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Nonverbal Switching Ability of Monolingual and Bilingual Children with and without Developmental Language Disorder

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Abstract: Bilingualism is associated with enhanced switching skills, while a developmental language disorder (DLD) may negatively impact switching ability. However, both studies with bilinguals as well as studies including children with DLD have revealed mixed results. Moreover, the interaction of bilingualism and DLD has not been addressed and the origin of the stronger or weaker switching performance is unknown. The current study aimed to fill these gaps. Monolingual and bilingual children with and without DLD (n = 32 in each of the four groups) completed a nonverbal color/shape switching task when they were 7 to 8 years old, and a Continuous Performance Task two years earlier. The latter tapped into their response inhibition and sustained attention skills, which may underlie switching ability. No differences between monolinguals and bilinguals were found on the switching task. Children with DLD had higher mixing costs than peers without DLD, which was driven by differences in sustained attention skills. These results add to the body of research indicating that the cognitive advantages of bilingualism are unstable. Additionally, the results substantiate the hypothesis that attention processes are foundational for complex cognitive skills, such as switching, and suggest cascading effects for children with weaker attention skills, such as children with DLD.

Keywords: bilingualism; developmental language disorder; executive functioning; switching; sustained attention; response inhibition

Citation: Boerma, Tessel, Merel van Witteloostuijn, and Elma Blom. 2022. Nonverbal Switching Ability of Monolingual and Bilingual Children with and without Developmental Language Disorder. *Languages* 7: 108. https://doi.org/10.3390/languages7020108

Academic Editor: Stephanie Durrleman

Received: 3 December 2021
Accepted: 21 April 2022
Published: 28 April 2022

1. Introduction

In everyday life, children continuously need to adapt to changing situations. This requires cognitive switching: the ability to adapt behavior to new situations and switch flexibly between tasks or perspectives (Diamond 2013; Legare et al. 2018). Switching, sometimes referred to as cognitive flexibility or shifting, is one of the core components of executive functioning (EF), which also includes the updating of working memory and the inhibition of unwanted behavior (Miyake et al. 2000). Together, these EF components regulate one's thoughts and actions, allow for complex skills such as the planning and execution of goal-oriented behavior (Barkley 2012; Diamond 2013), and are essential for school success and quality of life (Borella et al. 2010; Brown and Landgraf 2010).

Previous research has shown that EF may be positively affected by bilingualism (Hilchey and Klein 2011; Martin-Rhee and Bialystok 2008; van den Noort et al. 2019; Ware et al. 2020). In contrast, having a developmental language disorder (DLD), which is characterized by weak language ability without a known origin, may negatively impact EF (Aljahlan and Spaulding 2021; Kapa and Plante 2015; Pauls and Archibald 2016). Specifically for the ability to switch between tasks, the literature likewise suggests a pattern of differential effects of bilingualism and DLD. Bilinguals have been reported to outperform monolingual peers on tasks assessing switching ability (e.g., Barac and Bialystok 2012; Prior and MacWhinney 2010), although some studies do not find evidence for such a bilingual advantage (e.g., Paap et al. 2017; Timmermeister et al. 2020). Collapsing evidence from multiple studies, two recent meta-analyses report superior switching performance of bilingual participants (Gunnerud et al. 2020; Ware et al. 2020). Conversely, children with DLD have been suggested to have weaker switching ability than their typically developing (TD) peers in some studies (e.g., Blom et al. 2021; Farrant et al. 2012), but not in others (e.g., Henry et al. 2012). In line with these mixed findings, meta-analyses showed small but reliable effects of DLD on switching (Pauls and Archibald 2016) which were dependent on the type of task (Aljahlan and Spaulding 2021).

Thus, findings on the relationship between both bilingualism and switching ability as well as DLD and switching ability are mixed and have been the subject of discussion (see, Kapa and Plante 2015; Poarch and Krott 2019). To our knowledge, previous work has not addressed the interaction of bilingualism and DLD on switching ability. This is important, as it provides insight into the EF profile of children with DLD who grow up bilingually, which is a large and ever-growing group of children given increases in global mobility and migration (for Dutch statistics, see Centraal Bureau voor de Statistiek 2021). Moreover, it may reveal whether a bilingual benefit can be observed despite impaired language development, informing us about the mechanisms underlying such an advantage. In the present study, we aimed to further elucidate the effects of both bilingualism and DLD on nonverbal switching by adopting a four-group design. We focus on nonverbal switching because nonverbal tasks can inform us whether switching problems or benefits extend beyond the linguistic domain (see also Pauls and Archibald 2016). The four groups consisted of monolingual and bilingual children, both with and without DLD. Furthermore, we aimed to explore potential causes for differences in performance between groups, which may inform us about the origin of enhanced or weakened switching ability. To this end, we investigated the role of inhibition and attention skills in explaining group effects on switching ability. Inhibition and attention are both implicated in switching ability (Garon et al. 2008) and have been suggested to be strengthened in bilinguals (Ware et al. 2020) and weakened in children with DLD (Ebert et al. 2019; Pauls and Archibald 2016; Smolak et al. 2020), possibly driving group effects (see also Pauls and Archibald 2016).

1.1. Development and Assessment of Switching Ability

Although all core EF components start to develop during infancy and preschool years, switching ability is known to develop later than inhibition and working memory (Diamond 2013; Garon et al. 2008), following a protracted development through adolescence (Best and Miller 2010). Switching is considered the most complex EF component (Garon et al. 2008). It builds on inhibition and working memory but involves more than only the sum of the two. To be able to switch from one perspective to another, for example, a person needs to inhibit the first perspective and then load the new perspective into working memory (Diamond 2013; Dajani and Uddin 2015), but it also requires a person to reconfigure his/her responses according to the new situation (Dajani and Uddin 2015). Moreover, in addition to dependencies among the three core EF components, basic and early-developing attentional processes are proposed to underlie EF in general, including the development of switching (Garon et al. 2008; Rothbart and Posner 2001). As suggested by Kapa et al. (2017), these hierarchical relations between attention, working memory, inhibition, and switching have important implications for children with weaknesses or strengths in one of these components. Impaired or enhanced development in a lower-level component may have cascading effects on higher-level components. This may be key in explaining the observed effects of bilingualism and DLD on switching ability, which will be reviewed in Sections 1.2 and 1.3.

