch children. The second aim of this study was to gain a better understanding of factors potentially influencing the accuracy and fluency in the language production of monolingual and bilingual children. We wanted to know whether language knowledge (vocabulary, grammar), as well as processing resources (PSTM, WM) are related to accuracy and fluency in the language production of children and whether relations are different for monolingual and bilingual children.

Regarding accuracy, we hypothesized that – related to the expected lower Dutch language proficiency in the bilingual children as compared to the monolingual children – the bilingual children would produce more errors than the monolingual children. As expected, we found that the bilingual children had higher error rates than the monolingual children, which is in line with previous research (Paradis, 2005). Furthermore, grammar skills predicted accuracy in both language groups. This is not surprising as the majority of errors were syntactic and morphological errors and the grammar test focused on these two aspects. In the bilingual group, the vocabulary test predicted errors rates as well. This may be related to more lexical errors in the bilingual group, but also to lexical and grammatical development being more closely related in the bilingual group than in the monolingual group. The bilingual children represent an earlier stage in their grammatical development of Dutch and lexical and grammatical development are particularly closely-related in early language acquisition (Marchman et al., 2004). In line with our expectations, the effect of language group on error rates was mediated by vocabulary and grammar knowledge, which means that group differences for error rates in language production can be partly attributed to differences in children’s vocabulary and grammar level. However, there was still a significant effect of language group on error rates that could not be explained by vocabulary and grammar knowledge, indicating that other factors affect accuracy in the bilingual sample as well, for example lexical access, as suggested by Ivanova and Costa (2008).

Regarding fluency, our study showed that the bilingual children produced more repetitions and revisions than the monolingual children. At first sight, this is different from previous work on Spanish-English bilingual children, which did not show differences between bilingual and English monolingual children for fluency when repetitions and revisions were collapsed (Bedore et al., 2006; Fiestas et al., 2005). However, mediation analyses indicated that the effect of language group on fluency outcomes disappeared when PSTM was controlled for. Disfluency rates were not related to vocabulary or grammar knowledge in either of the two groups. This is different from studies on adult L2 learners, which found relations between language proficiency and fluency (Gilabert & Muñoz, 2010; Hilton, 2008). Those studies measured fluency in terms of speech rate rather than the number of disfluencies. Moreover, other factors than language proficiency, such as speaking rate or content are likely to influence fluency in children (Yaruss et al., 1999). The higher number of disfluencies in the bilingual group compared to the monolingual group cannot be attributed to the lower scores on the vocabulary and grammar tasks in the bilingual group, as disfluency rates were not related to language proficiency in our study, but the higher numbers of disfluencies in the bilingual children could be caused by less automatized Dutch speech production compared to monolingual children who speak only Dutch. Another explanation is that while producing language in Dutch, the bilingual children may experience cross-language competition from their other language (Costa et al., 1999). This competition may have a negative influence on bilingual children's fluency when speaking in the L2, similar to what has been found for adult L2 learners (Bergman et al., 2015).

In addition to studying relations between language-specific knowledge (vocabulary and grammar) of Dutch and accuracy and fluency in children's oral language production, this study aimed to investigate to what extent processing resources, specifically PSTM and WM, are related to accuracy and fluency in the language production of bilingual and monolingual children. We found that PSTM predicted the frequency of disfluencies in the bilingual group, but not in the monolingual group. This asymmetry may be related to lexical access, which is related to disfluencies (Bergman et al., 2015), but also to PSTM. Kaushanskaya and colleagues (2012) found that vocabulary retrieval and PSTM skills were strongly linked in bilinguals, but not in monolinguals. The effect of language group on disfluency rates was moreover mediated by PSTM: when controlling for PSTM the effect of language group on disfluency rates was no longer significant.

WM was not related to accuracy or fluency, in line with a study by Mizera (2006) with adult L2 learners, but other research with adult L2 learners found relations between WM and either both accuracy and fluency or only fluency in adults L2 learners (Daneman, 1991; Fortkamp, 1999; Gilabert & Muñoz, 2010; Guara-Tavares, 2009; Mota, 2003). Most of the latter studies made use of a speaking span tasks, which are more dependent on language abilities than the backward digit span task that we used. It is therefore possible that reported correlations represent relations between language production and language proficiency rather than WM (Gilabert & Muñoz, 2010), although Trebits and Kormos (2008) also used a backward digit span and did observe relationships between WM and fluency. We suggest that in future research, it would be useful to include different measures of accuracy and fluency, as well as different measures of WM. Such a design would inform us whether relations with accuracy and fluency are stronger for speaking span tasks than for less language-dependent tasks, such as the backward digit span. A major limitation of our study is the fact that we were only able to study the spontaneous speech in the majority language, i.e., the L2, of the bilingual children. In a follow-up study, it would be insightful to study to what extent accuracy and fluency in the children's heritage language are similar to the performance of Dutch monolingual children in their L1. Furthermore, examining whether the relationship between PSTM and fluency found for the L2 is also evident in the L1 of the bilingual children, would provide important additional information about the cognitive processes involved during bilingual language production.

In conclusion, 5- to 7-year-old children of Turkish and Moroccan descent who are L2 learners of Dutch made more errors and produced more disfluencies in Dutch language production than their monolingual Dutch age-peers. It is important to know that both accuracy and fluency can be compromised in typically developing bilingual children to prevent overdiagnosis, as errors and disfluencies may also be indicators of an innate language impairment (e.g., Guo et al., 2008; Navarro-Ruiz & Rallo-Fabra, 2001). Moreover, language production problems may have repercussions for academic achievements. Regarding the underlying causes of children's language production errors, the results of this study demonstrated that less knowledge of Dutch explained in part why the bilingual children produced more errors, whereas PSTM had no effect on children's language production errors. Language knowledge, on the other hand, did not affect fluency, while less PSTM capacity was associated with more disfluencies. The relation between PSTM emerged for the bilingual children, and not for monolingual children. Moreover, when PSTM was controlled, the bilingual children produced the same number of disfluencies as their monolingual peers. WM had no effect on accuracy and fluency in language production. We suggest that future research should investigate relationships between PSTM, lexical access in relation to cross-language competition, and disfluencies in bilingual children. Additional research with different WM tasks is needed to determine whether relations between WM and language production found for adult L2 learners extend to bilingual children.

Chapter 4

No bilingual benefits despite relations between language switching and task switching

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Abstract

Previous research has shown that bilingual children outperform monolinguals on tasks testing cognitive control. Bilinguals' enhanced cognitive control is thought to be caused by the necessity to exert more language control in bilingual compared to monolingual settings. Surprisingly, between-group research of cognitive effects of bilingualism is hardly ever combined with within-group research that investigates relationships between language control and cognitive control. The present study compared 27 monolingual Dutch and 27 bilingual Turkish-Dutch children matched on age and fluid intelligence on their performance in a nonverbal switching task. Within the group of bilinguals, the relationship between nonverbal switching and language switching was examined. The results revealed no between-group differences on nonverbal switching. Within the bilingual sample, response times in the language switching and nonverbal switching tasks were related, although no relationships were found between accuracy, switch cost and mixing cost on both tasks. The results support the hypothesis that children utilize domain-general cognitive control in language switching, but this relationship does not entail that bilinguals have better cognitive control than monolinguals.

Introduction

An important aspect of growing up bilingually is learning to control one's languages. For example, some bilingual children grow up in single-language contexts where one language is used in one environment and the other language in another environment, as is the case for children who grow up in families where the home language differs from the language used at school. At home, these children need to suppress the language used at school and at school they need to suppress the home language. Other children grow up in dual-language contexts in which both languages are used in the same environments, but typically with different speakers (Green & Abutalebi, 2013), as in bilingual families characterized by a one-parent-one-language pattern. In such a situation, children suppress one of their languages while interacting with one parent and suppress their other language when they interact with their other parent (Verhagen et al., 2017). Both single- and dual-language contexts are common (de Houwer, 2007) and exemplify that bilingual children often need to inhibit one of their languages and resist interference from this language.

Theoretical accounts of bilingual language use, e.g., the Inhibitory Control Model (Green, 1998) or the Adaptive Control Hypothesis (Green & Abutalebi, 2013), suggest that the mechanisms underlying bilingual language control draw on domain-general cognitive control processes, which are also used when switching between different nonverbal cognitive tasks. Because bilingual speakers engage their cognitive control processes frequently to control their language use, the cognitive control processes of bilinguals may be optimized (Bialystok & Craik, 2010; Stocco et al., 2014), leading to cognitive control benefits for bilinguals. In the last decades, the hypothesis that bilingual children outperform their monolingual peers on cognitive control has been explored extensively by comparing bilingual and monolingual children on tasks that test specific cognitive control functions such as attention, switching, and working memory. Many of these studies confirmed the hypothesis that the bilingual children have cognitive control advantages (e.g., Barac & Bialystok, 2012; Martin-Rhee & Bialystok, 2008; Morales et al., 2013; for review studies, see Adesope et al., 2010; Barac & Bialystok, 2011; Hilchey & Klein, 2011). The results of individual studies are not unanimous, however, as there are also studies in which no differences were observed (e.g., Duñabeitia et al., 2014; Morton & Harper, 2007; Paap et al., 2015). It has been argued that bilingual effects on executive functions are more prominent in children and elderly people (Bialystok, 2015), although there are also studies that do not find such effects for these age groups (Duñabeitia et al., 2014; Lehtonen et al., 2018). The growing number of studies with null results in this field has created doubts regarding the robustness of effects showing bilingual advantages in executive functions and suggests that effects might depend on specific aspects of the bilingual experience, for example the frequency of language switching in real life (Barbu et al., 2018; Verreyt et al., 2016).

Studies on the relationship between cognitive control and language control within bilinguals and studies that compare cognitive control across bilinguals and monolinguals are typically part of two separate lines of research. The main goal of this study is to combine these lines of research and conduct both a between- and within-group study. Combining the two types of studies is particularly important in light of the variable findings regarding cognitive effects of bilingualism. What we wanted to know, was: Does the presence of a bilingual advantage in a group of bilinguals go hand-in-hand with the expected cross-domain link between language control and cognitive control in the same group of bilinguals and, vice versa, does the absence of a bilingual advantage coincide with the absence of a cross-domain relation? Finding a difference in cognitive tasks between bilinguals and monolinguals without a relationship between language control and cognitive control within the group of bilinguals could suggest that other variables, such as demographic differences (e.g., SES) or task-specific effects are responsible for a bilingual advantage (Paap et al., 2015). Failing to find a between-group difference in the presence of a significant within-group relation demonstrates that the absence of cognitive effects does not necessarily imply the absence of cross-domain links and may suggest that any training effects in the bilinguals are masked by other variables. To investigate these different scenarios, the current study investigated the cognitive switching function. Switching between languages has been found to be effortful (Kohnert et al., 1999) which can be a basis for practice effects (Morton & Harper, 2007) that, in turn, lead to cognitive effects in nonverbal switching.

One type of switching task that has been used repeatedly to study effects of bilingualism on cognitive abilities is a color/shape switching task (e.g., Prior & MacWhinney, 2010; Stasenko et al., 2017), a paradigm in which participants have to identify either the color or the shape of an object presented on a computer screen depending on which rule is cued to be active. After completing single-task blocks in which participants have to respond either *only* to the color or *only* to the shape of an object, they engage in a task switching block. In that block, for each trial the relevant aspect (color or shape) is indicated by a cue and participants have to switch between trials in which they respond to the color and trials in which they respond to the shape of an object. As switching between languages can be regarded as a specific kind of switching, this task appears to be of relevance to bilingual language use, tapping into the domain-general mechanisms that have been claimed to underlie language switching.

Effects of bilingualism on nonverbal switching can be determined by looking at two different dependent variables, which are thought to represent different types of cognitive control, namely switching and mixing cost (Braver et al., 2003). A cued switching test provides not only information about accuracy and response times of switching between different tasks but also allows for calculating different processing costs related to task-switching. The difference in response times between trials where the task changes from responding to color to responding to shape, or vice versa, ('switch trials') and trials where there is no change of task ('repeat trials') is called *switching cost*. The difference in response times between repeat trials in a switching block and trials in a single task block (*only* respond to color or *only* respond to shape) is called *mixing cost.* It has been suggested that switching costs draw on reactive control processes (Braver et al., 2003), used for stimulus-driven goal reactivation and interference resolution (Braver, 2012), whereas mixing costs may reflect proactive control processes (Braver et al., 2003), where sustained attention is used to maintain goal-relevant information.

A recent review article by Paap and colleagues (2016) focuses on comparisons between bilingual and monolingual groups on such switching tests and shows that although some studies have reported a bilingual advantage on nonverbal task switching (Prior & MacWhinney, 2010; Prior & Gollan, 2011; Barac & Bialystok, 2012; Wiseheart et al., 2014), other studies yield no significant differences (De Bruin et al., 2015; Paap & Sawi, 2014; Prior & Gollan, 2013; Tare & Linck, 2011). These contrasting findings could be related to a more general issue of studies that make use of a between-group design that compares bilinguals and monolinguals, namely, the difficulty of finding purely monolingual controls (Paap et al., 2016). This issue should be less of a problem when comparing bilingual and monolingual groups of children instead of adolescents or adults, as children who are raised monolingually have often not yet been systematically exposed to a second language (L2) during the first years of elementary school. Another potential advantage of studying effects of bilingualism on cognitive control in children, as compared to adults, is that they are still in the early stages of their cognitive development (Carlson, 2005) and therefore are more likely to show variability in cognitive skills than for example young adults who are at the peak of their cognitive abilities (Bialystok et al., 2005; Bialystok et al., 2014; Hilchey & Klein, 2011). Interestingly, the only study in the review by Paap and colleagues (2016) that tested task-switching in children reports better switching abilities for three groups (Chinese-English, French-English, Spanish-English) of bilingual children as compared to monolingual children (Barac & Bialystok, 2012).

The number of studies that compare bilingual and monolingual children on a color/shape switching task is limited, but there are studies (e.g., Bialystok, 1999) that use the dimensional change card sorting task (DCCS) (Zelazo, 2006), which is a related but simpler task. In the DCCS task children have to sort cards that show objects in different colors, first according to one dimension (e.g., color), and subsequently according to the other (e.g., shape). In contrast to color/shape switching tasks, the DCCS typically does not include a block in which both sorting rules are mixed, which makes it impossible to derive switching costs and mixing costs. In the DCCS, the ability of children to switch between rules is usually measured by the accuracy scores of the post-switch block, but some computerized versions of the task also measure response times. Whereas most 3-year-olds preserve the first sorting rule when instructed to sort according to a new rule, by the age of 5 most children are able to switch to the new sorting rule without error (Zelazo, 2006).

Bilingual children from different age groups have been found to perform more accurately in the post-switch phase of the card sorting task than monolingual children (Bialystok, 1999 for 3-4 and 5-6 year-olds; Bialystok & Martin, 2004 for three studies with 4-5 year-olds), but some studies report equal performance of bilingual and monolingual children (Gathercole et al., 2014 for accuracy; Yang & Lust, 2004) or even cases where monolingual children outperformed the bilingual groups (Gathercole et al., 2014 for response times). The similar performance of bilingual and monolingual children (mean age: 4.8) in the study by Yang and Lust (2004) may have been caused by ceiling effects for accuracy scores in a post-switch phase. Merely comparing accuracy scores of a post-switch phase might thus not be sufficiently sensitive in groups of children who are already able to switch to a new sorting rule. In such cases, a more complex switching task, such as the cued color/shape switching tasks that has often been used in studies with (young) adults (e.g., Prior & MacWhinney, 2010), is needed. Next to accuracy scores and response times, such a task allows for the calculation of switch and mixing costs. To the best of our knowledge, only Barac and Bialystok (2012) have reported switching costs and mixing costs in a study with bilingual children. Our study will therefore not only compare bilingual and monolingual children for accuracy and response times on task switching but also include switching costs and mixing costs as additional measures of domain-general cognitive control and thus expand our understanding of the effect of (early) bilingualism on cognitive control.

The hypothesis that bilingual language use draws on domain-general control mechanisms has also been tested in studies that looked for relationships between measures of bilingual language control and cognitive control. This line of research focuses on within-group analyses instead of between-group analyses. To test the relation between language control and cognitive control, studies have used different approaches, with diverging results. A number of studies provide evidence for a relationship between bilingual language control and performance on tasks tapping into general cognitive control processes, such as the Flanker task (Festman & Münte, 2012), the Go/NoGo task (Rodriguez-Fornells et al., 2005) and task switching tasks (Declerck et al., 2017; Prior & Gollan, 2011, 2013). Neuroimaging studies moreover suggest that brain areas known to be related to cognitive control are also active during bilingual language use (Abutalebi et al., 2013; Guo et al., 2011; Luk et al., 2012; Weissberger et al., 2015), suggesting that there is overlap between mechanisms of bilingual language control and general cognitive control. However, several studies did not find relationships between language switching and tasks of general cognitive control, such task-switching tasks (e.g., Branzi et al., 2016; Calabria et al., 2015; Calabria et al., 2011), a flanker task (Declerck et al., 2019) or a Simon task (Jylkkä et al., 2018). Other evidence suggests that the frequency of language switching in real life affects performance on domain-general cognitive measures. Bilinguals who frequently switch between their languages were found to have better interference control (Verreyt et al., 2016) and better cognitive flexibility (Barbu et al., 2018) than bilinguals who switch less frequently.

A possible explanation for the absence of a relationship between language control and cognitive control in many behavioral studies is that these studies tested adults who have been functioning in bilingual settings for many years. Especially for bilingual language use in situations where code-switching is very common and bilinguals use words from both languages without paying attention to the target language, demands on language control mechanisms are likely to be smaller than in situations where one of the languages has to be (partly) inhibited (Green & Abutalebi, 2013), but also language switching in general may be more automatized in experienced bilingual adults and draw less on general cognitive control mechanisms than in bilinguals who have fewer years of bilingual experience, such as bilingual children.

To date, one study has investigated a potential interplay between bilingual language control and general cognitive control in bilingual children. In a recent study with 5- to 7-year-old Spanish-English bilingual children, Gross and Kaushanskaya (2016) tested to what extent children's performance on a cued color/shape switching task could predict their performance on a cued language switching task. They found that accuracy in nonverbal task switching predicted both naming speed and the number of cross-language intrusion errors (responses given in the non-target language) on cued language switching, indicating that children with better cognitive control were faster and made fewer errors during language switching than children with less developed cognitive control abilities. Whereas task switching accuracy predicted language intrusion errors in both languages, the relationship between task switching and naming speed was only found for the children's non-dominant language, which – according to the authors – may be caused by the stronger inhibition of the dominant language. Moreover, naming speed on task switching predicted naming speed on language switching. However, similar to studies with adult bilinguals (Branzi et al., 2016; Calabria et al., 2011; Calabria et al., 2015;), Gross and Kaushanskaya (2016) did not find any correlations with regard to switching and mixing costs between the two tasks.

The aim of present study was to obtain a better understanding of the interplay between bilingual language control and domain-general cognitive control in bilingual children by comparing nonverbal task switching across bilingual and monolingual children and investigate within the bilinguals, relations between language switching and nonverbal task switching. Specifically, we investigated whether bilingual advantages in nonverbal task switching previously found in one study (Barac & Bialystok, 2012) can be replicated. In addition, we expected that within the bilingual group, language switching abilities would be positively related to nonverbal task switching abilities. This association is possible between accuracy scores and response times from both tasks, as well as switching and mixing costs from both tasks. Investigating this association allows us to test the underlying assumption that bilingual language use is related to cognitive control and a possible consequence, namely that bilinguals have enhanced cognitive control. In so doing, we combined two lines of research that are conceptually closely related, but have rarely been combined in empirical research.

The bilingual sample in the present study consisted of Turkish-Dutch bilinguals. Children from Turkish-speaking families in the Netherlands are particularly suitable for studying relationships between bilingual language control and cognitive control. In their home environment speakers commonly use both languages, whereas the schools of these children are strictly single-language environments where only Dutch is used. This means that the children frequently find themselves in communicative situations that require a high amount of bilingual language control (Green & Abutalebi, 2013). In previous research, it was moreover found that Turkish-Dutch 5- and 6-year-old children showed cognitive benefits in working memory tasks, if socioeconomic status (SES) and language proficiency were statistically controlled (Blom et al., 2014). A similar impact of SES and verbal ability, but with respect to inhibition tasks, was found in research with Spanish-English bilinguals who were 6 years old, on average (Carlson & Meltzoff, 2008). In line with previous studies that provide evidence for better nonverbal switching abilities in bilingual children (Barac & Bialystok, 2012; Bialystok, 1999; Bialystok & Martin, 2004), we also expected better task switching performance of the bilingual Turkish-Dutch children compared to monolingual

Dutch children. Based on previous research on working memory and inhibition (Blom et al., 2014; Carlson & Meltzoff, 2008), we expected that bilinguals' enhanced task switching would surface if SES and verbal ability are controlled.

Method

Participants

The study included 54 children divided into two groups: 27 Turkish-Dutch bilinguals and 27 Dutch monolinguals. Children were regarded monolingual if Dutch was the only language spoken in the family. For a child to be assigned to the bilingual group at least one of the child's parents had to speak Turkish in the home environment. At the time of testing, all children were between 5 and 8 years old (mean age = 7.5). We matched the two groups at child level for age and nonverbal intelligence scores (NVIQ) (Table 1). Non-verbal intelligence was measured with the short version of the Wechsler Nonverbal-NL (Wechsler & Naglieri, 2008). There was no significant age difference between the groups ($F(1,54) = .22$, $p > .05$, $\eta_p^2 = .004$) and no significant difference between the groups in NVIQ ($F(1,54) = .006$, $p > .05$, $\eta_p^2 < .001$). We furthermore aimed to create groups that were comparable on socioeconomic status (SES) and Dutch receptive vocabulary outcomes. SES was indexed by the average educational level of both parents of the child, based on the Questionnaire for Parents of Bilingual Children (PaBiQ; Tuller, 2015). Receptive vocabulary in Dutch was measured with the Peabody Picture Vocabulary Test (PPVT-III-NL; Schlichting, 2005). However, despite our efforts, SES did differ significantly across the groups ($F(1,54) = 7.1$, $p = .01$, $\eta_p^2 = .12$), reflecting lower socioeconomic positions of Turkish families in the Netherlands as compared to native Dutch (monolingual) families. There was also a significant difference between the two groups for Dutch receptive vocabulary scores: $F(1,54) = 16.7$, $p < .001$, $\eta_p^2 = .24$, indicating higher scores for the monolingual children than for the bilingual children, as has been found in previous studies (Bialystok et al., 2010).

Table 1

Average age in months, nonverbal IQ scores, socioeconomic status and Dutch receptive vocabulary per group

	N	Age (SD)	NVIQ (SD)	SES (SD)	PPVT (SD)
Monolinguals	27	91.5 (6.0)	101.9 (12.3)	6.1 (2.1)	105.6 (10.1)
Bilinguals	27	90.5 (9.4)	102.1 (13.2)	4.6 (2.0)	91.4 (14.9)

Note: NVIQ = nonverbal intelligence standardized score; SES = socioeconomic status, average educational level of both parents measured on a nine-point scale; PPVT = Peabody Picture Vocabulary Test, receptive Dutch vocabulary score converted to standardized age-corrected normative scores ($M = 100$, $SD = 15$).

Table 2 gives an overview of the proportions of language use (Dutch, Turkish) in the home environment of the bilingual children and language proficiency in both languages. Information on language use at home was collected with the PaBiQ (Tuller, 2015), Dutch language proficiency scores were based on the Dutch PPVT, and Turkish language proficiency scores were based on a Turkish translation of the PPVT (see materials for more information). The receptive vocabulary scores in Table 2 show the percentages of correct items.

Table 2

Proportion of language use (percentage of time, with SD and range) of the bilingual children in the home environment and % accuracy for receptive vocabulary in the two languages (with SD and range)

	Language use at home in % (SD)	Range	Receptive vocabulary in % correct (SD)	Range
Dutch	41.6 (10.8)	21.4 – 66.7	50.6 (14.0)	20.0 – 72.5
Turkish	58.4 (10.8)	33.3 – 78.6	58.0 (12.2)	27.5 – 77.5

On average, Turkish was used more often than Dutch ($t(22) = 3.7$, $p = .001$). According to the parental questionnaire data, 70% of the families used Turkish more frequently than Dutch at home, 17% used Dutch more frequently than Turkish and 13% used the two languages equally often. In addition, the majority of parents (87%) reported that they mixed the two languages in the home environment. On average, receptive vocabulary scores are higher for Turkish than for Dutch ($t(26) = 2.5$, $p = .02$), but the ranges and standard deviations show that there is much variation within this group. It is important to note that all of these children had started elementary school, where Dutch is the only language of instruction, at age 4. Thus, whereas the children are in a dual-language situation at home, they are in a single-language situation at school.

Background information

Language use at home. Information on bilingual language use at home was gathered by using a parental questionnaire based on the PaBiQ (Tuller, 2015). Turkish-Dutch bilingual assistants administered the questionnaire during a telephone interview with one of the child's parents. Dutch language use was measured as frequency with which a child was addressed in Dutch in the home environment and tested by a single question. This information was collected for the mother, father, other caregivers and siblings on a five-point scale ranging from 0 = *never* to 4 = *always*. The same measure was applied for use of Turkish. Information regarding other caregivers was only included when these individuals were present in the home environment at least several times per week. The frequency of language use in the home environment was calculated for each language.

Language proficiency. Receptive vocabulary size was assessed by the Dutch Peabody Picture Vocabulary Task (PPVT-III-NL; Schlichting, 2005). The PPVT is a standardized receptive vocabulary test designed for the age range from 2 years and 3 months up to 90 years and contains 204 items divided over 17 sets. Each set consists of 12 items and the level of difficulty increases throughout the sets. In this task, children heard a stimulus word and had to choose the correct referent out of four pictures. The PPVT-III-NL was administered and scored according to the official guidelines: the starting set was determined by a child's age and the task was terminated after a child produced nine or more errors within one set. Raw scores were converted to standardized scores based on age-corrected norms. These standardized scores were used for the matching of bilingual and monolingual children. For the bilingual children, we also administered a Turkish version, which was a translation of the Dutch task for which permission was obtained from the publisher (Blom, 2019). The translation of the task was done by a bilingual speaker of Turkish and Dutch. Turkish items that were cognates or – according to the bilingual translator – not comparable to the Dutch item with regard to difficulty were deleted, which resulted in a task with 8 items per set instead of 12. To compare vocabulary skills in both languages, we calculated the percentage of correct answers for all the items that were used in both the Dutch and the Turkish versions of the task as presented in Table 2.

Switching tasks

Language switching. Language switching was measured in the bilingual group with a cued picture naming task that was developed with the software package E-Prime 2.0 Standard (Psychology Software Tools, Pittsburgh, PA). The task included 32 colored pictures of objects, selected from a picture database (Rossion & Pourtois, 2004). Pictures were chosen to refer to highly frequent concrete Dutch nouns (based on SUBTLEX-NL; Keuleers et al., 2010) that were all included in a list of words that children in the Netherlands are expected to be familiar with in kindergarten (Basiswoordenlijst Amsterdamse Kleuters (BAK); Mulder et al., 2009). This was done so that the task would test the children's ability to rapidly access words and not their knowledge of words. To ensure that the level of difficulty of naming these words in Turkish was comparable to naming these words in Dutch, only pictures that native speakers rated as 'very easy' were included. None of the words for pictures in the task were cognates between Dutch and Turkish. All items in the task were divided into lists by first creating pairs of words that were from the same semantic category, e.g., 'animal', and were comparable with regard to word frequency and word length, and then assigned the two words of each pair to different lists. For example, the word 'cat' in list A would be matched with the word 'dog' in list B. This resulted in two comparable word lists with 14 different items each for each language (see Appendix 1). Each of the single language blocks consisted of two practice trials and 28 test trials. Children either started with Dutch or Turkish. The order of the two languages was counterbalanced among the participants. The order of the two word lists remained the same for the single language blocks so that children who started with Dutch named word list A in Dutch followed by word list B in Turkish and children who started with Turkish named list A in Turkish and list B in Dutch. The mixed language block always followed the two single language blocks and consisted of four practice trials and 56 test trials which consisted of 28 trials per language. The order of the trials was fixed. The target language changed every 2 to 5 trials. The target language stayed the same as in the previous trials for 75% of the trials and changed to the other language for 25% of the trials. The language switching task was presented on a 15-inch laptop screen. The two single language blocks introduced two different interlocutors, a cartoon face of girl and a cartoon face of a boy. The girl was introduced as a monolingual speaker of Dutch and gave instructions for the Dutch language block. The face of the boy was introduced as a monolingual speaker of Turkish and explains the Turkish single language block. The instructions for the mixed language condition were explained both in Dutch (by the girl) and in Turkish (by the boy).

The purpose of introducing the two faces was to cue the language of the test condition during the task. The girl's face served as language cue for Dutch and the boy's face was the language cue for naming in Turkish. The children were familiarized with the language cues during the single language blocks, where they were the same for all trials of a block. In the mixed language condition children had to respond either in Dutch or in Turkish, depending on the cue that was located above the target item. By introducing two interlocutors that differed in the language in which they had to be addressed, the task was assumed to better resemble a real-life mixed language situation than when arbitrary cues, e.g., colors, would have been used (Peeters & Dijkstra, 2018). In each language, the cue was presented for 650ms, followed by a fixation cross for 350ms, then a blank screen for 150ms, and then the target picture. The target picture remained on the screen until a response was given. After the child's response the test assistant clicked the mouse to proceed to the following item. This was done to prevent data loss due to the child's inattention. Test assistants were instructed to only click to the next item if the child was still paying attention and was not distracted. This procedure was practiced with all test assistants prior to testing and test assistants were instructed to keep up a steady pace to minimalize variability in response-to-cue intervals. The cue remained on the screen until the end of the trial. There was a time limit of 7,000ms for the child to respond. Children's spoken responses were picked up by a microphone connected to a PST serial response box with a voice key function. Responses were also recorded via an external USB microphone for offline scoring of accuracy.

Nonverbal task-switching. The color/shape switching task was designed in E-Prime 2.0 Standard (Psychology Software Tools, Pittsburgh, PA) and had a largely similar design as the language switching task. It consisted of two single task blocks and a cued task switching block. Children were presented blue or orange triangles or squares and for each trial they had to respond to either the color (blue vs. orange) or the shape (triangle vs. square) of the target. Before each single task block a cartoon face showing 'Mr. Color' or 'Mr. Shape' (see Appendix 2) gave instructions on the task rules. The two faces also served as task cues for the switching block. By introducing the cues already in the single task blocks children were able to familiarize themselves with the cues. During all trials children saw a blue square in the left bottom corner and an orange triangle in the right bottom corner. For each trial children had to respond by pressing one of two fixed buttons on the far left and far right sides of the keyboard. When responding to color, the left button was for *blue* and the right button for *orange*. When responding to shape, the left button was for *square* and the right button was for *triangle*. This was in line with the symbols they saw in the bottom corners of the screen and was additionally indicated by stickers on the corresponding keys. Other details regarding the design of the task, such as number of trials and length of duration of cues and stimuli, were exactly the same as in the language switching task.

Data preparation

Language switching. For each language, accuracy scores were calculated as the percentage of correct trials during the mixed language block. Scoring was done by trained assistants using the audio recordings. For calculations of mean response times (RTs), only accurate responses were used. Response latencies were measured as the interval between picture presentation and onset of the target response, disregarding all audible noise or filled pauses preceding the target response. Trials in which a child said something else prior to the target word (e.g., "I know this one, tree") were excluded. All RTs smaller than 200ms were excluded and all RTs smaller than 500ms were checked and measured manually to determine e.g., if the voice key had been triggered accidentally by other sounds, such as background noise. For each child we computed means and standard deviations per language and trial type (repeat vs. switch trial). The first trial of the mixed language block was excluded as this is neither a repeat nor a switch trial. All trials that were 3 standard deviations above the mean were excluded. Together with trials yielding incorrect responses, this led to the exclusion of 9.1% of the data. Per language, we calculated two types of costs, switching costs and mixing costs. Switching costs were calculated per child by subtracting the mean response time on repeat trials from the mean response time on switch trials. Mixing costs were calculated by subtracting the mean response time on trials from the single language block from the mean response time on repeat trials in the mixed language block.

Nonverbal task-switching. Paired samples t-tests showed that there were no significant differences between the single task conditions for color and shape, neither for accuracy scores ($t(26) = 1.04$, $p = .31$), nor for response times ($t(25) = 1.7$, $p = .1$). Therefore, color and shape trials were pooled for analyses of the task-switching block, which resulted in four measures for task-switching: overall accuracy during the switching block, mean response time during the switching block, switching costs (difference in response times between switch and repeat trials during the switching block), and mixing costs (difference in response times between the repeat trials of the switching block and the average response times of the two single task blocks). Mean response times were calculated only for accurate trials and trials with response times > 200ms. Trials with response times that were above three standard deviations above a child's mean were not included. Together with excluding incorrect responses, this led to the exclusion of 15.1% of the data.

Procedures

The research was screened by the Standing Ethical Assessment Committee of the Faculty of Social and Behavioral Sciences at Utrecht University. Criteria were met and further verification was not deemed necessary. Parents of participating children signed an informed consent form. Children were tested individually in a quiet room at their schools. The tests were administered by trained assistants following a standardized protocol. The tasks used for this study were part of a larger test battery divided into two test sessions, with one week in between the two sessions. In the bilingual sample, the language switching task was part of the first test session whereas the nonverbal task switching was part of the second test session. Monolinguals did not engage in language switching. They completed the nonverbal switching task in the first test session. The parental questionnaire was administered during a telephone interview with one of the child's parents. The interview was conducted by bilingual assistants who were proficient in both Dutch and the heritage language of the child, and could therefore be carried out in the preferred language of the parent. Per language, the percentage of language use in the home environment was calculated. SES was measured by level of education on a nine-point scale for both the mother and the father of the child. Averages of both parents were calculated and used in the analyses as a covariate.