Experimentally, switching has been probed with a multitude of measures, which, for example, differ depending on the frequency and regularity of switches, the presence of explicit cues indicating to switch, and/or the level at which switching takes place (i.e., switching between different task goals or between different rules while the task goal remains constant). An example of a task that has often been used with children is the Dimensional Card Change Sort (DCCS; Zelazo 2006), in which children are asked to sort cards according to one dimension (e.g., color) after which they need to switch to a second dimension (e.g., shape). Most 5-year-old children are able to correctly make the switch to the second sorting rule, while this is still too difficult at the age of 3 (Zelazo 2006). For the present study, including participants between 5 and 8 years old, we used a slightly more complex color–shape task-switching paradigm. Children had to indicate whether a stimulus corresponded to one of two colors or shapes through button presses where each of two buttons was associated with one feature of the task. The left button corresponded to a blue or square object, while the right button corresponded to an orange or triangular object. Comparable to the DCCS, the task started with two subsequent single-task blocks, in which children were presented with one task (i.e., sorting either on color or shape). In the current paradigm, these two single-task blocks were followed by a switching block in which children had to flexibly switch between the two sorting rules: if the task was to sort according to color, the stimulus "blue triangle" would require a left button press, while it would require a right button press when sorting according to shape. A cue indicated which sorting rule was active. Previous research with such a task-switching paradigm showed a decrease with age in the performance costs associated with switching between tasks (e.g., Huizinga and van der Molen 2011; see also Cragg and Chevalier 2012).

These performance costs are typically indexed by two outcome measures: *mixing costs* and *switching costs*. Mixing costs are the global performance costs associated with the presence of two different tasks (single-task/task-switch), as indicated by the performance difference between trials in the switching block that do not involve a switch (repeat trials) and trials in the single-task blocks. As argued by Braver et al. (2003), mixing costs reflect proactive control processes, including the use of sustained attention to keep multiple tasks activated. Switching costs are the local costs related to the necessity to switch from one task to the other and are measured by looking at the difference between trials in the switching block that involve a switch (switch trials) and those that do not (repeat trials). Switching costs may more closely reflect reactive control processes (Braver et al. 2003), which enable a successful response after the detection of interference and the reactivation of goals (Braver 2012). As such, switching costs reflect the inhibition of previous stimulus-response associations (i.e., response inhibition; Druey and Hübner 2008; Vandierendonck et al. 2010).

1.2. Nonverbal Switching in Bilingual Children

The use of more than one language requires bilinguals to switch between languages, which in turn involves the inhibition of the non-target language and the selection of the target language depending on the context (Green and Abutalebi 2013). This natural switching in bilingual language use is suggested to draw on domain-general EF, which is thereby continuously trained (Green 1998; Green and Abutalebi 2013). This training effect may explain why bilinguals have been shown to outperform monolinguals on a wide range of EF tasks, including verbal and nonverbal measures (Adesope et al. 2010; Bialystok and Craik 2010; Hilchey and Klein 2011; van den Noort et al. 2019; Ware et al. 2020). A bilingual EF benefit has been found in both adult and child populations, although the evidence appears stronger for older groups (Gunnerud et al. 2020; van den Noort et al. 2019; Ware et al. 2020). As numerous studies failed to find positive effects of bilingualism or found effects to be very small (de Bruin et al. 2015; Duñabeitia et al. 2014; Gathercole et al. 2014), open questions are whether EF differences between monolinguals and bilinguals hold for all bilinguals, including bilinguals with development disabilities, which factors modulate these differences, and what they mean in real life (Poarch and Krott 2019).

The focus of the present study is on nonverbal switching, a domain-general ability that may underlie switching between languages. In a comprehensive meta-analysis of 170 studies, using tasks tapping into different EF domains and including both children and adults, Ware et al. (2020) report superior performance of bilinguals as compared to monolinguals on two dependent variables of the task-switching paradigm. A bilingual benefit was found for accuracy on incongruent trials (corresponding to switch trials in the task-switching paradigm; Hedges' g = 0.225) and on interference effects (corresponding to switching and/or mixing costs in the task-switching paradigm; Hedges' g = 0.693). Accuracy on congruent trials as well as reaction times on congruent and incongruent trials did not reveal significant effects. Focusing only on children, another recent meta-analysis including 100 publications also supports stronger switching performance of bilinguals relative to monolinguals (Hedges' g = 0.329; Gunnerud et al. 2020). Switching was the only EF domain for which effects remained significant after controlling for publication bias.

When we further zoom in on child participants, there are only a few studies that used a similar cued color–shape switching task as included in the present study. Barac and Bialystok (2012) assessed switching performance in 78 6-year-old children in three bilingual groups (Chinese-English, French-English, and Spanish-English) as well as in 26 English monolinguals. All three bilingual groups were found to perform similarly and exceeded the monolinguals as shown by smaller mixing costs. However, no differences between groups were found for switching costs. Antoniou et al. (2016) only looked at switching costs and also found a bilingual advantage, including 44 bilectal, 22 multilingual, and 25 monolingual children aged 6 to 9 years old from Cyprus and Greece. Finally, Timmermeister et al. (2020) likewise adopted a similar task design and assessed nonverbal switching ability in a sample of 27 5- to 8-year-old Turkish-Dutch bilinguals and 27 age-matched Dutch monolinguals. Their study resulted in comparable mixing and switching costs for bilinguals and monolinguals.

1.3. Nonverbal Switching in Children with DLD

Children with DLD have severe difficulties learning language, in the absence of an obvious cause, such as a hearing impairment or low intellectual functioning (Leonard 2014). While some argue that DLD is a domain-specific deficit that selectively impairs language acquisition (Rice and Wexler 1996; Van der Lely 2005), the current dominant view is that the language problems coincide and interact with broader impairments in cognitive and/or perceptual mechanisms, including attention and EF (Botting and Marshall 2017; Kapa and Plante 2015). Research indeed indicates that children with DLD are outperformed by TD peers on a wide range of EF measures (for reviews/meta-analyses, see Aljahlan and Spaulding 2021; Kapa and Plante 2015; Pauls and Archibald 2016; Vissers et al. 2015). Studies have, however, not revealed unequivocal results (Archibald and Gathercole 2006; Henry et al. 2012; Im-Bolter et al. 2006; Lukács et al. 2016; Noterdaeme et al. 2001). For example, several studies only found differences between children with DLD and TD peers on verbal EF tasks and not on nonverbal measures (Archibald and Gathercole 2006; Henry et al. 2012; Lukács et al. 2016; but see, Kapa et al. 2017). As of yet, the breadth and origin of the EF weaknesses of children with DLD remain unclear.