Results

Comparing bilingual and monolingual children on nonverbal task-switching

Table 3 shows the accuracy, response times, switching costs and mixing costs in the bilingual and monolingual samples in the mixed task condition.

Table 3

Average accuracy, response times, switching costs, and mixing costs in nonverbal task-switching for the monolingual and bilingual group (mixed task condition)

	N	Accuracy in % (SD)	RTs (SD)	Switching costs (SD)	Mixing costs (SD)
Monolinguals	27	82.3 (12.5)	1247.0 (405.4)	137.7 (202.7)	338.2 (218.8)
Bilinguals	27	78.1 (10.6)	1273.3 (345.2)	265.4 (396.2)	471.2 (280.2)

Note: RTs = response times.

Before comparing the groups, we inspected correlations to determine the strength of interrelationships between the four dependent variables. Accuracy showed a positive correlation with switching costs, indicating that children who made fewer errors needed relatively more time between switch and repeat trials than children who made more errors, pointing to a trade-off effect. Mixing costs showed a positive correlation with overall response times, demonstrating that children who needed relatively much time to respond to repeat trials in the mixing condition, were also overall relatively slow in responding in the mixing condition. There was no overall speed-accuracy trade-off.

Table 4

Correlations between accuracy, response times, switching costs, and mixing costs in nonverbal task-switching (both groups collapsed; mixed task condition)

	Accuracy	RTs	Switching costs
Accuracy			
RTs	.05		
Switching costs	.29*	.10	
Mixing costs	-.05	.78**	.12

Note: RTs = response times.

We conducted Multivariate Analysis of Variance (MANOVA) analyses. A MANOVA is a more powerful test that is able to identify smaller effects than a regular ANOVA by taking into account correlations between different dependent variables. Two MANOVA's were conducted that combined those outcome measures that were correlated: 1) accuracy and switching costs, and 2) RTs and mixing costs. Each MANOVA was followed by a MANCOVA in which SES and Dutch receptive vocabulary were included as covariates, to see if effects remain when controlling for the group differences in SES and Dutch vocabulary. The first MANOVA returned a non-significant effect for accuracy and switching costs ($F(2,51) = 2.96$, $p = .06$, $\eta_p^2 = .10$); a trend suggested that the bilinguals had lower accuracy and larger switching costs. The follow-up MANCOVA returned a clearly non-significant effect ($F(2,49) = 2.96$, $p = .51$, $\eta_p^2 = .03$). The second MANOVA showed a significant effect for RTs and mixing costs ($F(2,50) = 3.77$, $p = .03$, $\eta_p^2 = .13$), indicating that the bilinguals had larger RTs and higher mixing costs. The follow-up MANCOVA returned a non-significant effect ($F(2,48) = 1.44$, $p = .25$, $\eta_p^2 = .06$). In summary, the results show that any differences between monolinguals and bilinguals are related to differences in SES and knowledge of Dutch. When these factors are controlled, there are no differences between monolinguals and bilinguals on nonverbal task-switching.

Language switching and nonverbal task-switching in bilingual children

To test whether bilingual language control and domain-general cognitive control are related in the bilingual group we computed Pearson correlations between the dependent measures drawn from the nonverbal switching task and the language switching task. Accuracy scores from the language switching task were at ceiling (mean > 85%) and therefore not included. There was a marginally significant moderate correlation between accuracy on nonverbal task-switching and response times for Dutch trials during language switching, indicating that higher accuracy at nonverbal task switching is related to faster response times during language switching, $r(25)=-.39$, $p=.06$. Accuracy on nonverbal task-switching was not related to response times of Turkish trials during language switching, $r(25)=-.11$, $p=.61$. Analyses of the correlations between the mean response times of the two tasks showed that children's response times during nonverbal task switching showed a significant, positive correlation with children's response times during language switching and that this was the case for Dutch trials, *r*(25)=.45, *p*=.02, as well as Turkish trials, *r*(25)=.50, *p*=.01. Switching costs (Dutch: *r*(25)=.11, *p*=.59; Turkish: *r*(25)=.04, *p*=.86) and mixing costs (Dutch: *r*(24)=-.01, *p*=.96; Turkish: *r*(24)=.21, *p*=.33) of the two tasks were unrelated.

To ensure that the correlations between response times on the two tasks were not affected by confounding factors, we ran four separate partial correlations with age, NVIQ, SES and vocabulary in Dutch as control variables (Table 5). Compared to the correlations where these factors were not controlled for, most of the correlation coefficients either increased in size or stayed similar. All partial correlations between response times on language switching and nonverbal task-switching were significant, indicating that the relationship between response times on the two switching tasks cannot be attributed to individual differences between children in age, NVIQ, SES or vocabulary scores.

Table 5

Partial Pearson's correlations between response times of nonverbal task-switching (mixed task block) and language switching (mixed language block) controlling for age, nonverbal IQ, socioeconomic status and proficiency in Dutch

	Control variable	RTs Dutch	RTs Turkish
RTs nonverbal task-switching	Age	*r*(22)=.43, *p*=.04	*r*(22)=.50, *p*=.01
	NVIQ	*r*(22)=.46, *p*=.02	*r*(22)=.50, *p*=.01
	SES	*r*(22)=.49, *p*=.02	*r*(22)=.55, *p*=.01
	PPVT	*r*(22)=.48, *p*=.02	*r*(22)=.51, *p*=.01

Note: RTs = response times; NVIQ = nonverbal intelligence; SES = socioeconomic status; PPVT = Dutch receptive vocabulary measured with the Peabody Picture Vocabulary Test.

Additionally, we computed Pearson correlations between the response times from the single language blocks of the language switching test (Dutch, Turkish) and the single task blocks (color, shape) from the nonverbal task-switching test to make sure that the relationship between response times in the mixed blocks of the language switching test and the nonverbal task-switching test did not merely reflect individual differences in task speed in general. One correlation may suggest a trend (RTshape-RTTurkish: *r*(24)=.37, *p*=.08), but most of the correlations were far from significant (RTcolor-RTDutch: *r*(25)=.11, *p*=.60; RTcolor-RT Turkish: *r*(25)=-.01, *p*=.97; RTshape-RTDutch: *r*(24)=.13, *p*=.56). It is thus unlikely that the correlations between response times in the switching blocks of the two tests simply reflect associations between performance speed on the two tests.

Discussion

The current study investigated if Turkish-Dutch bilingual children outperform their monolingual peers on nonverbal switching, and if language switching and nonverbal switching are related to each other within the sample of Turkish-Dutch bilingual children. Starting with the second relationship, we found that response times on language switching and response times on nonverbal task-switching were significantly related: children who are faster at switching between Turkish and Dutch are also faster at switching in a nonverbal task in which they have to switch between a shape and color sorting rule. These results are in line with a recent similar study that tested cued task-switching in Spanish-English bilingual children (Gross & Kaushanskaya, 2016). As Gross and Kaushanskaya (2016) mention, it is possible that this association reflects similar speed demands of the two tasks. However, since the relationship in our study only emerged for the response times during mixed language/nonverbal task blocks and not during single language/nonverbal task blocks, we conclude that this finding provides evidence for shared domain-general control mechanisms that are utilized for switching between languages and between nonverbal tasks. This relationship was robust and not confounded by factors such as age, nonverbal intelligence, socioeconomic status or language proficiency.

The data showed a trend that accuracy on nonverbal task-switching was related to response times for the Dutch trials during language switching but not to response times for the Turkish trials. Gross and Kaushanskaya (2016) only found this relationship for the non-dominant language of the children, irrespective of whether this was English or Spanish. Because of different patterns in bilingual language use in our participants, it was not possible for us to make a distinction between the children's dominant versus non-dominant language rather than distinguishing between Dutch and Turkish. We can therefore neither confirm nor refute the idea that naming pictures in the non-dominant language (as opposed to the dominant language) draws on domain-general cognitive control mechanisms. Similar to previous research, both on bilingual children (Gross & Kaushanskaya, 2016) and adults (Branzi et al., 2016; Calabria et al., 2011; Calabria et al., 2015), our study did not find direct relationships between the processing costs (switching/mixing costs) caused by language switching and nonverbal task-switching, although there are also studies that report relationships between language switching and task switching with regard to these measures (Declerck et al., 2017; Timmer et al., 2018).

The assumption that bilingual language control draws on domain-general cognitive control has also been used to explain why bilingual children outperform their monolingual peers on tasks tapping into cognitive control (Bialystok, 1999; Bialystok & Martin, 2004). However, despite significant relations between language switching and nonverbal task-switching in the bilingual group, our results do not provide any evidence for better nonverbal task-switching abilities in the bilingual group as compared to a monolingual control group, neither based on accuracy nor on response times, switching or mixing costs. This is different from some previous studies with children using a dimensional change card sort task (DCCS) (Bialystok & Martin, 2004) or a very similar color/shape switching task (Barac & Bialystok, 2012).

Unlike Barac and Bialystok (2012), we could not match the two language groups on socioeconomic status. Moreover, whereas two of the bilingual groups in the study of Barac and Bialystok (2012) show slightly lower English vocabulary scores than the monolingual children and one bilingual group, the difference in Dutch vocabulary scores between the two groups in our study was considerably larger. However, even when socioeconomic status and verbal ability were statistically controlled, the bilingual children did not outperform their monolingual peers on nonverbal task-switching. In matching, we focused on a number of factors that are most likely to differ across the bilinguals and monolinguals in our study. In addition, we co-varied those factors that could not be matched in order to exclude confounding variables. Unfortunately, we were unable to match the groups on all factors that have been shown to impact cognitive control, e.g., playing a musical instrument (Musacchia et al., 2007) or playing computer games (Merzenich et al., 1996; but see also Unsworth et al., 2015). It is possible that factors like these are unequally distributed across the two groups, and create a confound. In addition to confounding variables, it is important to consider whether our study had sufficient power to detect a difference between the two groups. The samples in our study were similar in size to those of Barac and Bialystok (2012) who did find a significant effect using a similar task. A power calculation based on the reported effect size in this this previous study suggests that our study was not underpowered. However, the task used in our study had fewer trials than the task used in the study by Barac and Bialystok (2012). The absence of an effect ties in with other research that failed to find an effect of bilingualism on other cognitive control tasks (Duñabeitia, 2015). It confirms the conclusion that cognitive effects lack stability and robustness (Paap et al. 2015), and may depend on specific properties of the sample, such as age (Bosma et al., 2017).

In conclusion, as the relationship between bilingual language control and cognitive control is the underlying assumption for potentially enhanced cognitive control in bilingual as opposed to monolingual speakers, the current study combined both types of study. The results demonstrated that bilingual children with better nonverbal cognitive control have better language control, which is consistent with the hypothesis that domain-general cognitive resources are utilized for language switching (Green, 1998; Green & Abutalebi, 2013). Importantly, this relationship does not necessarily entail a cognitive training effect in bilinguals, at least not to the extent that the bilingual children outperform their monolingual peers on a task tapping into cognitive control. In fact, without controlling for differences in socioeconomic status and Dutch receptive vocabulary, the monolinguals outperformed the bilinguals on cognitive control. When both factors were controlled, the monolingual advantage disappeared. These outcomes have important implications for the debate on bilingual children's cognitive advantages, as they demonstrate that finding no cognitive advantages cannot be taken as evidence for the absence of a relation between language control and cognitive control. Moreover, the results suggest that bilingual-monolingual comparisons involve factors that exert greater influence on cognitive control than frequent practice in language switching does, and that such (confounding) factors may even lead to observing monolingual instead of bilingual cognitive control advantages. Unfortunately, we were only able to study the relationship between linguistic and non-linguistic switching with two tasks. For future research, it might be insightful to include different tasks of non-linguistic switching, to ensure that relationships are not purely task-related and to allow analyses with latent variables based on multiple indicators (e.g., Miyake et al., 2000). A further limitation of our study is that we only studied this relationship by means of behavioral tasks. It would be more insightful to incorporate neurolinguistic measures, such as brain imaging, to see if the results from behavioral experiments can be confirmed by neurolinguistic measures.

Appendix 1*: List of picture names from the language switching task*

Dutch	Turkish	English translation
vis	balık	fish
oog	göz	eye
hart	kalp	heart
appel	elma	apple
deur	kapı	door
mes	bıçak	knife
auto	araba	car
vogel	kuş	bird
sleutel	anahtar	key
oor	kulak	ear
varken	domuz	pig
bank	koltuk	couch
konijn	tavşan	rabbit
boom	ağaç	tree
kip	tavuk	chicken
neus	burun	nose
ster	yıldız	star
wortel	havuç	carrot
bed	yatak	bed
vork	çatal	fork
fiets	bisiklet	bike
paard	at	horse
schaar	makas	scissors
vinger	parmak	finger
schaap	koyun	sheep
tafel	masa	table
olifant	fil	elephant
bloem	çiçek	flower

Appendix 2: *Illustrations of the tasks*

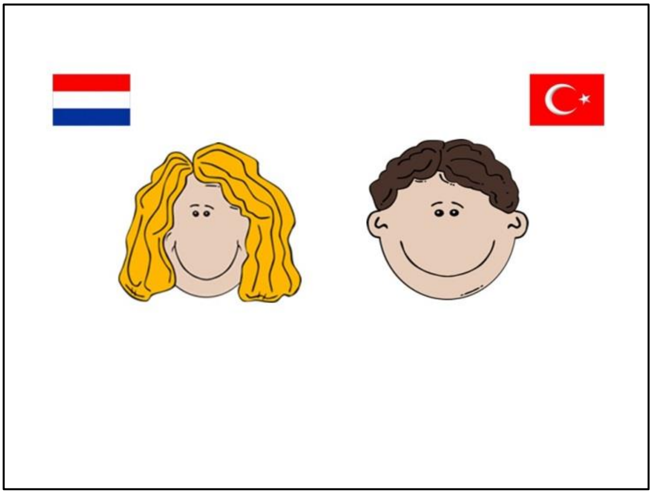

Image 1: *Introduction of cues on language switching task*

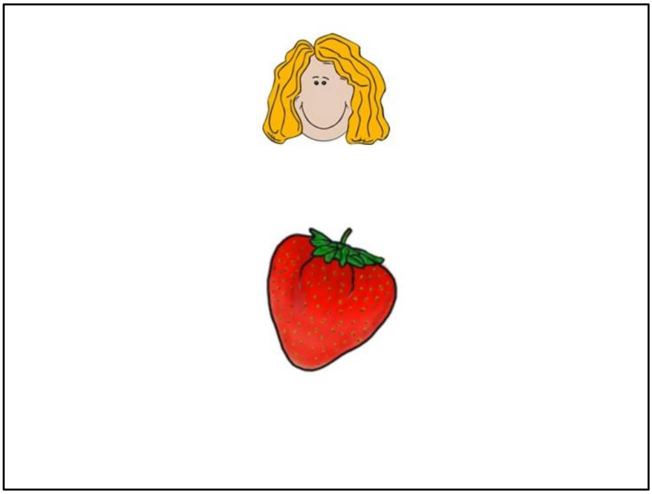

Image 2: *Example of a Dutch language trial on language switching task*

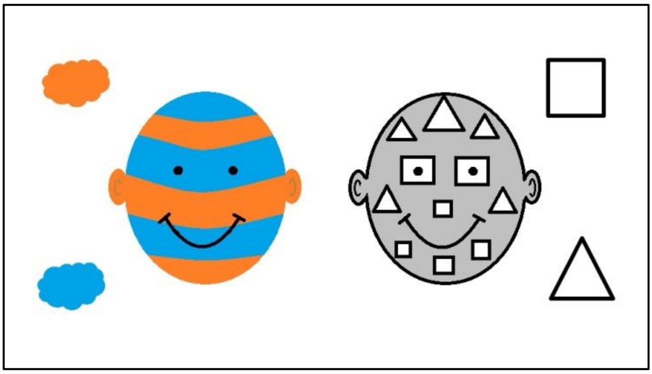

Image 3: *Introduction of cues on the nonverbal switching task*

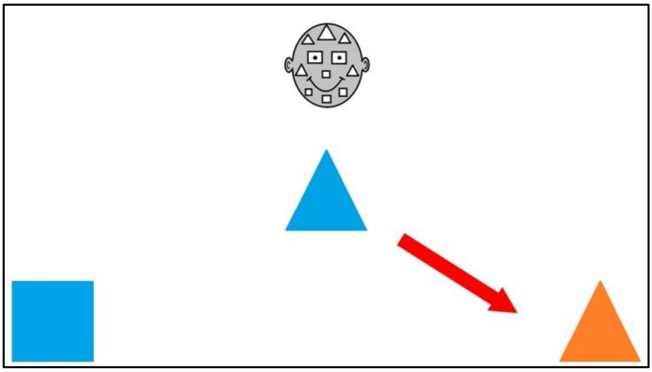

Image 4: *Example of a shape trial (the arrow only appeared during the instructions)*

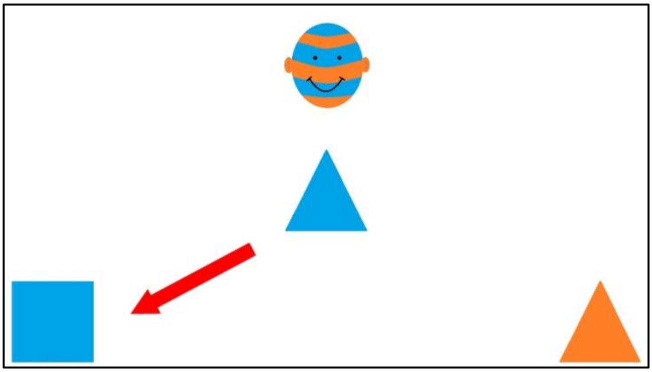

Image 5: *Example a color trial (the arrow only appeared during the instructions)*

Chapter 5

General Discussion

Children who are born into families with a background of migration often grow up bilingually, as child heritage speakers, learning the language of their parents' or grandparents' country of origin (the heritage language), as well as the main language of their country of residence (the majority language). Child heritage speakers form a large population of bilingual children in countries with immigrant populations. In the Netherlands, where this study was carried out, almost 28% of the population between age 0 and 25 has a migration background (Centraal Bureau voor de Statistiek, 2020). The language development of child heritage speakers often differs from that of other bilingual children (e.g., children from parents with different native languages) in the way that they are mainly exposed to the heritage language in the first years of their lives, but often become dominant in the majority language at some point after entering the education system (Benmamoun et al., 2013). As their education is usually offered exclusively in the majority language, understanding which factors affect their language development, especially in the majority language, is very crucial. The current study was set out to investigate the language production skills of child heritage speakers in the Netherlands coming from a Turkish or Moroccan background. We looked at different aspects of language production, namely lexical access, accuracy and fluency, and language switching. For the study of lexical access and language switching we included data from both the heritage language and the majority language. For the analysis of accuracy and fluency, we only included data from the majority language Dutch, as we were mainly interested in how the child heritage speakers perform in comparison to monolingual Dutch children.

One of the goals of the study was to compare different aspects of the children's language production in the majority language to that of monolingual Dutch children. We wanted to investigate whether child heritage speakers in the Netherlands show disadvantages for lexical access and produce more disfluencies and errors in their majority language speech than monolingual children, as has been found in other bilingual populations (Gollan et al., 2005; Paradis, 2005) (Chapter 3). A second goal was to study whether the amount of heritage language input in the home environment affects the children's language production skills (Chapter 2). Finally, a main goal of this dissertation was to investigate whether measures of language production and the children's ability to switch between the two languages are related to general cognitive measures, such as memory skills or task-switching (Chapter 3 & 4). We wanted to know whether child heritage speakers in the Netherlands show cognitive advantages similar to findings in other groups of bilingual children (e.g., Barac et al., 2014; Bialystok, 1999; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008; Morales et al., 2013, Poarch & van Hell, 2012).

In this general discussion of the dissertation, the main findings from the three empirical studies are summarized and discussed with regard to previous findings about language production. Next, some limitations of the study are addressed, followed by suggestions for future research and a summary of the main conclusions and implications that can be drawn from the research in this dissertation.

Effects of bilingualism on language production in child heritage speakers in the Netherlands

It is known from research on bilingual adults, that bilingual language production is not entirely the same as language production in monolinguals. Even though the general stages of production are thought to be more or less the same (De Bot, 1992), bilingual language production is different in the way that the language that is not being used during production is always activated as well (Bialystok et al., 2009; Green, 1998), which can lead to cross language competition (Kroll et al., 2006). There is ample evidence from bilingual adults that bilingualism affects different aspects of language production, for example that bilinguals have slower and less accurate lexical access and that they show more disfluencies and errors in their speech when compared to monolingual speakers (Bialystok et al., 2009; Byrd et al., 2015). As the research on language production in child heritage speakers in general is still limited, it was relevant for us to study whether effects that are found in bilingual adults are also found in Turkish-Dutch and Berber-Dutch child heritage speakers in the Netherlands, since they have specific characteristics not present in all bilingual populations. For example, in contrast to adults, they often become dominant in their second language Dutch, the majority language of their environment. Apart from that, child heritage speakers in the Netherlands often come from low SES families. Children from a low SES background can have lower language input quantity and/or quality than children in high SES families (Hart & Risley, 1995; Hoff & Naigles, 2002), which could be a reason for lower language production skills in bilingual children when compared to monolingual children (Paradis, 2005). However, there is also a lot of variation within low-income families (Sperry et al., 2019) and a direct link between low SES and lower language input quantity and quality cannot simply be assumed (Golinkoff et al., 2019).

With regard to language input, our study confirmed previously demonstrated differences between children from Turkish and children from Moroccan families in the Netherlands (Scheele et al., 2010). The Turkish-Dutch children received significantly more input in the heritage language than the Berber-Dutch children (see Chapter 2). Whereas the Turkish-Dutch children showed both receptive and productive skills in the heritage language, many of the Berber-Dutch children only had receptive skills in the heritage language, even though they received input in that language. This finding stresses the heterogeneity in child bilinguals and shows a 'receptive-expressive gap' that has been described in child heritage speakers (Ribot & Hoff, 2014). It further stresses that language use and language proficiency are two different aspects of bilingualism that result in different bilingual profiles (Francot et al., 2021). Regarding language production, the difference in heritage language input between the two groups only affected language production (in Dutch) at the level of lexical access, but did not affect the accuracy and fluency of produced speech. This might indicate that lexical access is a more sensitive measure than accuracy and fluency when it comes to competition effects in language production. The Turkish-Dutch children showed slower and less accurate lexical access in Dutch than the monolingual Dutch children. The Berber-Dutch children who receive more Dutch input at home than Berber did not significantly differ from monolingual children in their lexical access skills in Dutch. This indicates that bilingualism does not always lead to disadvantages in lexical access, which are present in other groups of bilinguals (e.g., Bialystok et al., 2008; Gollan et al., 2005; Gollan et al., 2002; Sandoval et al., 2010; Zeng et al., 2019). Child heritage speakers are able to perform at monolingual levels, given that they receive a sufficient amount of input in the majority language. This outcome is evidence for a positive relation between language input and lexical access and can be explained both by cross-language competition (Costa et al., 1999) as well as frequency-of-use accounts (e.g., Gollan et al., 2011). More heritage language input at home would therefore lead to more cross-language competition when accessing the majority language Dutch, while at the same time, more language input in Dutch would lead to higher activation frequency of Dutch words and therefore better lexical access in Dutch.

Interestingly, a similar effect of heritage language input was not found for measures of accuracy and fluency in the Dutch speech of the child heritage speakers. For these two measures, there were no significant differences between the Turkish-Dutch and the Berber-Dutch children (see Chapter 3). Both groups of bilingual children produced more errors and disfluencies when speaking Dutch than monolingual Dutch children. Accuracy of Dutch speech production was related to the children's language knowledge in Dutch, in this case vocabulary and grammar skills. Lower scores on vocabulary and grammar tests in the majority language Dutch were related to higher error rates when speaking Dutch. Fluency when speaking Dutch, however, was not related to vocabulary or grammar knowledge but to phonological memory abilities (see section 6.2). These findings stress the complexity of language production as a whole, as they show how the different stages of production are affected by different speaker-dependent variables. Whereas lexical access is more related to bilingual language use and potential competition from the non-target language, accuracy of language production depends more on language proficiency, specifically the vocabulary and grammar knowledge of the children. Finally, monitoring and articulation are more affected by phonological memory skills than language proficiency in the majority language.

Another main finding of our study is that regarding lexical access, the Turkish-Dutch and Berber-Dutch child heritage speakers in our study showed dominance in the majority language at age 5-6. This is different from other studies of this population that report heritage language dominance for 6-7-year-old Turkish-Dutch children (Verhoeven et al., 2012), although this difference might also have sample-specific reasons. At the first wave of testing in our study, all children had been going to a Dutch-only kindergarten for at least half a year. The fact that especially many of the Berber-Dutch children had only very limited productive skills in the heritage language raises the question whether these children were actually Berber-dominant at some point or that the majority language Dutch was already their dominant language during the first years of their lives. Unfortunately, we were unable to answer this question in the scope of this dissertation. In general, our study confirms the large variation in bilingual experience found in other studies (e.g., Francot et al., 2021), and shows that the use of the heritage language can affect the performance of the children on different language tasks. This demonstrates the importance of paying careful attention to the selection of bilingual participants, since even groups of bilingual children learning the same majority language and coming from a very comparable socio-economic background can show very different performance on language tasks. It might therefore be problematic to study very heterogeneous groups of bilingual children with different language combinations and bilingual experiences as one group of bilingual speakers and compare them to monolinguals.

The interplay between bilingual language production and general cognition

One of the main aims of this dissertation was to contribute to the knowledge concerning the relationship between bilingual language use and general cognition. Bilinguals are thought to make use of general cognitive skills when processing their two languages (Filippi et al., 2015). It is assumed that they use general cognitive control to inhibit the competition from the non-target language and to switch from one language to the other (Anderson et al., 2018). It has further been hypothesized that this additional use of general cognitive skills during bilingual language use could lead to training effects for these skills and thus enhanced cognitive skills in bilingual speakers as compared to monolingual speakers (Bialystok, 2011). This question has often been studied by comparing groups of bilinguals to groups of monolinguals on tasks tapping into general cognitive control skills. Whereas some studies show evidence for such a bilingual advantage (Baum & Titone, 2014; Bialystok et al., 2008; Bialystok, 2011; Costa & Sebastián-Gallés, 2014; Filippi et al., 2015; Luk et al., 2011), others were unable to replicate this finding (e.g., Duñabeitia et al., 2014; Lehtonen et al., 2018; Paap & Greenberg, 2013; Paap et al., 2015). These diverging results have caused a lot of controversy in the field regarding the robustness of the effect.

Instead of focusing exclusively on the bilingual advantage on cognitive control, this dissertation was directed towards studying the interplay between language and cognition in bilinguals. In the study in Chapter 3, this was investigated by examining potential effects of phonological short-term memory and working memory on accuracy and fluency during speech production. We found that child heritage speakers produced more errors and more disfluencies (in this case repetitions and revisions) when producing semi-spontaneous speech in their majority language Dutch than monolingual Dutch children. Accuracy was not related to the two memory measures, neither in bilingual nor monolingual children. The difference between child heritage speakers and monolingual children with regard to disfluencies was explained by lower scores for phonological short-term memory in the bilingual children. When phonological short-term memory was controlled for, there was no longer a difference in disfluencies between bilingual and monolingual children. This finding suggests a relationship between phonological short-term memory and language production in child heritage speakers. Phonological short-term memory is considered important during the monitoring stage of language production (Mizera, 2006). When producing language, the preverbal message has to be temporarily stored in the mind. Also, the recently produced speech has to be checked and revised in case of errors or deviations from the planned output.

Contrary to our expectations and previous research in bilingual adults (Guara-Tavares, 2009; Mizera, 2006; Mota, 2003), there was no relationship between working memory and accuracy and fluency, neither in the group of child heritage speakers, nor in the monolingual control group. This could be related to the fact that the participants in the studies with adults were all L2 learners in an instructional setting. Working memory might be more relevant during explicit language learning, where the focus is more on memorizing forms and grammatical rules, than it is the case for child heritage learners. Moreover, the absence of a relation between working memory and accuracy is in line with recent research that reports no relation between working memory and grammatical inflections in bilingual children (Blom et al., 2021). It is likely that phonological short-term memory is more important for the monitoring process in language production as it is more related to the cognitive processing of linguistic material than working memory. In the study described in Chapter 3, phonological short-term memory was tested with a nonword repetition task that was based on the sounds of the Dutch language (Rispens & Baker, 2012). Based on the results of the study, it might be useful to intentionally train phonological short-term memory in child heritage speakers, using tasks that include sound combinations specific to their majority language. That way, better phonological short-term memory skills could lead to fewer disfluencies when speaking the majority language.

The interplay between bilingual language production and general cognitive skills was further studied in Chapter 4. In that study, Turkish-Dutch child heritage speakers performed both a language switching task as well as a non-verbal task switching task. A relation was found between response times in the mixed language/mixed task condition of both tasks. This means that those children who are faster at switching between two languages are also faster at switching between nonverbal tasks (in this case sorting objects by color or shape). These findings support previous evidence from behavioral (Declerck et al., 2017), as well as neuro-linguistic studies (for a review, see Hervais-Adelman et al., 2011) for a relationship between bilingual language control and general cognitive control. They contribute to this line of research by extending the relationship between linguistic and non-linguistic switching to a population of child heritage speakers. The performance of the child heritage speakers on the non-linguistic switching task was further compared to the performance of a control group of monolingual Dutch children. Our study did not provide any indication for a bilingual advantage in cognitive control. It was the monolingual children who had faster response times and were less slowed down by the mixing of tasks. However, when controlling for differences in SES and knowledge of Dutch between the two groups, differences in task-switching performance disappeared. This indicates that evidence for a relationship between bilingual language control and cognitive control does not automatically entail a bilingual advantage in cognitive control for the same sample of participants. A discrepancy of this kind stresses the importance of combining within-group and between-group designs, in order to test whether a potential bilingual advantage in cognitive control can indeed be explained by and interplay between bilingual language use and general cognitive skills.

Limitations of this dissertation

Although the research for this dissertation was thoroughly planned and designed, the different studies also have some limitations regarding the selection of participants, the data that was gathered and their design. For the selection of participants, a problem we encountered was the matching of bilingual and monolingual participants regarding their socio-economic status. Although the monolingual and bilingual participants were recruited at the same elementary schools with the intention to avoid demographic differences between the groups, the bilingual children had significantly lower scores for SES than the monolingual children, similar to other studies comparing bilingual and monolingual groups of children (Gangopadhyay et al., 2016; Kapa & Colombo, 2013; Park et al., 2018) We added SES as control variable in all of our analyses to limit this effect on other measures, but we are aware that this might not have been the most ideal solution. SES has been shown to affect different aspects of language development in children and lower SES has been related to lower cognitive functioning (Rosen et al., 2020). Therefore, excluding this information in the selection of participants could have had severe impacts on the results of a study.

Another aspect that complicated our study was the great variation in heritage language input and proficiency in our bilingual participants. Even though we conducted a detailed parental questionnaire about the children's bilingual language use, we were unable to define variables such as language dominance. This made it more difficult to compare our results to those of studies that report their findings based on language dominance (e.g., Fu et al., 2017), which is the case for many studies about language switching and symmetric vs. asymmetric switch costs (e.g., Bobb & Wodniecka, 2013). Due to the variation in heritage language proficiency, for many of the children (especially from the Berber-Dutch group), we did not have sufficient data in the heritage language to analyze accuracy and fluency in the heritage language or language switching between Dutch and the heritage language. It would have been very insightful to compare production of spontaneous speech in both languages of the child heritage speakers.

A further limitation of this dissertation is that for the cognitive measures such as working memory or task-switching, only one experimental task was used per measure. Within the research on executive functions, there is an issue of task-impurity when it comes to the experimental paradigms that are used (Miyake et al., 2000; Miyake & Friedman, 2012). Different tasks that are supposed to measure the same executive function construct do not always show strong correlations with each other (Jylkkä et al., 2017), which can make it difficult to separate task-specific effects from more general effects (Laine & Lehtonen, 2018). As studies have used a vast number of different tasks to measure executive functions, it is difficult to determine to what extent they actually measure the same construct. Even for the same task, different studies have used very different versions of the task, which complicates the comparability of the results (Giovannoli et al., 2020).