With respect to switching, two meta-analyses compile the evidence. A recent meta-analysis of 20 studies by Aljahlan and Spaulding (2021) demonstrated poorer performance of children with DLD in comparison with TD peers (Hedges' $g = -0.42$). This corresponds to an earlier meta-analysis of 22 studies by Pauls and Archibald (2016), showing a small, but reliable, effect of DLD on switching (Hedges' $g = -0.27$). Both meta-analyses investigated a number of potential moderating variables, and both found no moderating effect of age. In addition, the linguistic demand of the task (Pauls and Archibald 2016), the severity of DLD (Pauls and Archibald 2016), and the outcome measure (i.e., accuracy or reaction time; Aljahlan and Spaulding 2021) were not related to the poor switching performance of children with DLD. Aljahlan and Spaulding (2021) did find a significant moderating effect of the type of switching task, showing a significant negative effect of DLD on *set-*

shifting tasks (Hedges' $g = -0.52$) in contrast to *alternating* tasks (Hedges' $g = -0.18$). The authors defined set-shifting tasks (e.g., DCCS) as tasks in which children were asked to sort stimuli according to more than one rule, but in which a novel rule was only introduced after a dominant response pattern was established, thus involving infrequent switches between rules. In contrast, alternating tasks were defined as tasks in which participants are familiarized with an alternating set of rules and are asked to respond in a consistent, predictable alternating pattern (e.g., following numbers and letters alternately in sequence, 1-A-2-B-3-C, in the Trail-Making Test). Aljahlan and Spaulding (2021) indicate that their findings may be explained by the extent to which a specific task taxes additional executive processes, such as inhibition and attention, which are also weak in children with DLD. Some set-shifting tasks may rely more extensively on such processes than alternating tasks. Important to note here is that the task-switching paradigm of the current study does not fall perfectly into either task category as defined by Aljahan and Spaulding, although it more closely fits the set-shifting category. To our knowledge, the task-switching paradigm has not yet been used in DLD research and is thus not directly comparable with previously used measures in that field.

The hypothesis that other cognitive processes play an important role in explaining the switching abilities of children with DLD is also discussed by Pauls and Archibald (2016). They speculate that the observed small effect of DLD on switching tasks may be driven by an inhibition deficit, as switching to another task is difficult when a previous task is not adequately suppressed (Cragg and Chevalier 2012; see also Im-Bolter 2003). The results of a study by Kapa et al. (2017) further support this hypothesis, showing a linear increase in the effect of DLD from working memory to inhibition to switching. As EF components become more complex and there is more need to coordinate lower-level skills, deficits of children with DLD seem to increase. Consequently, the relatively large switching deficit of the children with DLD may have been caused by more subtle weaknesses in lower-level components, including working memory and inhibition. This possibility has, however, not been directly investigated. In addition, the role of attentional processes, which are thought to be the lowest in the hierarchy (Garon et al. 2008), needs to be studied as well. Against their predictions, the children with DLD in the study of Kapa et al. (2017) showed the largest deficit in sustained attention. There is an increasing body of work reporting weak sustained attention skills of children with DLD (for a meta-analysis, see Ebert and Kohnert 2011; Ebert et al. 2019), which are, furthermore, found to be associated with children's language skills (Boerma et al. 2017; Smolak et al. 2020). It is unknown whether sustained attention is also key in explaining the difficulties of children with DLD in nonlinguistic domains, such as nonverbal switching.

1.4. The Present Study

Previous research reported opposite effects of bilingualism and DLD on switching ability, respectively, being associated with enhanced (Ware et al. 2020) and weakened (Aljahlan and Spaulding 2021; Pauls and Archibald 2016) performance. However, both studies with bilinguals as well as studies including children with DLD have revealed mixed results. Moreover, the two fields have, as of yet, operated separately with respect to the investigation of switching, which means that it is unknown how switching ability is impacted by the interaction of bilingualism and DLD. It may be that the positive effects of bilingualism on switching mitigate the negative effects of DLD, as is shown by two studies on the switching abilities of bilingual children and children with Autism Spectrum Disorder (ASD), who also often have language and EF deficits (Gonzalez-Barrero and Nadig 2019; Peristeri et al. 2021). However, previous work on bilingual children and children with DLD has not found such mitigating effects in other EF domains. These studies, investigating working memory, inhibition (Boerma and Blom 2020), and attention (Ebert et al. 2019), suggest that the effect of bilingualism on these cognitive skills is not different for TD children or children with DLD and that, likewise, DLD does not impact monolingual and bilingual children in different ways. In both studies, children with DLD scored weaker than

TD children, while no effect of bilingualism nor an interaction between bilingualism and DLD was found. A third study on three attention processes partly replicated these findings but also showed a bilingual advantage in orientation skills, which was restricted to the DLD group (Park et al. 2019). This may indicate that children with DLD can benefit more from bilingual experience than TD children. However, previous research on switching demonstrated that bilingual children with high language proficiency outperform those with low language proficiency (Iluz-Cohen and Armon-Lotem 2013), suggesting that the low language abilities of children with DLD could actually weaken a bilingual advantage. Although no clear pattern can thus be distilled from these studies, their findings, together with the results from the current study, have important implications for the growing number of bilingual children on clinical caseloads, and for furthering our understanding of the factors moderating EF strengths and weaknesses.

The first aim of the current study is to investigate the independent and interaction effects of bilingualism and DLD on nonverbal switching ability. Particularly in the literature on DLD, the large majority of switching tasks used have a high verbal load (Pauls and Archibald 2016). This may disadvantage children with DLD and blur results, although linguistic demand was not found to be a significant moderator of the effect of DLD on switching ability (Pauls and Archibald 2016). We used a nonverbal switching task to eliminate the effect of language proficiency as much as possible, providing insight into the breadth of switching problems or benefits. We included four groups of children, monolingual and bilingual children with and without DLD, between the ages of 5 and 8 years old.

The second aim of the present study is to better understand the origin of strong or poor nonverbal switching ability of, respectively, bilingual children and children with DLD. Previous work indicates that switching is a complex process, which builds on other lower-level EF components and on more basic attentional processes (Garon et al. 2008). As these may also be enhanced due to bilingualism (Ware et al. 2020) and weakened due to DLD (Pauls and Archibald 2016; Smolak et al. 2020), it is possible that such lower-level cognitive processes explain switching problems or benefits (see Kapa et al. 2017). Here, we included two measures of cognitive processes on which switching skills may rely: response inhibition and sustained attention. These measures were chosen, because our switching outcome variables, mixing and switching costs, have been suggested to reflect sustained attention and response inhibition, respectively (Braver 2012; Braver et al. 2003; Druey and Hübner 2008; Vandierendonck et al. 2010). Moreover, Pauls and Archibald (2016) specifically suggest that the inhibition of a previously established response is the aspect of switching tasks that may be most challenging for individuals with DLD (see also Im-Bolter 2003). We conducted mediation analyses to investigate the role of response inhibition and sustained attention in explaining the significant effects of bilingualism and DLD on nonverbal switching ability.

For our first research aim, we hypothesized that, in line with the above-mentioned research, bilingual children would outperform monolingual peers on our nonverbal switching task, while children with DLD would score lower than TD peers. Given the mixed findings in the literature, we also reckoned with the possibility of finding null results. With respect to the interaction of bilingualism and DLD, we can only rely on studies that have investigated other EF domains in bilingual children with DLD or on studies using a switching task with bilinguals with ASD, as described above. As no clear pattern emerged from these studies, we refrain from formulating specific hypotheses. With respect to the second aim of the current study, our hypothesis was that response inhibition and sustained attention would mediate group effects on switching ability. Specifically, sustained attention was thought to be associated with mixing costs and response inhibition with switching costs.