An outlook on future research

As many studies in the past two decades have focused on the relationship between bilingualism and general cognitive control skills, the body of research on this topic is vast and very heterogenous regarding aspects such as selection of experimental tasks, age of the participants, type of bilingualism or language combinations of the participants. To gain a better overview of the findings and as an attempt to find consistencies or patterns in the results, several review articles or meta-analyses have been published in recent years (e.g., Giovannoli et al., 2020; Lehtonen et al., 2018). One aspect that makes the comparison of studies in this field very challenging are the different definitions of bilingualism that have been used to assign participants to bilingual or monolingual groups (Giovannoli et al., 2020; Leivada et al., 2021). Some authors suggest that future research should rather consider bilingualism as a spectrum (De Cat et al., 2018; DeLuca et al., 2019), as it is not simply a categorical variable (Luk & Bialystok, 2013). De Cat et al. (2018), for example, study if a person needs to have a certain level of bilingual experience to benefit from any cognitive advantages. They do this by calculating a Bilingual Profile Index (BPI) based on different input and output measures of their bilingual participants and are indeed able to measure a certain threshold of BPI necessary to see bilingual effects on inhibitory control (in this case the *Simon task*). Others have used latent profile analysis to find within-group patterns of bilingual language use and bilingual proficiency (Francot et al., 2021). In the future, more studies should approach bilingualism by studying within-group variation. More authors agree that future studies in bilingualism and cognition research should focus more on individual differences within groups of bilingual speakers and avoid group designs with monolingual control groups (Laine & Lehtonen, 2018; Poarch & Krott, 2019). For the research in this dissertation, a follow-up study would be to analyze how different aspects of the bilingual experience (e.g., language input, language use, language proficiency, language dominance) are related to measures of language production. We have seen large variation in the use and proficiency of the heritage language of the children in this study. A next step should therefore be to study what causes this variation in bilingual experience and how this relates to the acquisition of the majority language. Another step would be to gain a better understanding of language dominance in this group of child heritage speakers, to be able to connect our findings to theoretical approaches about language dominance in the context of language production.

Moreover, more attention should be given to the characteristics of the two languages of the participants. Studies should include measures of language proximity (Blom et al., 2020; Grohmann & Kambanaros, 2016), as this aspect might affect the level of cognitive control needed to manage the two languages. Others suggest that including the societal prestige of a language should be considered as well, as this could affect language use (Leivada et al., 2021). This might be particularly relevant in the study of (child) heritage speakers with regard to the heritage language they learn or use. If the heritage language has low societal status, heritage speakers might be less likely to use this language or teach it to their children. Even though we did not measure language prestige or language attitudes in our studies, there is a clear difference in status between the two heritage languages Turkish and Berber in the Netherlands, as Turkish is a more established and widely used language than Berber. This likely affects the attitudes that child heritage speakers or their families have towards the heritage language. Apart from that, future research on bilingual children, especially child heritage speakers should try to study language skills in both languages of the children. This is particularly relevant when trying to avoid misdiagnosis of language impairments, as children with low majority language skills share profiles with children who suffer from language impairment (Boerma & Blom, 2017). It is therefore possible that some of the children in our studies with lower skills of language production in the majority language are undiagnosed children with a language impairment.

A possible solution to study effects of bilingualism on general cognitive skills and account for all the variability between different groups of bilinguals all over the world, could be to strengthen collaborations between multiple labs to increase the statistical power of studies and avoid a potential publication bias (Leivada et al., 2021). By using larger samples, individual differences in bilingual groups would not be complicating the study of bilingual effects, but could be added to the analysis as factors. Such collaborations could make use of the same experimental tasks (see for example COST Action IS0804: Language impairment in a multilingual society: Linguistic patterns and the road to assessment), which would be particularly relevant in the study of language switching and language mixing, where different language combinations of the speakers already complicate comparisons between studies. Apart from that, studies should focus more on longitudinal designs to study long-term effects of bilingualism on cognition in the same participants (Poarch & Krott, 2019) (see Chapter 2).

Next to changing the methodology of studies about the bilingual effect on general cognition, it has also been suggested that future research should focus more on the real-life benefits of bilingualism. Bilingualism seems to have positive effects on a number of aspects, such as perspective taking (Schroeder, 2018), meta-linguistic awareness (Bialystok et al., 2014), creative thinking (Van Dijk et al., 2019; Kharkhurin, 2009), tolerance of ambiguity (Dewaele & Li, 2013), and open-mindedness and cultural empathy (Dewaele & Stavans, 2014). In elderly bilinguals, evidence for a cognitive reserve against the symptoms of dementia is rather robust (Alladi et al., 2013; Bialystok et al., 2007). With regard to bilingual children, the question arises which real-life benefits children would experience by having significantly faster reaction times than monolinguals by hundreds of milliseconds. When finding relationships between bilingual language use and general cognitive measures, the focus should be on the question of how we can apply these insights to eliminate potential delays in language learning in bilingual children or avoid disadvantages in their educational careers.

Main conclusions and implications

The studies in the current dissertation contribute to the understanding of language production in child heritage speakers. The results demonstrate the large variation of language use and language proficiency in (child) heritage speakers and stress the importance of including individual differences or within-group analyses when studying this type of bilingual speakers. Child heritage speakers with a background of migration form a large part of the bilingual children in the education systems of many countries today and, unfortunately, these children often show language delays, especially in the majority language. The results of the current study contribute to a better understanding of potential factors that influence the development of child heritage speakers' productive skills in the majority language. By including linguistic as well as non-linguistics measures, the different studies also contribute to a better understanding of the interplay between bilingual language use and general cognition. We can conclude from Chapter 2 that with sufficient language input in the majority language, potential bilingual disadvantages in lexical access can be prevented in child heritage speakers, although this happens at the cost of heritage language skills. Implications from Chapter 3 are that higher levels of phonological memory skills can benefit the fluency of speech production in the majority language and that strengthening bilingual children's vocabulary and grammar skills in the majority language are important for producing error-free speech in that language. Finally, Chapter 4 has shown us that child heritage speakers' ability to switch languages is related to general cognitive skills.

The findings from this dissertation can be applied in educational contexts in order to improve the language development of child heritage speakers and to ensure better educational opportunities for these children. Due to the high number of multilingual children with varying heritage languages, teachers and other educators are faced with the challenge of deciding which of their languages children should use and strengthen during their learning process. Recent pedagogical approaches to multilingualism often include the concept of 'translanguaging', where all languages of the children are to some extent incorporated into their learning environment and teachers support a multilingual setting (Ticheloven et al., 2021). From a psycholinguistic perspective, translanguaging has been argued to be beneficial, as language mixing can facilitate cross-linguistic transfer, for example in vocabulary acquisition (Bosma et al., 2022). The results from this study contribute to the cognitive understanding of translanguaging in two ways. Based on our finding that switching between languages is related to general cognitive control, translanguaging can be considered as a dual language context (Green & Abutalebi, 2013), drawing on general cognitive control, which might have positive effects of the cognitive control skills of the students engaging in this practice. Apart from that, our finding that lexical access is more effortful in a mixed language context might also be seen as a factor that could make translanguaging in the classroom more effortful to bilingual students as opposed to only facilitating their learning. However, it has to be noted that language switching in real life (as opposed to forced switching in an experimental context) is motivated by different factors (e.g., sociolinguistics or language proficiency) and that voluntary switching between languages is usually not related to a processing cost (Backus & Demirçay, 2021). It is therefore important to know whether the use of translanguaging takes place voluntarily or in a forced manner, as involuntary language mixing might be more effortful.

In general, it can be concluded that it is particularly important to strengthen child heritage speakers' language proficiency in the majority language, as well as in their heritage language and that the language development in the majority language is likely to benefit from strengthening the children's general cognitive skills, as well as their phonological memory.

References

Aarssen, J. (1998). *Relating events in two languages: Acquisition of cohesive devices by Turkish-Dutch bilingual children at school age*. Doctoral dissertation. Katholieke Universiteit Brabant. Publisher: Tilburg University Press, The Netherlands.

Aarts, R., & Verhoeven, L. (1999). Literacy attainment in a second language submersion context. *Applied Psycholinguistics*, *20*(3), 377-393.

Abutalebi, J., & Green, D. W. (2008). Control mechanisms in bilingual language production: Neural evidence from language switching studies. *Language and Cognitive Processes*, *23*(4), 557-582.

Abutalebi, J., Della Rosa, P. A., Ding, G., Weekes, B., Costa, A., & Green, D. W. (2013). Language proficiency modulates the engagement of cognitive control areas in multilinguals. *Cortex*, *49*, 905–911.

Abutalebi, J., Della Rosa, P. A., Green, D. W., Hernandez, M., Scifo, P., Keim, R., Cappa, S. F., & Costa, A. (2012). Bilingualism tunes the anterior cingulate cortex for conflict monitoring. *Cerebral Cortex*, *22*, 2076–2086.

Adams, A. M., & Gathercole, S. E. (1995). Phonological working memory and speech production in preschool children. *Journal of Speech, Language, and Hearing Research*, *38*(2), 403-414.

Adams, A. M., & Gathercole, S. E. (1996). Phonological working memory and spoken language development in young children. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology*.

Adams, A. M., & Gathercole, S. (2000). Limitations in working memory: implications for language development. *International Journal of Language & Communication Disorders*, *35*(1), 95-116.

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*(2), 207-245.

Alladi, S., Bak, T. H., Duggirala, V., Surampudi, B., Shailaja, M., Shukla, A. K., Kaul, S. (2013). Bilingualism delays age of onset of dementia, independent of education and immigration status. *Neurology*, *81*(22), 1938–1944.

Alloway, T.P. (2012). *Alloway Working Memory Assessment* (AWMA). London: Pearson.

Altinkamis, F., & Simon, E. (2020). Language abilities in bilingual children: The effect of family background and language exposure on the development of Turkish and Dutch. *International Journal of Bilingualism*, *24*(5-6), 931-951.

Anderson, J. A., Chung-Fat-Yim, A., Bellana, B., Luk, G., & Bialystok, E. (2018). Language and cognitive control networks in bilinguals and monolinguals. *Neuropsychologia*, *117*, 352-363.

Antoniou, M. (2019). The advantages of bilingualism debate. *Annual Review of Linguistics*, *5*, 395-415.

Backus, A. (2005). Turkish as an immigrant language in Europe. In J. F. Kroll & A. M. B. De Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 689–723). Oxford: Oxford University Press.

Backus, A., & Demirçay, D. (2021). Intense Turkish-Dutch bilingualism leads to intense Turkish-Dutch mixing: A usage-based account of increasing integration of two typologically different languages. *Belgian Journal of Linguistics, 35*(1), 13-33.

Baddeley, A. (2003). Working memory and language: An overview. *Journal of Communication Disorders*, *36*(3), 189-208.

Barac, R., & Bialystok, E. (2011). Cognitive development of bilingual children. *Language Teaching 44,* 36-54.

Barac, R., & Bialystok, E. (2012). Bilingual effects on cognitive and linguistic development: Role of language, cultural background, and education. *Child Development, 83*(2), 413–422.

Barac, R., Bialystok, E., Castro, D. C., & Sanchez, M. (2014). The cognitive development of young dual language learners: A critical review. *Early Childhood Research Quarterly, 29*(4), 699-714.

Barbu, C., Orban, S., Gillet, S., & Poncelet, M. (2018). The impact of language switching frequency on attentional and executive functioning in proficient bilingual adults. *Psychologica Belgica, 58*(1), 115.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173–1182.

Baum, S., & Titone, D. (2014). Moving toward a neuroplasticity view of bilingualism, executive control, and aging. *Applied Psycholinguistics, 35*(5), 857.

Bedore, L. M., Fiestas, C. E., Pena, E. D., & Nagy, V. J. (2006). Cross-language comparisons of maze use in Spanish and English in functionally monolingual and bilingual children. *Bilingualism: Language and Cognition*, *9*(03), 233-247.

Benmamoun, E., Montrul, S., & Polinsky, M. (2013). Heritage languages and their speakers: Opportunities and challenges for linguistics. *Theoretical Linguistics, 39,* 129–181.

Bergmann, C., Sprenger, M. & Schmid, M. (2015). The impact of language co-activation on L1 and L2 speech fluency. *Acta Psychologica, 161,* 25-35.

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

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

Bialystok, E. (2011). Reshaping the mind: the benefits of bilingualism. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *65*(4), 229.

Bialystok, E. (2015). Bilingualism and the development of executive function: The role of attention. *Child development perspectives, 9*(2), 117-121.

Bialystok, E., & Craik, F. I. (2010). Cognitive and linguistic processing in the bilingual mind. *Current Directions in Psychological Science, 19*(1), 19-23.

Bialystok, E., & Feng, X. (2011). Language proficiency and its implications for monolingual and bilingual children. *Language and literacy development in bilingual settings*, 121–138.

Bialystok, E., & Martin, M. M. (2004). Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. *Developmental science, 7*(3), 325-339.

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

Bialystok, E., Craik, F. I. M., & Freedman, M. (2007). Bilingualism as protection against the onset of symptoms of dementia. *Neuropsychologia, 45*, 459–464.

Bialystok, E., Craik, F. I. M., & Luk, G. (2008). Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34*, 859–873.

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

Bialystok, E., Luk, G., Peets, K. F., & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition*, *13*(04), 525-531.

Bialystok, E., Martin, M. M., & Viswanathan, M. (2005). Bilingualism across the lifespan: The rise and fall of inhibitory control. *International Journal of Bilingualism*, *9*(1), 103-119.

Bialystok, E., Peets, K. F., & Moreno, S. (2014). Producing bilinguals through immersion education: Development of metalinguistic awareness. *Applied psycholinguistics*, *35*(1), 177.

Bialystok, E., Poarch, G., Luo, L., & Craik, F. I. (2014). Effects of bilingualism and aging on executive function and working memory. *Psychology and aging*, *29*(3), 696.

Bloem, I., van den Boogaard, S., & La Heij, W. (2004). Semantic facilitation and semantic interference in language production: Further evidence for the conceptual selection model of lexical access. *Journal of Memory and Language, 51,* 307–323.

Blom, E. & Baayen, H. (2013). The impact of verb form, sentence position, home language and proficiency on subject-verb agreement in child L2 Dutch. *Applied Psycholinguistics*, *34*(4), 777-811.

Blom, E. (2010). Effects of input on the early grammatical development of bilingual children. *International Journal of Bilingualism*, *14*(4), 422-446.

Blom, E. (2019), Domain-general cognitive ability predicts bilingual children's receptive vocabulary in the majority language. *Language Learning*, *69*, 292-322.

Blom, E., Boerma, T., Bosma, E., Cornips, L., van den Heuij, K., & Timmermeister, M. (2020). Cross-language distance influences receptive vocabulary outcomes of bilingual children. *First Language*, *40*(2), 151-171.

Blom, E., Bosma, E., & Heeringa, W. (2021). Regular and irregular inflection in different groups of bilingual children and the role of verbal short-term and verbal working memory. *Languages*, *6*(1), 56.

Blom, E., Küntay, A. C., Messer, M., Verhagen, J., & Leseman, P. (2014). The benefits of being bilingual: Working memory in bilingual Turkish-Dutch children. *Journal of Experimental Child Psychology, 128*, 105-119.

Bobb, S. C., & Wodniecka, Z. (2013). Language switching in picture naming: What asymmetric switch costs (do not) tell us about inhibition in bilingual speech planning. *Journal of Cognitive Psychology*, *25*(5), 568-585.

Boerma, T. D. (2017). *Profiles and paths: Effects of language impairment and bilingualism on children's linguistic and cognitive development* (Doctoral dissertation, Utrecht University).

Boerma, T., & Blom, E. (2017). Assessment of bilingual children: What if testing both languages is not possible?. *Journal of Communication Disorders*, *66*, 65-76.

Boerma, T., Chiat, S., Leseman, P., Timmermeister, M., Wijnen, F., & Blom, E. (2015). A quasi-universal nonword repetition task as a diagnostic tool for bilingual children learning

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

Bos, P. (2001). Temporality issues in Moroccan Arabic and Dutch. *Narrative development in a multilingual context*, 233-254.

Bosma, E., Bakker, A., Zenger, L., & Blom, E. (2022). Supporting the development of the bilingual lexicon through translanguaging: a realist review integrating psycholinguistics with educational sciences. *European Journal of Psychology of Education*, 1-23.

Bosma, E., Hoekstra, E., Versloot, A., & Blom, E. (2017). The minimal and short-lived effects of minority language exposure on the executive functions of bilingual Frisian-Dutch children. *Frontiers in Psychology, 8*, article number 1453.

Branzi, F. M., Calabria, M., Boscarino, M. L., & Costa, A. (2016). On the overlap between bilingual language control and domain-general executive control. *Acta Psychologica, 166*, 21–30.

Braver, T. S. (2012). The variable nature of cognitive control: a dual mechanisms framework. *Trends in Cognitive Science, 16*, 106–113.

Braver, T. S., Reynolds, J. R., & Donaldson, D. I. (2003). Neural mechanisms of transient and sustained cognitive control during task-switching. *Neuron, 39*, 713–726.

Buac, M., Gross, M., & Kaushanskaya, M. (2016). Predictors of processing-based task performance in bilingual and monolingual children. *Journal of communication disorders*, *62*, 12-29.

Byrd, C.T, Bedore, L.M., & Ramos, D. (2015). The disfluent speech of bilingual Spanish-English children: Considerations for differential diagnosis of stuttering. *Language, Speech and Hearing Services in Schools, 46*, 30-43.

Calabria, M., Branzi, F. M., Marne, P., Hernández, M., & Costa, A. (2015). Age-related effects over bilingual language control and executive control. *Bilingualism: Language and Cognition*, *18*(01), 65-78.

Calabria, M., Hernández, M., Branzi, F. M., & Costa, A. (2011). Qualitative differences between bilingual language control and executive control: Evidence from task switching. *Frontiers in Psychology, 2,* Article 399.

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, *28*(2), 595-616.

Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental science*, *11*(2), 282-298.

Carroll, S. E. (2017). Exposure and input in bilingual development. *Bilingualism: Language and Cognition*, *20*(1), 3-16.

Centraal Bureau voor de Statistiek (2016). *Jaarrapport Integratie 2016*. Den Haag, Centraal Bureau voor de Statistiek.

Centraal Bureau voor de Statistiek (2020). *Jaarrapport Integratie 2020*. Den Haag, Centraal Bureau voor de Statistiek.

Chambers, F. (1997). What do we mean by fluency? *System, 25*(4), 535-544.

Christoffels, I. K., Firk, C., & Schiller, N. O. (2007). Bilingual language control: An event-related brain potential study. *Brain research*, *1147*, 192–208.

Clark, E. V. (1995). *The lexicon in acquisition* (Vol. 65). Cambridge University Press.

Colomé, À. (2001). Lexical activation in bilinguals' speech production: Language-specific or language-independent?. *Journal of memory and language*, *45*, 721–736.

Cornips, L., Van der Hoek, M., & Verwer, R. (2006). The acquisition of grammatical gender in bilingual child acquisition of Dutch (by older Moroccan and Turkish children): The definite determiner, attributive adjective and relative pronoun. *Linguistics in the Netherlands*, *23*(1), 40-51.

Costa, A., & Sebastián-Gallés, N. (2014). How does the bilingual experience sculpt the brain?. *Nature Reviews Neuroscience*, *15*(5), 336-345.

Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The cognate facilitation effect: implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*, 1283.

Costa, A., Miozzo, M., & Caramazza, A. (1999). Lexical selection in bilinguals: Do words in the bilingual's two lexicons compete for selection?. *Journal of Memory and Language*, *41*, 365–397.

Cottini, M., Pieroni, L., Spataro, P., Devescovi, A., Longobardi, E., & Rossi-Arnaud, C. (2015). Feature binding and the processing of global–local shapes in bilingual and monolingual children. *Memory & cognition*, *43*(3), 441-452.

Daneman, M. (1991). Working memory as a predictor of verbal fluency. *Journal of Psycholinguistic Research*, *20*(6), 445-464.

Daneman, M., & Case, R. (1981). Syntactic form, semantic complexity, and short-term memory: Influences on children’s acquisition of new linguistic structures. *Developmental Psychology*, *17*, 367–378.

Daneman, M., & Green, I. (1986). Individual differences in comprehending and producing words in context. *Journal of Memory and Language*, *25*(1), 1-18.

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, *44*(11), 2037-2078.

De Bot, K. (1992). A Bilingual Production Model: Levelt's Speaking Model Adapted. *Applied linguistics*, *13*(1), 1-24.

De Bruin, A., Samuel, A. G., & Duñabeitia, J. A. (2020). Examining bilingual language switching across the lifespan in cued and voluntary switching contexts. *Journal of Experimental Psychology: Human Perception and Performance*.

De Bruin, A., Treccani, B., & Della Sala, S. (2015). Cognitive advantage in bilingualism: An example of publication bias? *Psychological Science*, *26*(1), 99–107.

De Cat, C., Gusnanto, A., & Serratrice, L. (2018). Identifying a threshold for the executive function advantage in bilingual children. *Studies in Second Language Acquisition*, *40*(1), 119-151.

De Houwer, A. (2007). Parental language input patterns and children's bilingual use. *Applied psycholinguistics*, *28*(3), 411-424.

De Jong, N. H., Groenhout, R., Schoonen, R., & Hulstijn, J. H. (2015). Second language fluency: Speaking style or proficiency? Correcting measures of second language fluency for first language behavior. *Applied Psycholinguistics*, *36*(2), 223-243.

Declerck, M., & Philipp, A. M. (2015). A review of control processes and their locus in language switching. *Psychonomic bulletin & review*, *22*(6), 1630-1645.

Declerck, M., Eben, C., & Grainger, J. (2019). A different perspective on domain-general language control using the flanker task. *Acta psychologica*, *198*, 102884.

Declerck, M., Grainger, J., Koch, I., & Philipp, A. M. (2017). Is language control just a form of executive control? Evidence for overlapping processes in language switching and task switching. *Journal of Memory and Language*, *95*, 138-145.

Declerck, M., Grainger, J., Koch, I., & Philipp, A. M. (2017). Is language control just a form of executive control? Evidence for overlapping processes in language switching and task switching. *Journal of Memory and Language*, *95*, 138-145.

Delcenserie, A., & Genesee, F. (2016). The effects of age of acquisition on verbal memory in bilinguals. *International Journal of Bilingualism*, *21*(5), 600-616.

Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological review*, *93*(3), 283.

DeLuca, V., Rothman, J., Bialystok, E., & Pliatsikas, C. (2019). Redefining bilingualism as a spectrum of experiences that differentially affects brain structure and function. *Proceedings of the National Academy of Sciences*, *116*(15), 7565-7574.

Dewaele, J. M., & Li, W. (2013). Is multilingualism linked to a higher tolerance of ambiguity?. *Bilingualism: Language and Cognition*, *16*(2), 231-240.

Dewaele, J. M., & Stavans, A. (2014). The effect of immigration, acculturation and multicompetence on personality profiles of Israeli multilinguals. *International Journal of Bilingualism*, *18*(3), 203-221.

Diamond, A. (2013). Executive functions. *Annual review of psychology*, 64, 135-168.

Dixon, L. Q., Wu, S., & Daraghmeh, A. (2012). Profiles in bilingualism: Factors influencing kindergartners' language proficiency. *Early Childhood Education Journal*, *40*(1), 25-34.

Doğruöz, A. S., & Gries, S. T. (2012). Spread of on-going changes in an immigrant language. *Review of Cognitive Linguistics. Published under the auspices of the Spanish Cognitive Linguistics Association*, *10*(2), 401-426.

Droop, W., & Verhoeven, L. T. W. (2003). Language proficiency and reading ability in first- and second-language learners. *Reading Research Quarterly, 38,* 78-103.

Duñabeitia, J. A., Hernández, J. A., Antón, E., Macizo, P., Estévez, A., Fuentes, L. J., & Carreiras, M. (2014). The inhibitory advantage in bilingual children revisited: Myth or reality? *Experimental Psychology, 61*(3), 234–251.

Engel De Abreu, P. (2011). Working memory in multilingual children: Is there a bilingual effect?. *Memory, 19*, 529-537.

Festman, J., & Münte, T. F. (2012). Cognitive control in Russian–German bilinguals. *Frontiers in Psychology, 3,* 115.

Fiestas, C. F., Bedore, L. M., Peña, E. D., Nagy, V. J., Cohen, J., McAlister, K. T., & MacSwan, J. (2005). Use of mazes in the narrative language samples of bilingual and monolingual 4-to 7-year old children. *Proceedings of the 4th International Symposium on Bilingualism*. 730-740.

Filippi, R., Morris, J., Richardson, F. M., Bright, P., Thomas, M. S., Karmiloff-Smith, A., & Marian, V. (2015). Bilingual children show an advantage in controlling verbal interference during spoken language comprehension. *Bilingualism (Cambridge, England)*, *18*(3), 490.

Foote, R. (2011). Integrated knowledge of agreement in early and late English–Spanish bilinguals. *Applied Psycholinguistics*, *32*, 187–220.

Forster, K. I., & Chambers, S. M. (1973). Lexical access and naming time. *Journal of verbal learning and verbal behavior, 12*, 627–635.

Fortkamp, M. B. M. (1999). Working memory capacity and aspects of L2 speech production. *Communication & Cognition*, *32*(3/4), 259-296.

Francot, R., Blom, E., Broekhuizen, M., & Leseman, P. (2021). Profiles of bilingualism in early childhood: A person-centred Latent Profile Transition Approach. *Bilingualism: Language and Cognition*, *24*(3), 569-582.

French, L. M., & O'Brien, I. (2008). Phonological memory and children's second language grammar learning. *Applied Psycholinguistics*, *29*(03), 463-487.

Friesen, D. C., Luo, L., Luk, G., & Bialystok, E. (2015). Proficiency and control in verbal fluency performance across the lifespan for monolinguals and bilinguals. *Language, cognition and neuroscience*, *30*(3), 238-250.

Fromkin, V. (Ed.). (1973). *Speech Errors as Linguistic Evidence* (Vol. 77). Walter de Gruyter.

Fu, Y., Lu, D., Kang, C., Wu, J., Ma, F., Ding, G., & Guo, T. (2017). Neural correlates for naming disadvantage of the dominant language in bilingual word production. *Brain and language*, *175*, 123-129.

Gagarina, N., Klop, D., Kunnari, S., Tantele, K., V.limaa, T., Balčiūnienė, I., Bohnacker, U., & Gangopadhyay, I., Davidson, M. M., Weismer, S. E., & Kaushanskaya, M. (2016). The role of nonverbal working memory in morphosyntactic processing by school-aged monolingual and bilingual children. *Journal of experimental child psychology*, *142*, 171-194.

Garraffa, M., Beveridge, M., & Sorace, A. (2015). Linguistic and cognitive skills in Sardinian–Italian bilingual children. *Frontiers in psychology*, *6*, 1898.

Garrett, M. F. (1989). Processes in language production. *Linguistics: The Cambridge survey, III. Language, Psychological and Biological Aspects*, 69-96.

Gathercole, S. E., & Baddeley, A. D. (1990). Phonological memory deficits in language disordered children: Is there a causal connection?. *Journal of Memory and Language*, *29*(3), 336-360.

Gathercole, V. C. M., & Thomas, E. M. (2009). Bilingual first-language development: Dominant language takeover, threatened minority language take-up. *Bilingualism: language and cognition*, *12*(2), 213-237.

Georgiadou, E., & Roehr-Brackin, K. (2017). Investigating executive working memory and phonological short-term memory in relation to fluency and self-repair behavior in L2 speech. *Journal of psycholinguistic research*, *46*(4), 877-895.

Gilabert, R., & Muñoz, C. (2010). Differences in attainment and performance in a foreign language: The role of working memory capacity. *International Journal of English Studies*, *10*(1), 19-42.

Giovannoli, J., Martella, D., Federico, F., Pirchio, S., & Casagrande, M. (2020). The Impact of Bilingualism on Executive Functions in Children and Adolescents: A Systematic Review Based on the PRISMA Method. *Frontiers in Psychology*, *11*, 2398.

Golinkoff, R. M., Hoff, E., Rowe, M. L., Tamis-LeMonda, C. S., & Hirsh-Pasek, K. (2019). Language matters: Denying the existence of the 30-million-word gap has serious consequences. *Child development*, *90*(3), 985-992.

Gollan, T. H., & Acenas, L. A. R. (2004). What is a TOT? Cognate and translation effects on tip-of-the-tongue states in Spanish-English and Tagalog-English bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *30*(1), 246.

Gollan, T. H., & Silverberg, N. B. (2001). Tip-of-the-tongue states in Hebrew–English bilinguals. *Bilingualism: language and cognition*, *4*(1), 63-83.

Gollan, T. H., Montoya, R. I., & Bonanni, M. P. (2005). Proper names get stuck on bilingual and monolingual speakers' tip of the tongue equally often. *Neuropsychology*, *19*, 278.

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

Gollan, T. H., Montoya, R. I., Cera, C., & Sandoval, T. C. (2008). More use almost always means a smaller frequency effect: Aging, bilingualism, and the weaker links hypothesis. *Journal of Memory and Language*, *58*, 787–814.

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

Gollan, T. H., Schotter, E. R., Gomez, J., Murillo, M., & Rayner, K. (2014). Multiple levels of bilingual language control: Evidence from language intrusions in reading aloud. *Psychological science*, *25*(2), 585-595.

Gollan, T. H., Slattery, T. J., Goldenberg, D., van Assche, E., Duyck, W., & Rayner, K. (2011). Frequency drives lexical access in reading but not in speaking: The frequency-lag hypothesis. *Journal of Experimental Psychology: General, 140*, 186–209.

Granena, G., & Yilmaz, Y. (2019). Phonological short-term memory capacity and L2 oral performance. *Journal of Second Language Studies*, *2*(2), 317-335.

Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and cognition*, *1*(2), 67-81.

Green, D. W. (2018). Language control and code-switching. *Languages*, *3*(2), 8.

Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology*, *25*(5), 515-530.

Green, D. W., & Abutalebi, J. (2016). Language control and the neuroanatomy of bilingualism: in praise of variety. *Language, Cognition and Neuroscience, 31*(3), 340-344.

Grohmann, K. K., & Kambanaros, M. (2016). The gradience of multilingualism in typical and impaired language development: positioning bilectalism within comparative bilingualism. *Frontiers in Psychology*, *7*, 37.

Grosjean, F. (2012). Bilingual and monolingual language modes. *The encyclopedia of applied linguistics.*

Gross, M., & Kaushanskaya, M. (2016). Contributions of nonlinguistic task-shifting to language control in bilingual children. *Bilingualism: Language and Cognition*, 1-14.

Guará-Tavares, M. G. (2009). The relationship among pre-task planning, working memory capacity, and L2 speech performance: a pilot study. *Linguagem & Ensino*, *12*(1), 165-194.

Guo, L. Y., Tomblin, J. B., & Samelson, V. (2008). Speech Disruptions in the Narratives of English-Speaking Children With Specific Language Impairment. *Journal of Speech, Language, and Hearing Research*, *51*, 722-738.

Guo, T. M., Liu, H. Y., Misra, M., & Kroll, J. F. (2011). Local and global inhibition in bilingual word production: fMRI evidence from Chinese-English bilinguals. *Neuroimage, 56*, 2300–2309

Gupta, P., & Tisdale, J. (2009). Word learning, phonological short-term memory, phonotactic probability and long-term memory: towards an integrated framework. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1536), 3755-3771.

Gupta, P., MacWhinney, B., Feldman, H. M., & Sacco, K. (2003). Phonological memory and vocabulary learning in children with focal lesions. *Brain and Language*, *87*, 241-252.

Hammer, C. S., Hoff, E., Uchikoshi, Y., Gillanders, C., Castro, D. C., & Sandilos, L. E. (2014). The language and literacy development of young dual language learners: A critical review. *Early Childhood Research Quarterly*, *29*(4), 715-733.

Han, W. J. (2012). Bilingualism and academic achievement. *Child Development*, *83*(1), 300-321.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore, MD: Paul H. Brookes.

Hartgers, M. (2012). Onderwijs. In: Vliet, R. van der, en J. Ooijevaar en R. van der Bie (red), *Jaarrapport Integratie 2012* (pp. 69–92). Den Haag/Heerlen: Centraal Bureau voor de Statistiek.

Hermans, D., Bongaerts, T., De Bot, K., & Schreuder, R. (1998). Producing words in a foreign language: Can speakers prevent interference from their first language? *Bilingualism: Language and Cognition, 1*, 13–230.

Hernández, M., Martin, C. D., Barceló, F., & Costa, A. (2013). Where is the bilingual advantage in task-switching?. *Journal of Memory and Language*, *69*(3), 257-276.

Hervais-Adelman, A. G., Moser-Mercer, B., & Golestani, N. (2011). Executive control of language in the bilingual brain: integrating the evidence from neuroimaging to neuropsychology. *Frontiers in psychology, 2*, 234.

Hilchey, M. D., & Klein, R. M. (2011). Are there bilingual advantages on nonlinguistic interference tasks? Implications for the plasticity of executive control processes. *Psychonomic Bulletin & Review, 18*, 625–658.

Hilchey, M. D., & Klein, R. M. (2011). Are there bilingual advantages on non-linguistic interference tasks? Implications for the plasticity of executive control processes. *Psychonomic Bulletin & Review 18*, 625-658.

Hilton, H. (2008). The link between vocabulary knowledge and spoken L2 fluency. *Language Learning Journal*, *36*(2), 153-166.

Hindman, A. H., & Morrison, F. J. (2012). Differential contributions of three parenting dimensions to preschool literacy and social skills in a middle-income sample. *Merrill-Palmer Quarterly (1982-)*, 191-223.

Hoff, E. (2018). Bilingual development in children of immigrant families. *Child development perspectives*, *12*(2), 80-86.

Hoff, E., & Naigles, L. (2002). How children use input to acquire a lexicon. *Child Development, 73*,418–433.

Hoff, E., Core, C., Place, S., Rumiche, R., Señor, M., & Parra, M. (2012). Dual language exposure and early bilingual development. *Journal of child language*, *39*(1), 1-27.

Housen, A., & Kuiken, F. (2009). Complexity, accuracy, and fluency in second language acquisition. *Applied Linguistics*, 30(4), 461-473.