2. Materials and Methods

2.1. Participants

The data of the present study were collected in the context of a longitudinal research project investigating the linguistic and cognitive development of children growing up in the Netherlands. It included three waves of data collection, with intervals of one year. For the present study, the same sample of participants was used as in the previous work of (Boerma et al. 2017; Boerma and Blom 2020), consisting of monolingual TD children (MOTD), bilingual TD children (BITD), monolingual children with DLD (MODLD), and bilingual children with DLD (BIDLD). The four groups of children were a subsample of the full sample and were matched on a number of background variables (see Table 1). As the BIDLD group was the smallest group, we matched one child from each other group to a child in the BIDLD group based on these background variables. There were no significant differences between the four groups in terms of chronological age (wave 1: $F(3,124) = 0.25$, $p = 0.86$, $\eta_p^2 < 0.01$; wave 2: $F(3,124) = 0.03$, $p = 0.99$, $\eta_p^2 < 0.01$; wave 3: $F(3,124) = 0.07$, $p = 0.98$, $\eta_p^2 < 0.01$), nonverbal intelligence ($F(3,124) = 1.02$, $p = 0.39$, $\eta_p^2 = 0.02$), and socio-economic status ($H(3) = 5.5$, $p = 0.14$). Nonverbal intelligence (NVIQ) was tested in wave 1 with the *Wechsler Nonverbal-NL* (Wechsler and Naglieri 2008) and socio-economic status (SES) was estimated by the average parental education level in wave 1. The groups of children with DLD included relatively many boys, which is expected given previously reported prevalence rates (e.g., Tomblin et al. 1997), although group differences did not reach significance ($\chi^2(3, N = 128) = 6.4$, $p = 0.09$).

Table 1. Background characteristics of the four groups of participants.

			Chronological Age in Months				
		Gender	Wave 1	Wave 2	Wave 3	Nonverbal Intelligence	Socio-Economic Status [b]
	N [a]	Girls/Boys	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Median (Range)
MOTD	32	14/18	70.9 (7.0)	82.5 (6.9)	94.1 (6.9)	100.4 (11.9)	6.8 (2–9)
MODLD	32	8/24	71.4 (6.3)	82.8 (6.5)	94.6 (6.6)	97.5 (12.9)	5.0 (2–8.5)
BITD	32	17/15	71.3 (7.3)	83.0 (7.1)	94.8 (7.1)	95.8 (15.0)	5.4 (1–9)
BIDLD	32	10/22	72.4 (8.6)	83.0 (8.9)	94.7 (8.8)	94.7 (15.3)	5.8 (2–9)

Note. MOTD: monolingual typically developing; MODLD: monolingual language disorder; BITD: bilingual typically developing; BIDLD: bilingual language disorder. [a] All children participated in each wave. [b] Socio-economic status was indexed by parental education (based on the International Standard Classification of Education) and could range from 1 (no education) to 9 (university degree). A value of 5 corresponds to intermediate vocational education.

All participants were born in the Netherlands and attended elementary school from the age of 4 years onward. Dutch was the language of instruction at all schools of the participating children. Children's home language environment determined whether they were classified as monolingual or bilingual, using parental report through the Questionnaire for Parents of Bilingual Children (PaBiQ; Tuller 2015). Parents of monolingual participants were both native speakers of Dutch and spoke this language with their child. One or both parents of bilingual participants were native speakers of another language than Dutch and spoke this language with their child on a regular basis. The bilingual children were exposed to another language than Dutch at least 30% of the time before the age of 4, but they varied considerably in how much Dutch input they received. The group of bilingual TD children and the group of bilingual children with DLD were therefore matched on percentage of exposure to Dutch before the age of 4 years (BITD: Mean(SD) = 43.0 (8.3), BIDLD: Mean(SD) = 40.9 (11.1); $F(1,61) = 0.68$, $p = 0.41$, $\eta_p^2 = 0.01$) and percentage of exposure to Dutch in wave 1 (BITD: Mean(SD) = 50.9 (12.0), BIDLD: Mean(SD) = 45.2 (16.5); $F(1,62) = 2.5$, $p = 0.12$, $\eta_p^2 = 0.04$). Four-fifths of the bilingual participants came from the two largest immigrant groups in the Netherlands, coming from Turkish or Moroccan descent.

All participants in the current study had an NVIQ of 70 or above, did not have hearing problems or severe articulatory difficulties, and were not diagnosed with Autism Spectrum Disorder or Attention Deficit Hyperactivity Disorder. None of the TD participants were reported to have language problems and all attended regular elementary schools, through which they were recruited. The participants with DLD were recruited through Royal Dutch Kentalis or Royal Auris Group. In waves 1 and 2, they all received educational support (i.e., either special education or regular education with ambulatory care) for their language difficulties and thus met the official Dutch criteria which specify when a child is eligible for such support (Stichting Siméa 2014). This was established by clinicians before the start of data collection and meant that they scored at least 1.5 standard deviations (SD) below the mean on two out of four subscales of a standardized language assessment test battery. Alternatively, they scored at least 2 SD below the mean on an overall score of this test battery. For the bilingual children, language development was evaluated with a bilingual anamnesis and, if possible, assessment of both languages (Stichting Siméa 2016). In the bilingual anamnesis, parental information is obtained on whether language difficulties are present in both languages, the persistence of these difficulties, and the amount of language input in both languages. In wave 3, there were four monolingual and four bilingual children with DLD who did not qualify for educational support anymore. These children were not excluded, as DLD and language difficulties are known to be persistent (Scarborough and Dobrich 1990) and diagnostic categories have been shown to be unstable (Conti-Ramsden and Botting 1999).

The *Peabody Picture Vocabulary Test* (PPVT; Schlichting 2005) and the subtest Sentence Repetition from the *Taaltoets Alle Kinderen* (TAK; Verhoeven and Vermeer 2001) measured Dutch receptive vocabulary and grammatical skills, respectively (see Table 2). There were significant group differences in each wave on both the PPVT (wave 1: $F(1,122) = 24.7$, $p < 0.001$, $\eta_p^2 = 0.38$; wave 2: $F(1,123) = 15.1$, $p < 0.001$, $\eta_p^2 = 0.27$; wave 3: $F(1,124) = 12.4$, $p < 0.001$, $\eta_p^2 = 0.23$) and the TAK (wave 1: $F(1,122) = 74.9$, $p < 0.001$, $\eta_p^2 = 0.65$; wave 2: $F(1,123) = 57.3$, $p < 0.001$, $\eta_p^2 = 0.58$; wave 3: $F(1,124) = 42.6$, $p < 0.001$, $\eta_p^2 = 0.51$). The MOTD and BITD group consistently outperformed the MODLD and BIDLD group, respectively. The BITD group scored lower on vocabulary than the MOTD group in waves 1 and 2, but caught up in wave 3. With respect to grammar, significant differences between the two TD groups only emerged in wave 1. The BIDLD group had weaker vocabulary skills than the MODLD group in each wave, but no differences between the two groups were found for grammatical skills.