Housen, A., Kuiken, F., & Vedder, I. (2012). Complexity, accuracy and fluency. *Dimensions of L2 performance and proficiency: Complexity, accuracy and fluency in SLA*, *32*, 1-20.

Houwer, A. de (2007). Parental language input patterns and children's bilingual use. *Applied Psycholinguistics*, *28*, 411-424.

Ionin, T., & Wexler, K. (2002). Why is “is” easier than “-s”?: Acquisition of tense/agreement morphology by child second language learners of English. *Second Language Research*, *18*, 95–136.

IS0804, C. A. (2009). Language impairment in a multilingual society: Linguistic patterns and the road to assessment. *Brussels: COST Office. Available online at: http://www. bi-sli. org*.

Ivanova, I., & Costa A. (2008). Does bilingualism hamper lexical access in speech production? *Acta Psychologica, 127*, 277–288.

Jarvis, S. (2003). Probing the effects of the L2 on the L1: A case study. *Effects of the second language on the first*, *3*, 81-102.

Jia, G., Kohnert, K., & Collado, J. (2006). Action naming in Spanish and English by sequential bilingual children and adolescents. *Journal of Speech, Language, and Hearing Research*, *49*, 588–602.

Jylkkä, J., Lehtonen, M., Lindholm, F., Kuusakoski, A., & Laine, M. (2018). The relationship between general executive functions and bilingual switching and monitoring in language production. *Bilingualism: Language and Cognition*, *21*(3), 505-522.

Kan, P. F., & Kohnert, K. (2005). Preschoolers Learning Hmong and English Lexical-Semantic Skills in L1 and L2. *Journal of Speech, Language, and Hearing Research, 48*, 372–383.

Kapa, L. L., & Colombo, J. (2013). Attentional control in early and later bilingual children. *Cognitive development*, *28*(3), 233-246.

Kaushanskaya, M., Blumenfeld, H. K., & Marian, V. (2011). The relationship between vocabulary and short-term memory measures in monolingual and bilingual speakers. *The International Journal of Bilingualism: Cross-Disciplinary, Cross-Linguistic Studies of Language Behavior*, *15*(4), 408–425.

Keuleers, E., Brysbaert, M., & New, B. (2010). SUBTLEX-NL: A new measure for Dutch word frequency based on film subtitles. *Behavior research methods*, *42*, 643–650.

Kharkhurin, A. V. (2009). The role of bilingualism in creative performance on divergent thinking and invented alien creatures tests. *The Journal of Creative Behavior*, *43*(1), 59-71.

Kohnert, K. (2002). Picture Naming in Early Sequential Bilinguals: A 1-Year Follow-Up. *Journal of Speech, Language, and Hearing Research*, *45*, 759–771.

Kohnert, K. J., & Bates, E. (2002). Balancing Bilinguals II: Lexical Comprehension and Cognitive Processing in Children Learning Spanish and English. *Journal of Speech, Language, and Hearing Research*, *45*, 347–359.

Kohnert, K. J., Bates, E., & Hernandez, A. E. (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.

Kormos, J. (1999). Monitoring and self-repair in L2. *Language Learning*, *49* (2), 303–342.

Kossmann, M. G., & Grigore G, B. G. (2016). Yes/no interrogatives in Moroccan Dutch. In *Arabic Varieties: Far and Wide. Proceedings of the 11th International Conference of AIDA–Bucharest, 2015.* (pp. 351-358). Editura Universităţii din Bucureşti.

Kroll, J. F., Bobb, S. C., & Wodniecka, Z. (2006). Language selectivity is the exception, not the rule: Arguments against a fixed locus of language selection in bilingual speech. *Bilingualism: Language and Cognition, 9*, 119-135.

Kroll, J. F., Gollan, T. H., Goldrick, M., Ferreira, V., & Miozzo, M. (2014). Speech planning in two languages: What bilinguals tell us about language production. *The Oxford handbook of language production*, 165-181.

Laine, M., & Lehtonen, M. (2018). Cognitive consequences of bilingualism: where to go from here?. *Language, Cognition and Neuroscience, 33*(9), 1205-1212.

Lehtonen, M., Soveri, A., Laine, A., Järvenpää, J., De Bruin, A., & Antfolk, J. (2018). Is bilingualism associated with enhanced executive functioning? A meta-analytic review. *Psychological Bulletin, 144*(4), 394–425.

Leivada, E., Westergaard, M., Duñabeitia, J. A., & Rothman, J. (2021). On the phantom-like appearance of bilingualism effects on neurocognition:(How) should we proceed?. *Bilingualism: Language and Cognition*, *24*(1), 197-210.

Leseman, P. P. (2000). Bilingual vocabulary development of Turkish preschoolers in the Netherlands. *Journal of multilingual and multicultural development*, *21*(2), 93-112.

Levelt, W. J. (1989). *From Intention to Articulation*. MIT Press: Cambridge, MA.

Levelt, W. J., & Meyer, A. S. (2000). Word for word: Multiple lexical access in speech production. *European Journal of Cognitive Psychology*, *12*(4), 433-452.

Luk, G., & Bialystok, E. (2013). Bilingualism is not a categorical variable: Interaction between language proficiency and usage. *Journal of Cognitive Psychology*, *25*(5), 605-621.

Luk, G., Bialystok, E., Craik, F. I., & Grady, C. L. (2011). Lifelong bilingualism maintains white matter integrity in older adults. *Journal of Neuroscience*, *31*(46), 16808-16813.

Luk, G., Green, D., Abutalebi, J., & Grady, C. (2012). Cognitive control for language switching in bilinguals: A quantitative meta-analysis of functional neuro imaging studies. *Language and Cognitive Processes, 27,* 1479– 1488.

MacWhinney, B. (2000). *The CHILDES Project: Tools for Analyzing Talk*. 3rd Edition. Mahwah, NJ: Lawrence Erlbaum Associates.

Mägiste, E. (1992). Second language learning in elementary and high school students. *European Journal of Cognitive Psychology, 4,* 355–365.

Marchman, V. A., Martínez-Sussmann, C., & Dale, P. S. (2004). The language-specific nature of grammatical development: Evidence from bilingual language learners. *Developmental Science*, *7*(2), 212-224.

Martin-Rhee, M. M., & Bialystok, E. (2008). The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: language and cognition, 11*(1), 81-93.

Moradzadeh, L., Blumenthal, G., & Wiseheart, M. (2014). Musical training, bilingualism, and executive function: A closer look at task switching and dual-task performance. *Cognitive Science, 39*, 1–29.

Masoura, E. V., & Gathercole, S. E. (2005). Phonological short-term, memory skills and new word learning in young Greek children. *Memory, 13,* 422-429.

Merzenich, M. M., Jenkins, W. M., Johnston, P., Schreiner, C., Miller, S. L., & Tallal, P. (1996). Temporal processing deficits of language-learning impaired children ameliorated by training. *Science, 271*(5245), 77-81.

Michael, E. B., & Gollan, T. H. (2005). Being and becoming bilingual: Individual differences and consequences for language production. In J. F. Kroll, & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches*. (pp. 389–407). New York: Oxford University Press.

Michel, M. (2017). Complexity, accuracy, and fluency in L2 production. *The Routledge handbook of instructed second language acquisition*, *50*, 68.

Miller, J. F., Heilmann, J., Nockerts, A., Iglesias, A., Fabiano, L., & Francis, D. J. (2006). Oral language and reading in bilingual children. *Learning Disabilities Research & Practice*, *21*(1), 30-43.

Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions: Four general conclusions. *Current directions in psychological science*, *21*(1), 8-14.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*, 49–100.

Mizera, G. J. (2006). Working memory and L2 oral fluency. Doctoral Dissertation. University of Pittsburgh.

Morales, J., Calvo, A., & Bialystok, E. (2013). Working memory development in monolingual and bilingual children. *Journal of Experimental Child Psychology*, *114*(2), 187-202.

Morton, J. B., & Harper, S. N. (2007). What did Simon say? Revisiting the bilingual advantage. *Developmental Science*, *10*, 719–726.

Mota, M. B. (2003). Working memory capacity and fluency, accuracy, complexity, and lexical density in L2 speech production. *Fragmentos: Revista de Língua e Literatura Estrangeiras*, 24.

Mulder, F., Timman, Y., & Verhallen, S. (2009). Handreiking bij de Basiswoordenlijst Amsterdamse Kleuters (BAK). ITTA.

Murray, W. S., & Forster, K. I. (2004). Serial mechanisms in lexical access: the rank hypothesis. *Psychological Review, 111*(3), 721.

Musacchia, G., Sams, M., Skoe, E., & Kraus, N. (2007). Musicians have enhanced subcortical auditory and audiovisual processing of speech and music. *Proceedings of the National Academy of Sciences, 104*(40), 15894-15898.

Navarro-Ruiz, M. I., & Rallo-Fabra, L. (2001). Characteristics of mazes produced by SLI children. *Clinical linguistics & phonetics*, *15*(1-2), 63-66.

O'Brien, I., Segalowitz, N., Freed, B., & Collentine, J. (2007). Phonological memory predicts second language oral fluency gains in adults. *Studies in Second Language Acquisition*, *29*(04), 557-581.

Oller, D. K., Pearson, B. Z., & Cobo-Lewis, A. B. (2007). Profile effects in early bilingual language and literacy. *Applied Psycholinguistics, 28,* 191–230.

Paap, K. (2018). Bilingualism in cognitive science. In A. De Houwer & L. Ortega (Eds.), *Handbook of bilingualism*. Cambridge: Cambridge University Press.

Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cognitive Psychology, 66,* 232–258.

Paap, K. R., & Sawi, O. (2014). Bilingual advantages in executive functioning: Problems in convergent validity, divergent validity, and the identification of the theoretical constructs. *Frontiers in Psychology*, *5*(962), 1–15

Paap, K. R., Johnson, H. A., & Sawi, O. (2014). Are bilingual advantages dependent upon specific tasks or specific bilingual experiences? *Journal of Cognitive Psychology, 26*, 615–639.

Paap, K. R., Johnson, H. A., & Sawi, O. (2015). Bilingual advantages in executive functioning either do not exist or are restricted to very specific and undetermined circumstances. *Cortex 69,* 265-278.

Paap, K., Schwieter, J. W., & Paradis, M. (2019). The bilingual advantage debate. *The handbook of the neuroscience of multilingualism*, 701-735.

Paap, K.R., Myuz, H.A., Anders, R.T., Bockelman, M.F., Mikulinsky, R. & Sawi, O.M. (2016) No compelling evidence for a bilingual advantage in switching or that frequent language switching reduces switch cost. *Journal of Cognitive Psychology*, *29*(2), 89-112.

Pallotti, G. (2009). CAF: Defining, refining and differentiating constructs. *Applied linguistics*, *30*(4), 590-601.

Paradis, J. (2005). Grammatical morphology in children learning English as a second language. implications of similarities with Specific Language Impairment. *Language, Speech, and Hearing Services in Schools*, *36*(3), 172-187.

Paradis, J. (2010). Bilingual children's acquisition of English verb morphology: Effects of language exposure, structure complexity, and task type. *Language Learning, 60*(3), 651-680.

Paradis, J., Genesee, F., & Crago, M. (2011). *Dual language development & disorders: A handbook on bilingualism & second language learning*. Baltimore: Paul H. Brooks Publishing.

Park, J., Ellis Weismer, S., & Kaushanskaya, M. (2018). Changes in executive function over time in bilingual and monolingual school-aged children. *Developmental psychology*, *54*(10), 1842.

Pavlenko, A., & Jarvis, S. (2002). Bidirectional transfer. *Applied linguistics*, *23*(2), 190-214.

Pearson, B. Z., Fernandez, S. C., Lewedeg, V., & Oller, D. K. (1997). The relation of input factors to lexical learning by bilingual infants. *Applied psycholinguistics*, *18*(1), 41-58.

Peeters, D., & Dijkstra, T. (2018). Sustained inhibition of the native language in bilingual language production: A virtual reality approach. *Bilingualism: Language and Cognition*, *21*(5), 1035-1061.

Pires, A., & Rothman, J. (2009). Disentangling sources of incomplete acquisition: An explanation for competence divergence across heritage grammars. *International Journal of Bilingualism*, *13*(2), 211-238.

Place, S., & Hoff, E. (2011). Properties of dual language exposure that influence 2-year-olds' bilingual proficiency. *Child development*, *82*(6), 1834-1849.

Poarch, G. J., & Krott, A. (2019). A bilingual advantage? An appeal for a change in perspective and recommendations for future research. *Behavioral Sciences*, *9*(9), 95.

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*(4), 535-551.

Polinsky, M., & Kagan, O. (2007). Heritage languages: In the 'wild' and in the classroom. *Language and linguistics compass*, *1*(5), 368-395.

Portocarrero, J. S., Burright, R. G., & Donovick, P. J. (2007). Vocabulary and verbal fluency of bilingual and monolingual college students. *Archives of Clinical Neuropsychology*, *22*, 415–422.

Poulin-Dubois, D., Bialystok, E., Blaye, A., Polonia, A., & Yott, J. (2013). Lexical access and vocabulary development in very young bilinguals. *International Journal of Bilingualism*, *17*, 57–70.

Prevoo, M. J., Malda, M., Mesman, J., Emmen, R. A., Yeniad, N., van Ijzendoorn, M. H., & Linting, M. (2014). Predicting ethnic minority children's vocabulary from socioeconomic status, maternal language and home reading input: different pathways for host and ethnic language. *Journal of child language*, *41*(5), 963-984.

Prévost, P. (2003). Truncation and missing surface inflection in initial L2 German. *Studies in Second Language Acquisition*, *25*, 65–97.

Prior, A., & Gollan, T. H. (2011). Good language-switchers are good task-switchers: evidence from Spanish-English and Mandarin-English bilinguals. *Journal of the International Neuropsychological Society*, *17*(4), 682-691.

Prior, A., & Gollan, T. H. (2013). The elusive link between language control and executive control: A case of limited transfer. *Journal of Cognitive Psychology*, *25*(5), 622-645.

Prior, A., & MacWhinney, B. (2010). A bilingual advantage in task switching. *Bilingualism: Language and Cognition*, *13*(02), 253-262.

Raudszus, H., Segers, E., & Verhoeven, L. (2018). Lexical quality and executive control predict children's first and second language reading comprehension. *Reading and writing*, *31*(2), 405-424.

Ribot, K. M., & Hoff, E. (2014). "¿ Cómo estas?""I'm good." Conversational code-switching is related to profiles of expressive and receptive proficiency in Spanish-English bilingual toddlers. *International journal of behavioral development*, *38*(4), 333-341.

Rispens, J., & Baker, A. (2012). Nonword repetition: The relative contributions of phonological short-term memory and phonological representations in children with language and reading impairment.

Rispens, J., & De Bree, E. (2015). Bilingual children's production of regular and irregular past tense morphology. *Bilingualism: Language and Cognition*, *18*(2), 290-303.

Rodriguez-Fornells, A., van der Lugt, A., Rotte, M., Britti, B., Heinze, H. J., & Münte, T. F. (2005). Second language interferes with word production in fluent bilinguals: Brain potential and functional imaging evidence. *Journal of Cognitive Neuroscience, 17*, 422–433.

Rosen, M. L., Hagen, M. P., Lurie, L. A., Miles, Z. E., Sheridan, M. A., Meltzoff, A. N., & McLaughlin, K. A. (2020). Cognitive stimulation as a mechanism linking socioeconomic status with executive function: A longitudinal investigation. *Child development*, *91*(4), e762-e779.

Rossion, B., & Pourtois, G. (2004). Revisiting Snodgrass and Vanderwart's object pictorial set: the role of surface detail in basic-level object recognition. *Perception*, *33*, 217.

Rothman, J. (2007). Heritage speaker competence differences, language change, and input type: Inflected infinitives in Heritage Brazilian Portuguese. *International Journal of Bilingualism*, *11*(4), 359-389.

Runnqvist, E., Strijkers, K., & Costa, A. (2014). 11 Bilingual Word Access. *The Oxford handbook of language production*, 182.

Sandoval, T. C., Gollan, T. H., Ferreira, V. S., & Salmon, D.P. (2010). What causes the bilingual disadvantage in verbal fluency? The dual-task analogy. *Bilingualism: Language and Cognition*, *13*, 231–252.

Scheele, A. F., Leseman, P. P., & Mayo, A. Y. (2010). The home language environment of monolingual and bilingual children and their language proficiency. *Applied Psycholinguistics*, *31*(1), 117-140.

Schlichting, L. (2005). *Peabody picture vocabulary test-III-NL*. Amsterdam, the Netherlands: Hartcourt Assessment BV.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime User's Guide*. Pittsburgh, PA:

Schofield, T., Beaumont, K., Widaman, K., Jochem, R., Robins, R., & Conger, R. (2012). Parent and child fluency in a common language: Implications for the parent–child relationship and later academic success in Mexican American families. *Journal of Family Psychology*, *26*(6), 869.

Schroeder, S. R. (2018). Do bilinguals have an advantage in theory of mind? A meta-analysis. *Frontiers in Communication*, *3*, 36.

Segal, D., Prior, A., & Gollan, T. H. (2021). Do All Switches Cost the Same? Reliability of Language Switching and Mixing Costs. *Journal of cognition*, *4*(1).

Segalowitz, N., & Hulstijn, J. (2005). Automaticity in bilingualism and second language learning. *Handbook of bilingualism: Psycholinguistic approaches*, *371*, 388.

Sevinc, Y. (2014). Linguistic and social factors in Turkish-Dutch contact across generations. *Dutch Journal of Applied Linguistics*, *3*(1), 82-100.

Silven, M., Voeten, M., Kouvo, A., & Lunden, M. (2014). Speech perception and vocabulary growth: a longitudinal study of Finnish-Russian bilinguals and Finnish monolinguals from infancy to three years. *International Journal of Behavioral Development*, *38*(4), 323-332.

Skehan, P. (2003). Task-based instruction. *Language teaching*, *36*(1), 1-14.

Skehan, P. (2009). Modelling second language performance: Integrating complexity, accuracy, fluency, and lexis. *Applied linguistics*, *30*(4), 510-532.

Skehan, P., & Foster, P. (1999). The influence of task structure and processing conditions on narrative retellings. *Language Learning*, *49*(1), 93-120.

Smith, F. (1923). Bilingualism and mental development. *British Journal of Psychology. General Section*, *13*(3), 271-282.

Snow, C. E., Burns, M. S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. National Academies Press.

Speidel, G. E. (1993). Phonological short-term memory and individual differences in learning to speak: A bilingual case study. *First Language*, *13*, 69–91.

Speidel, G. E., & Herreshoff, M. J. (1989). Imitation and the construction of long utterances. In G. E. Speidel & K. E. Nelson (Eds.), *The many faces of imitation in language learning* (pp. 181–197). New York: Springer-Verlag.

Sperry, D. E., Sperry, L. L., & Miller, P. J. (2019). Reexamining the verbal environments of children from different socioeconomic backgrounds. Child development, 90(4), 1303-1318.

Stasenko, A., Matt, G. E., & Gollan, T. H. (2017). A relative bilingual advantage in switching with preparation: Nuanced explorations of the proposed association between bilingualism and task switching. *Journal of Experimental Psychology: General*, *146*(11), 1527.

Stocco, A., Yamasaki, B., Natalenko, R., & Prat, C. S. (2014). Bilingual brain training: A neurobiological framework of how bilingual experience improves executive function. *International Journal of Bilingualism*, *18*(1), 67-92.

Taliancich, C. L. (2015). Speech revisions in monolingual English and Spanish-English bilingual children. Doctoral dissertation, University of Texas.

Thordardottir, E. (2011). The relationship between bilingual exposure and vocabulary development. *International Journal of Bilingualism*, *15*(4), 426-445.

Thorn, A. S., & Gathercole, S. E. (1999). Language-specific knowledge and short-term memory in bilingual and non-bilingual children. *The Quarterly Journal of Experimental Psychology*: *Section A*, *52*(2), 303-324.

Ticheloven, A., Blom, E., Leseman, P., & McMonagle, S. (2021). Translanguaging challenges in multilingual classrooms: scholar, teacher and student perspectives. *International Journal of Multilingualism*, *18*(3), 491-514.

Timmer, K., Calabria, M., Branzi, F. M., Baus, C., & Costa, A. (2018). On the reliability of switching costs across time and domains. *Frontiers in psychology*, *9*, 1032.

Trebits, A., & Kormos, J. (2008). Working Memory Capacity and Narrative Task Performance. *Proceedings form the 33rd International LAUD Symposium*, Landau/Pfalz, Germany.

Tuller, L. (2015). Clinical use of parental questionnaires in multilingual contexts. In: S. Armon-Lotem, J. de Jong, & N. Meir (Eds.), *Methods for assessing multilingual children: disentangling bilingualism from Language Impairment*. Bristol: Multilingual Matters.

Unsworth, N., Redick, T. S., McMillan, B. D., Hambrick, D. Z., Kane, M. J., & Engle, R. W. (2015). Is playing video games related to cognitive abilities?. *Psychological science*, *26*(6), 759-774.

Unsworth, S. (2013). Assessing the role of current and cumulative exposure in simultaneous bilingual acquisition: The case of Dutch gender. *Bilingualism: Language and cognition*, *16*(1), 86-110.

Valdés, G. (2000). Teaching heritage languages: An introduction for Slavic-language-teaching professionals. In O. Kagan & B. Rifkin (Eds.), *Learning and teaching of*

Slavic languages and cultures: Toward the 21st century (pp. 375–403). Bloomington, IN: Slavica.

Valdés, G. (2014). Heritage language students: Profiles and possibilities. In *Handbook of heritage, community, and native American languages in the United States* (pp. 41-49). Routledge.

Van Dijk, M., Kroesbergen, E. H., Blom, E., & Leseman, P. P. (2019). Bilingualism and creativity: Towards a situated cognition approach. *The Journal of Creative Behavior, 53*(2), 178-188.

Verhagen, J., & Leseman, P. (2016). How do verbal short-term memory and working memory relate to the acquisition of vocabulary and grammar? A comparison between first and second language learners. *Journal of Experimental Child Psychology*, *141*, 65-82.

Verhagen, J., Leseman, P., & Messer, M. (2015). Phonological memory and the acquisition of grammar in child L2 learners. *Language Learning*, *65*(2), 417-448.

Verhagen, J., Mulder, H, & Leseman, P. (2017). Effects of home language environment on inhibitory control in bilingual three-year-old children. *Bilingualism: Language and Cognition*, *20*(1), 114-127

Verhoeven, L. T. (1994). Transfer in bilingual development: The linguistic interdependence hypothesis revisited. *Language learning*, *44*(3), 381-415.

Verhoeven, L. T. (2007). Early bilingualism, language transfer, and phonological awareness. *Applied Psycholinguistics, 28*, 425-439.

Verhoeven, L., & Vermeer, A. (2002). *Taaltoets Alle Kinderen* [Language Test for All Children]. Arnhem, The Netherlands: Cito.

Verhoeven, L., Steenge, J., & Van Balkom, H. (2011). Verb morphology as a clinical marker of specific language impairment: Evidence from first and second language learners. *Research in Developmental Disabilities, 32*, 1186–1193.

Verhoeven, L., Steenge, J., & van Balkom, H. (2012). Linguistic transfer in bilingual children with specific language impairment. *International Journal of Language & Communication Disorders*, *47*(2), 176-183.

Verreyt, N., Woumans, E. V. Y., Vandelanotte, D., Szmalec, A., & Duyck, W. (2016). The influence of language-switching experience on the bilingual executive control advantage. *Bilingualism: Language and Cognition*, *19*(1), 181-190.

Walters, J. (2012). MAIN – Multilingual Assessment Instrument for Narratives. *ZAS*

Wechsler, D. & Naglieri. J. A. (2008). *WNV NL. Wechsler Nonverbal Scale of ability*. Nederlandstalige bewerking. Amsterdam: Pearson.

Weissberger, G. H., Gollan, T. H., Bondi, M. W., Clark, L. R., & Wierenga, C. E. (2015). Language and task switching in the bilingual brain: Bilinguals are staying, not switching, experts. *Neuropsychologia*, *66*, 193-203.

Weissberger, G. H., Wierenga, C. E., Bondi, M. W., & Gollan, T. H. (2012). Partially overlapping mechanisms of language and task control in young and older bilinguals. *Psychology and Aging*, *27*(4), 959.

Wijnen, F. (1990). The development of sentence planning. *Journal of Child Language*, 17 (3), 651-675.

Wiley, T. G. (2001). On defining heritage languages and their speakers. *Heritage languages in America: Preserving a national resource*, 29-36.

Yaruss, J. S., Newman, R. M., & Flora, T. (1999). Language and disfluency in nonstuttering children's conversational speech. *Journal of Fluency Disorders*, *24*(3), 185-207.

Yim, O., & Bialystok, E. (2012). Degree of conversational code-switching enhances verbal task switching in Cantonese–English bilinguals. *Bilingualism: Language and Cognition*, *15*(04), 873-883.

Zelazo P.D. (2006). The dimensional change card sort (DCCS): A method of assessing executive function in children. *Nature Protocols*, *1*, 297–301.

Zeng, Z., Kalashnikova, M., & Antoniou, M. (2019). Integrating bilingualism, verbal fluency, and executive functioning across the lifespan. *Journal of Cognition and Development*, *20*(5), 656-679.

Samenvatting

(summary in Dutch)

Veel kinderen groeien als gevolg van migratie op met meer dan één taal. Zij leren dan vaak op school de taal van het land waarin zij wonen, de meerderheidstaal. Thuis spreken ze de taal van het land van herkomst, de minderheidstaal of erfgoedtaal. Hoe vaak zij thuis de erfgoedtaal gebruiken en hoe goed hun vaardigheden in deze taal zijn, verschilt tussen kinderen. De studie voor dit proefschrift werd uitgevoerd in Nederland, waar veel kinderen een Turkse of Marokkaanse afkomst hebben en thuis Turks, Berbers en/of Arabisch spreken. Door deze meertalige ervaringen is de taalontwikkeling van deze kinderen vaak anders dan die van ééntalige Nederlandse kinderen. Zij zijn vaak minder blootgesteld aan het Nederlands en gebruiken deze taal minder vaak waardoor hun vaardigheden in het Nederlands niet altijd op hetzelfde niveau zijn. Een ander verschil met ééntalige kinderen is het feit dat tweetalige kinderen tussen hun talen schakelen en dat zij tijdens het gebruik van de ene taal de activatie van de andere taal moeten onderdrukken. Het idee is dat tweetalige kinderen hierbij gebruik maken van algemene cognitieve vaardigheden en dat zij door het cognitief schakelen meer kansen hebben om hun cognitieve vaardigheden te trainen dan ééntalige kinderen. Hoe sterk dit cognitieve effect van meertaligheid is en onder welke omstandigheden het ontwikkelt, is echter nog onvoldoende bekend.

Het doel van het onderzoek in dit proefschrift was om de taalontwikkeling en de cognitieve vaardigheden van 5-8-jarige kinderen in Nederland met een Turkse en Marokkaanse afkomst te onderzoeken. De focus lag daarbij op hun taalproductie. Er werden bij deze kinderen verschillende taaltaken en cognitieve taken afgenomen. Dezelfde taken werden ook bij een controlegroep met ééntalige Nederlandse kinderen afgenomen. De vragen van het onderzoek waren in hoeverre de verschillen in blootstelling aan de erfgoedtaal en het Nederlands invloed hebben op de taalproductie in de twee talen en in hoeverre er verbanden zijn tussen de taalproductie (met name in het Nederlands) en algemene cognitieve vaardigheden van deze kinderen. Een ander doel was om te onderzoeken in hoeverre het schakelen tussen twee talen gerelateerd is aan non-verbaal schakelen. Deze samenhang wordt namelijk vaak gebruikt als verklaring voor betere cognitieve vaardigheden bij tweetalige kinderen.

De studie in hoofdstuk 2 onderzocht de lexicale toegang van de kinderen die een erfgoedtaal spreken in vergelijking tot de Nederlandse controlegroep. Lexicale toegang betekent het activeren van woorden in het mentale lexicon. Om deze lexicale toegang te meten werd bij de kinderen een taak afgenomen waarin zij zo snel mogelijk plaatjes moesten benoemen. De tweetalige kinderen deden dit in het Nederlands en in de erfgoedtaal, terwijl de Nederlandse kinderen dit alleen in het Nederlands deden. Gemeten werden de correctheid van hun antwoorden en de snelheid waarmee ze reageerden. Alle kinderen werden na één jaar weer getest met dezelfde taak. Beide tweetalige groepen (Turks-Nederlands, Berbers-Nederlands) lieten in het Nederlands een snellere lexicale toegang zien dan in hun erfgoedtaal. Omdat de kinderen van Marokkaanse afkomst te weinig productieve vaardigheden in de erfgoedtaal (Berbers) bleken te hebben, werden alleen de Turks-

Nederlandse kinderen ook getest in een conditie waarin ze Nederlands en de erfgoedtaal (Turks) mixen. Het bleek dat kinderen in deze ‘mix-conditie’ langzamer zijn dan wanneer ze alleen één van hun talen gebruikten. De tweetalig Berbers-Nederlandse kinderen reageerden in het Nederlands net zo snel als de ééntalige controlegroep. De Turks-Nederlandse kinderen waren langzamer in het produceren van Nederlandse woorden dan de ééntalige kinderen. Deze resultaten suggereren dat de mate van taalgebruik en blootstelling aan een taal van invloed zijn op de lexicale toegang in die taal.

Hoofdstuk 3 focust op taalproductie in de gesproken taal van ééntalige en tweetalige kinderen. Hierbij werd gekeken naar het aantal fouten dat de twee groepen kinderen maken als zij Nederlands spreken en hoe vloeiend hun taalproductie is. Het doel van het onderzoek was om erachter te komen in hoeverre taalvaardigheid, gemeten via woordenschat en grammatica, maar ook vaardigheden zoals fonologische korte-termijn geheugen en werkgeheugen de taalproductie beïnvloeden en of er hierbij verschillen zijn tussen ééntalige en tweetalige kinderen. Om dit te onderzoeken werden de opnames van gesproken taal van 40 ééntalige Nederlandse en 40 tweetalige Berbers-Nederlandse en Turks-Nederlandse kinderen gecodeerd en geanalyseerd. Zoals ook in eerder onderzoek gevonden, maakten de tweetalige kinderen meer fouten in het Nederlands en was hun taalproductie minder vloeiend dan de taal van de ééntalige kinderen. De observatie dat de tweetalige kinderen meer fouten maakten kon deels worden verklaard door verschillen in woordenschat en grammatica tussen de twee groepen. Vloeiendheid van taalproductie in het Nederlands bleek in de tweetalige groep verband te houden met hun fonologische korte-termijn geheugen en de het verschil in vloeiendheid met de eentalige groep bleek gerelateerd te zijn aan een verschil in fonologische korte-termijn geheugen. Tweetalige kinderen met een lagere taalvaardigheid in het Nederlands lopen dus kans om meer fouten te maken in hun taalproductie van het Nederlands. Tweetalige kinderen met een beperkter fonologische korte-termijn geheugen lopen het risico om minder vloeiend te spreken.

In hoofdstuk 4 stond het schakelen tussen talen bij tweetalige kinderen centraal. Als verklaring voor eventuele cognitieve voordelen bij tweetalige kinderen wordt vaak aangenomen dat het schakelen tussen talen beroep doet op algemene cognitieve vaardigheden. Eerder onderzoek heeft echter het cognitieve voordeel en het veronderstelde onderliggende mechanisme hiervan apart onderzocht. In deze studie werd daarom in twee vergelijkbare experimenten onderzocht of er verbanden zijn tussen het schakelen tussen twee talen en het schakelen tussen twee niet-talige taken. Deze zelfde groep tweetalige kinderen werd met een ééntalige controlegroep vergeleken om vast te stellen of zij beter presteerden in de niet-talige cognitieve taak. Binnen de tweetalige groep bleek er een verband te zijn tussen de reactietijden in de conditie waarin de talen gemixt waren en de reactietijden in de ‘mix-conditie’ in de niet-talige taak. In deze conditie moesten kinderen afwisselend plaatjes sorteren op kleur en vorm. Dit verband suggereert dat het schakelen tussen talen gerelateerd is aan algemene cognitieve vaardigheden. Deze conclusie wordt ondersteund door de observatie dat een soortgelijk verband niet werd gevonden in de experimentele condities waarin niet gemixt werd. Echter heeft deze studie ook laten zien dat dit verband niet altijd samenhangt met cognitieve voordelen in de tweetalige groep, want er was geen verschil in cognitieve prestaties tussen de tweetalige groep en de ééntalige controlegroep.

De studies in dit proefschrift onderzochten diverse aspecten van taalproductie van kinderen in Nederland die naast het Nederlands ook een erfgoedtaal spreken. Een belangrijke overkoepelende conclusie is dat de taalproductie van kinderen die een erfgoedtaal spreken niet alleen afhankelijk is van hun taalgebruik en taalvaardigheid, maar ook verband houdt met niet-talige vaardigheden zoals fonologische korte-termijn geheugen en algemene cognitieve vaardigheden. In de tweetalige groep bleek veel variatie te zijn. Toekomstig onderzoek zou de complexe verbanden die in het huidige proefschrift onderzocht zijn, kunnen onderzoeken door meertaligheid als continuüm te meten in plaats van een categorische variabele.

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Mona was born on May 27th, 1987 in Glandorf, Germany. After finishing high school in 2007, she moved to the Netherlands to study English and Linguistics at the University of Groningen. During her BA and MA studies, she developed her interest in second language acquisition and bilingualism. Mona worked in various research projects, studying age groups from toddlers to elderly bilinguals.

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