Table 2. Language skills of the four groups of participants (raw scores).

	PPVT			TAK Sentence Repetition		
	Wave 1	**Wave 2**	**Wave 3**	**Wave 1**	**Wave 2**	**Wave 3**
	Mean (*SD*)	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**
MOTD	86.6 (10.4)	98.5 (9.6)	103.8 (8.9)	28.7 (5.9)	32.0 (5.5)	34.3 (3.7)
MODLD	76.5 (9.2)	86.6 (11.9)	95.9 (10.1)	10.2 (5.7)	14.9 (6.1)	19.9 (7.2)
BITD	75.8 (10.5)	87.8 (11.5)	96.2 (12.4)	21.8 (7.0)	27.7 (7.1)	31.0 (6.3)
BIDLD	62.9 (13.3)	77.8 (15.5)	86.3 (14.0)	9.5 (5.8)	14.8 (7.5)	19.0 (8.7)

Note. MOTD: monolingual typically developing; MODLD: monolingual language disorder; BITD: bilingual typically developing; BIDLD: bilingual language disorder; PPVT: Peabody Picture Vocabulary Test (range from 0 to 204); TAK: Taaltoets Alle Kinderen (range from 0 to 40).

2.2. Instruments

2.2.1. Nonverbal Switching

Nonverbal switching ability was measured in waves 2 and 3 with a cued color/shape switching task (Timmermeister et al. 2020). In this task, square- or triangular-shaped objects which were blue- or orange-colored were presented on a 15-inch laptop screen using E-Prime 2.0 (Schneider et al. 2002). At the top of the screen, a cue in the form of one of two cartoon faces (“Mr. Color” or “Mr. Shape”) appeared. Based on the cue, children had to identify either the color or the shape of the target object. The target object was presented in the middle of the screen, preceded by a fixation cross (350 ms) and a blank space (150 ms). The cue was presented 650 ms before the fixation cross and remained on the screen until the end of the trial. A blue square and orange triangle were also present during all trials, on respectively the left and right sides of the bottom of the screen (see Figure 1). Children responded by pressing one of the two fixed buttons on the left and right sides of the keyboard, which corresponded to those two objects. When "Mr. Color" appeared, the left button had to be pressed for blue objects and the right button for orange objects. When "Mr. Shape" appeared, the left button was for squared objects and the right for triangles. Children had a maximum of 7 s to respond to a trial.

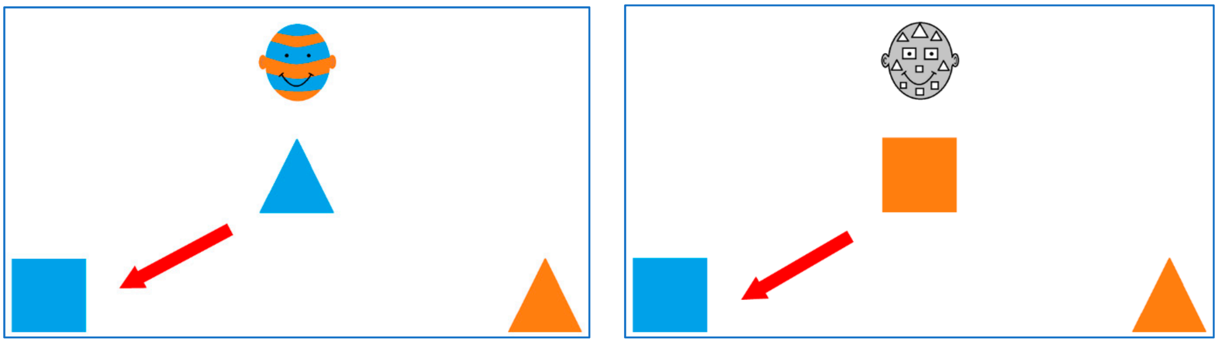

Figure 1. Example trials of the cued color/shape switching task. Note. The red arrow was presented for the purpose of instruction and was absent during the test phase.

The task started with two single-task blocks, both preceded by a practice phase (5 items each), in which the cue remained the same and children had to respond to either the color or shape of the target object throughout the block. The order of the two single-task blocks was counterbalanced, with some children starting with color and some children starting with shape. There were 28 trials in each of the two blocks. The single-task blocks were followed by a task-switching block, in which the cues for color and shape changed every two to five trials. The order of the trials was fixed but unpredictable. This block included a practice phase (8 items) and subsequently 56 trials, equally divided between color and shape. Trials in the task-switching block involved a cue switch in 25% of the trials (switch trials). In 75% of the trials in this block, there was no change of cue from color to shape or vice versa (repeat trials).

2.2.2. Response Inhibition and Sustained Attention

Response inhibition and sustained attention were measured in wave 1 with an integrated auditory and visual Continuous Performance Task (CPT; see Boerma et al. 2017) using E-Prime 2.0 (Schneider et al. 2002). Children saw (for 167 ms) or heard the number '1' or the number '2'. In response to the number '1', which was the target stimulus, children were instructed to press the space bar. When hearing or seeing the number '2', which was the distractor, children had to refrain from responding. The task started with a practice phase in which 10 items were presented visually, followed by 10 items that were presented auditorily, and finally 10 items in which the mode of presentation was mixed. The test phase consisted of 168 trials. In the first and third part (impulsivity blocks), the ratio of targets versus distractors was five to one, respectively, whereas this was reversed in the second and fourth part (inattention blocks).

2.3. Procedure

The longitudinal project, within which the data for the current study was collected, was approved by The Standing Ethical Assessment Committee of the the Faculty of Social and Behavioral Sciences at Utrecht University. Parents of participating children signed a written informed consent form. Testing took place in a quiet room at a child's school and was done individually by a trained researcher. Children completed several language and cognitive tasks in two test sessions. Instructions were in Dutch and could be repeated until a child understood the task. The CPT and NVIQ measures were administered in wave 1 and the nonverbal switching task was administered in waves 2 and 3. It was not feasible to administer the CPT and the switching task at all three waves, because the duration of the full test battery would have become too long. Other tasks were assessed at all three waves.

2.4. Data Preparation

2.4.1. Nonverbal Switching

We first looked at children's accuracy scores in the single-task blocks to ensure that children understood the basic instructions, as this is a prerequisite to measuring switching ability. The probability of scoring at least 19 out of the 28 trials correct (i.e., 67.8%) due to chance is smaller than 5% (based on a binomial distribution). This cut-off thus gives us relative certainty that children with a score of at least 19 performed above chance and did not respond randomly. In wave 2, there were 17 children who scored below this cut-off (scoring 18 trials correct or lower) on either the color or shape block or on both, including ten children from the BIDLD group. In wave 3, there were four children who scored below this cut-off, including one child from each of the four groups. Given the large number of children who were not able to accurately complete the single-task blocks in wave 2, we decided to focus on the nonverbal switching data from wave 3[1]. In all further analyses, the four children with poor accuracy scores on both or either one of the single-task blocks in wave 3 were excluded.

Accuracy. The first trial of the task-switching block was excluded, as this is not a repeat or a switch trial. Accuracy scores on the single-task blocks (Color: skewness = −1.36, kurtosis = 1.34; Shape: skewness = −1.07, kurtosis = 0.94; ColorandShape: skewness = −1.06, kurtosis = 0.82) and on the repeat trials of the task-switching block (skewness = −1.17, kurtosis = 0.996) were slightly skewed, which was not improved by transformation. Nonparametric test results confirmed parametric tests, which is why only the latter are reported. There were no significant differences between accuracy scores on the single-task blocks for color and shape, as indicated by a mixed ANOVA with Condition (color/shape) as within-subjects factor and Group as between-subjects factor. Results showed no significant effect of Condition ($F(1,120) = 0.20$, $p = 0.65$, $\eta_p^2 = 0.00$), Group ($F(3,120) = 1.33$, $p = 0.27$, $\eta_p^2 = 0.03$), nor interaction effect ($F(3,120) = 1.30$, $p = 0.28$, $\eta_p^2 = 0.03$). This gives reason to pool the color and shape conditions in the accuracy analyses of the task-switching block.

Reaction times. Mean reaction times (RT) were calculated using accurate responses and, like accuracy, the first trial of the task-switching block was excluded. Moreover, responses below 200 ms and responses of more than three SD above a child's mean RT were excluded. Together, this meant that we excluded 15.9% of the data for the RT analyses (of which 13.7% were incorrect responses). All reaction time outcome measures were logtransformed, resulting in normally distributed variables, and logtransformed variables were used in the analyses. There were no significant differences between RTs in the single-task blocks for color and shape, as indicated by a mixed ANOVA with Condition as the within-subjects factor and Group as the between-subjects factor. Results showed no significant effect of Condition ($F(1,120) = 2.09$, $p = 0.15$, $\eta_p^2 = 0.02$), Group ($F(3,120) = 1.11$, $p = 0.35$, $\eta_p^2 = 0.03$), nor interaction effect ($F(3,120) = 0.974$, $p = 0.41$, $\eta_p^2 = 0.02$). We therefore pooled the color and shape conditions in the RT analyses of the task-switching block.

2.4.2. Response Inhibition and Sustained Attention

Response inhibition was indexed by the number of false alarms in response to distractors on the CPT. Sustained attention was measured with the number of hits in response to target stimuli on the CPT. Accurate responses to targets with an RT below 100 ms were not included (<1% of all trials). The number of false alarms in the impulsivity blocks was strongly correlated with the overall number of false alarms ($r = 0.75$, $p < 0.001$). Similarly, the number of hits in the inattention blocks was strongly correlated with the overall number of hits ($r = 0.82$, $p < 0.001$). We therefore used the overall number of false alarms and hits as outcome measures, as these are based on a larger number of trials and are more robust. The number of false alarms and the number of hits were not significantly correlated ($r = -0.17$, $p = 0.06$), and were thus considered to underlie separate cognitive processes.

2.5. Data Analysis

All statistical analyses were done with SPSS 24 (IBM Corp 2016). The first analyses corresponded to the first aim of the study, investigating the effects of DLD and bilingualism on nonverbal switching ability. In line with previous research, we analyzed mixing costs and switching costs in both accuracy and RT (for similar analyses, see Prior and MacWhinney 2010). To analyze mixing costs, we ran a mixed ANOVA with accuracy scores and a similar model with RTs as the dependent variable. We investigated whether the groups of children responded differently to trials in the single-task blocks in comparison with repeat trials. Trial (trials in single-task blocks/repeat trials in task-switching block) was entered as the within-subjects factor and Language Group (monolingual/bilingual) and Impairment Status (TD/DLD) as between-subjects factors. The same was done to analyze switching costs, with the exception that the within-subjects factor Trial now included a comparison between the switch and repeat trials in the task-switching block. Analyses were subsequently conducted with NVIQ and SES as covariates. Moreover, we also ran the RT analyses only including the children who performed above chance in the task-switching block (scoring more than 34 of 56 trials correct; 60.7%).

In case of significant effects, we subsequently conducted mediation analyses to investigate the role of response inhibition (number of false alarms to distractor) and sustained attention (number of hits to target) in explaining the relation between Language Group/Impairment Status and switching. This corresponds to the second aim of the current study. The PROCESS macro for SPSS of Hayes (2017) was used for this purpose. One requirement of this mediation analysis is temporal precedence from the independent variable (X) to the mediator (M) to the dependent variable (Y). This requirement was met, since group distinction (X) was formed before the assessment of response inhibition and sustained attention (M) which were, in turn, assessed prior to the evaluation of switching ability (Y). To determine whether the effect of X on Y is significantly reduced due to M (i.e., the indirect or mediation effect), bootstrapped tests (5.000—bias-corrected) and confidence intervals were used, as these are more reliable than *p*-values. Meaningful mediation is assumed if zero is not included in the confidence intervals of the indirect effects.

3. Results

Tables 3 and 4 present the mean accuracy scores and reaction times, respectively, of the four groups of children on the single-task blocks (color/shape), on the repeat trials of the task-switching block, and on the switch trials of the task-switching block.

Table 3. Mean % accuracy scores of the four groups of children.

				Task-Switching Block			
		Single-Task Blocks		**Repeat Trials**		**Switch Trials**	
	N	**Mean (*SD*)**	**Range**	**Mean (*SD*)**	**Range**	**Mean (*SD*)**	**Range**
MOTD	31	94.5 (4.8)	84–100	85.8 (10.0)	53–100	77.8 (16.8)	31–100
MODLD	31	93.3 (5.7)	80–100	77.3 (16.2)	43–100	70.8 (14.2)	38–100
BITD	31	91.6 (6.0)	79–100	85.1 (10.0)	58–100	72.4 (11.7)	44–94
BIDLD	31	93.4 (6.8)	71–100	78.5 (17.4)	38–100	69.2 (15.7)	38–94

Note. Four children (one from each group) were excluded based on low accuracy scores on one or both single-task blocks.

Table 4. Reaction times (in milliseconds) of the four groups of children.

				Task-Switching Block			
		Single-Task Blocks		**Repeat Trials**		**Switch Trials**	
	N	**Mean (*SD*)**	**Range**	**Mean (*SD*)**	**Range**	**Mean (*SD*)**	**Range**
MOTD	31	805.7 (354.4)	555–1651	1179.7 (374.8)	614–2719	1330.6 (354.4)	836–2484
MODLD	31	822.8 (210.9)	543–1514	1233.4 (332.8)	693–1904	1572.7 (435.1)	649–2805
BITD	31	784.2 (207.5)	432–1170	1244.3 (367.1)	547–2043	1560.5 (525.6)	744–2884
BIDLD	31	881.1 (241.7)	544–1463	1361.5 (395.5)	756–2143	1705.8 (498.2)	597–2954

Note. Four children (one from each group) were excluded based on low accuracy scores on one or both single-task blocks.

3.1. Mixing Costs: Effects of DLD and Bilingualism

3.1.1. Accuracy

Results showed a significant effect of Trial ($F(1,120) = 107.34$, $p < 0.001$, $\eta_p^2 = 0.47$). Accuracy scores on the trials in the single-task blocks were significantly higher than scores on the repeat trials in the task-switching block. There was also a significant effect of Impairment Status ($F(1,120) = 5.48$, $p = 0.021$, $\eta_p^2 = 0.04$), showing that children with DLD scored lower than TD children. The main effect of Language Group was not significant ($F(1,120) = 0.14$, $p = 0.71$, $\eta_p^2 = 0.00$). Furthermore, there was a significant interaction effect of Trial*Impairment Status ($F(1,120) = 12.38$, $p = 0.001$, $\eta_p^2 = 0.09$), indicating that the effect of Trial type on children's accuracy scores was different for the TD group in comparison with the DLD group. Other interaction effects were not significant (Language Group*Impairment Status: $F(1,120) = 0.65$, $p = 0.42$, $\eta_p^2 = 0.01$; Trial*Language Group: $F(1,120) = 0.60$, $p = 0.44$, $\eta_p^2 = 0.01$; Trial*Impairment Status*Language Group: $F(1,120) = 0.05$, $p = 0.83$, $\eta_p^2 = 0.00$). The results did not change when controlling for SES and NVIQ, with NVIQ being a significant covariate and SES not.

We conducted two univariate ANOVAs to unpack the significant interaction between Impairment Status and Trial. The first analysis with accuracy scores on trials in the single-task blocks as the dependent variable and Impairment Status as the fixed factor showed that there was no difference between children with DLD and TD children ($F(1,122) = 0.07$, $p = 0.79$, $\eta_p^2 = 0.00$). The second analysis did reveal a significant effect ($F(1,122) = 9.3$, $p = 0.003$, $\eta_p^2 = 0.07$), indicating that children with DLD scored significantly lower on the repeat trials of the task-switching block than TD children. The results did not change when controlling for SES and NVIQ, with NVIQ being a significant covariate and SES not.

3.1.2. Reaction Times

Results showed a significant effect of Trial ($F(1,120) = 383.4$, $p < 0.001$, $\eta_p^2 = 0.76$). RTs on the trials in the single-task blocks were significantly lower than RTs on the repeat trials in the task-switching block. Other effects were not significant (Impairment Status ($F(1,120) = 2.58$, $p = 0.11$, $\eta_p^2 = 0.02$; Language Group: $F(1,120) = 0.95$, $p = 0.33$, $\eta_p^2 = 0.01$; Language Group*Impairment Status: $F(1,120) = 0.61$, $p = 0.44$, $\eta_p^2 = 0.01$; Trial*Impairment Status: $F(1,120) = 0.00$, $p = 0.97$, $\eta_p^2 = 0.00$; Trial*Language Group ($F(1,120) = 1.66$, $p = 0.20$, $\eta_p^2 = 0.01$); Trial*Impairment Status*Language Group: $F(1,120) = 0.34$, $p = 0.56$, $\eta_p^2 = 0.00$). The RTs of the groups of children were thus not differently affected by the two types of trials. The results did not change when controlling for SES and NVIQ. Neither NVIQ nor SES were significant covariates. When excluding children with low accuracy scores in the task-switching block (below 60.7% correct; 1 MOTD, 6 MODLD, 1 BITD, 5 BIDLD) and controlling for NVIQ and SES, the main effect of Impairment Status became significant ($F(1,105) = 4.07$, $p = 0.046$, $\eta_p^2 = 0.04$). Children with DLD responded slower than TD children. Other results, including the absence of an interaction between Trial and Impairment Status, remained similar.

3.2. Switching Costs: Effects of DLD and Bilingualism

3.2.1. Accuracy

Results showed a significant effect of Trial (F(1,120) = 56.96, p < 0.001, η_p^2 = 0.32) and Impairment Status (F(1,120) = 7.84, p = 0.006, η_p^2 = 0.06). Accuracy scores on repeat trials were significantly higher than scores on switch trials, and children with DLD had lower accuracy scores than TD children. Other effects were not significant (Language Group: F(1,120) = 0.51, p = 0.48, η_p^2 = 0.00; Language Group*Impairment Status: F(1,120) = 0.42, p = 0.52, η_p^2 = 0.00; Trial*Impairment Status: F(1,120) = 0.99, p = 0.32, η_p^2 = 0.01; Trial*Language Group: F(1,120) = 2.48, p = 0.12, η_p^2 = 0.02; Trial*Impairment Status*Language Group: F(1,120) = 0.14, p = 0.71, η_p^2 = 0.00). This means that the accuracy scores of the groups of children were not differently affected by the two types of trials. The results did not change when controlling for SES and NVIQ, with NVIQ being a significant covariate and SES not.

3.2.2. Reaction Times

Results showed a significant effect of Trial (F(1,120) = 88.76, p < 0.001, η_p^2 = 0.43). RTs on repeat trials were significantly lower than RTs on switch trials. There was also a significant effect of Impairment Status (F(1,120) = 4.42, p = 0.04, η_p^2 = 0.04), showing that children with DLD responded slower than TD children. Other effects were not significant (Language Group: F(1,120) = 3.39, p = 0.07, η_p^2 = 0.03; Language Group*Impairment Status: F(1,120) = 0.01, p = 0.93, η_p^2 = 0.00; Trial*Impairment Status: F(1,120) = 1.92, p = 0.17, η_p^2 = 0.02; Trial*Language Group: F(1,120) = 0.73, p = 0.39, η_p^2 = 0.01; Trial*Impairment Status*Language Group: F(1,120) = 1.48, p = 0.23, η_p^2 = 0.01). The RTs of the groups of children were thus not differently affected by the two types of trials. The results did not change when controlling for SES and NVIQ. Neither NVIQ nor SES were significant covariates. When excluding children with low accuracy scores in the task-switching block (below 60,7% correct; 1 MOTD, 6 MODLD, 1 BITD, 5 BIDLD), the main effect of Language Group became significant (F(1,120) = 4.98, p = 0.03, η_p^2 = 0.04), but this significant effect disappeared when controlling for NVIQ and SES (F(1,120) = 3.35, p = 0.07, η_p^2 = 0.03). Other results remained similar.

3.3. Mediation Effects: Mixing Costs

To understand the higher mixing costs of children with DLD, we conducted a mediation analysis. We first examined the correlations between mixing costs (i.e., accuracy scores on the repeat trials of the task-switching block minus accuracy scores on the single-task blocks) and the number of false alarms and number of hits on the CPT, respectively measuring response inhibition and sustained attention. Mixing costs were significantly related to both response inhibition (r = 0.27, p = 0.002) and sustained attention (r = −0.33, p < 0.001). Subsequently, we investigated relationships between Impairment Status (X), mixing costs (Y), and the mediators response inhibition and sustained attention (M).

Figure 2 presents the results of the mediation analysis. The results indicate that response inhibition and sustained attention mediated the effect of Impairment Status on mixing costs. The effect of Impairment Status on mixing costs did not remain significant when response inhibition and sustained attention were controlled for. The indirect effect of Impairment Status on mixing costs through both mediators accounts for 45.9% of the total effect of this relation. The results of the individual mediators show that the index of mediation (the standardized indirect effect) was larger for sustained attention (β = 0.20, 95% CI [0.01, 0.44]) than response inhibition (β = 0.08, 95% CI [−0.001, 0.22]). Only sustained attention showed a meaningful mediation effect (next to the total mediation effect of the two mediators together).

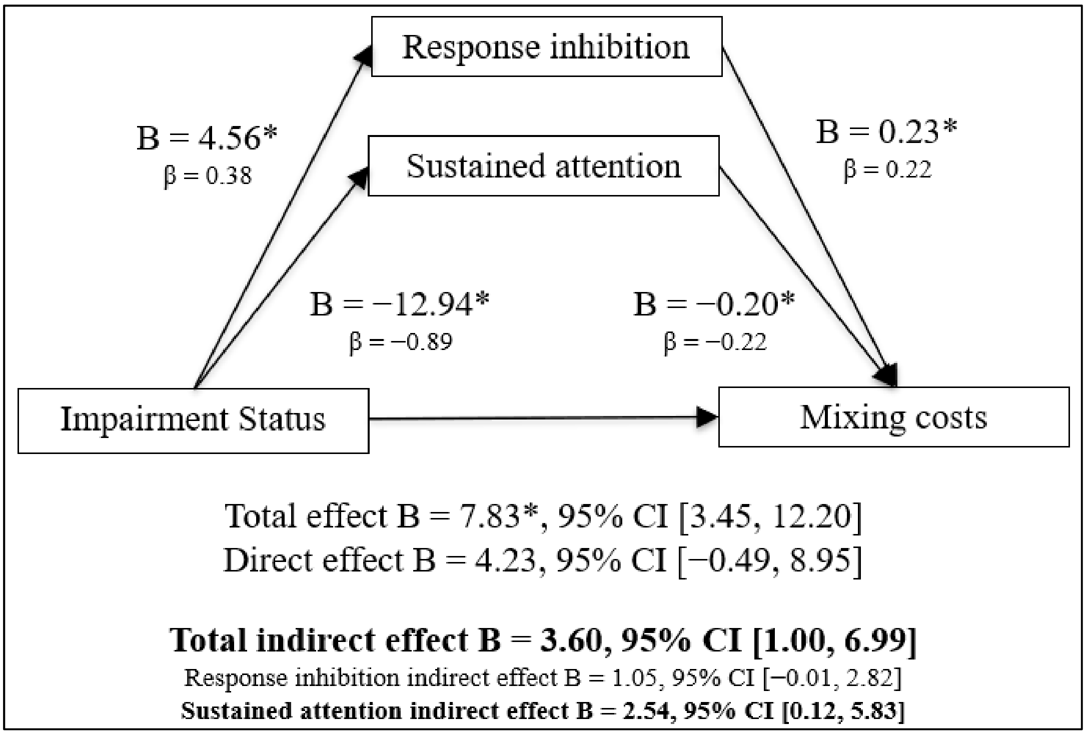

Figure 2. Mediation model. CI: Confidence Interval; *: $p < 0.05$; meaningful mediation effects are in boldface. The total effect is the effect of Impairment Status (X) on Mixing costs (Y), excluding Response inhibition/Sustained attention (M). The direct effect is the effect of Impairment Status (X) on Mixing costs (Y), controlling for Response inhibition/Sustained attention (M). The indirect effect is the effect of Impairment Status (X) on Mixing costs (Y) through Response inhibition/Sustained attention (M).

4. Discussion

While bilingualism is associated with enhanced switching skills, having a developmental language disorder (DLD) may negatively impact switching ability. However, previous work on bilingualism and/or DLD in relation to switching has revealed mixed results. Furthermore, the fields of bilingualism and DLD have largely operated separately, and it is thus unknown if and how switching ability is affected by the interaction of the two. In the present study, we first aimed to investigate not only the independent effects of bilingualism and DLD on nonverbal switching ability but also the interaction effect. Second, we aimed to elucidate the origin of (potential) strong or poor performance on a nonverbal switching task of, respectively, bilingual children and children with DLD. We adopted a four-group design to study children's nonverbal switching ability and used a longitudinal approach to investigate whether sustained attention and response inhibition skills mediated the possible effects of bilingualism and/or DLD on switching ability.

Our findings provide clear evidence for overall performance costs associated with switching on our cued color–shape switching task. However, these performance costs were not found to be different for monolingual and bilingual children, irrespective of whether NVIQ and SES were statistically controlled for. While this corresponds to other studies that did not find evidence for a bilingual benefit on switching (Paap et al. 2017; Timmermeister et al. 2020) and on EF in general (de Bruin et al. 2015; Duñabeitia et al. 2014; Gathercole et al. 2014), it is not in line with our hypothesis based on previous work which supported a bilingual switching advantage (for a meta-analysis on child studies, see Gunnerud et al. 2020). It hereby adds to the body of research that questions the robustness of such an advantage (Paap et al. 2018; Poarch and Krott 2019). Even between the studies using a similar task-switching paradigm with children of comparable ages, mixed findings are observed, in favor of (Antoniou et al. 2016; Barac and Bialystok 2012) and against a positive bilingual effect (Timmermeister et al. 2020; the present study). Unlike Antoniou et al. (2016), we did not control for language ability, which could thus be a factor in explaining the different findings. However, Barac and Bialystok (2012) did not control for language ability either, while Timmermeister and colleagues did, suggesting that other factors play a role in moderating the bilingual switching advantage (for a review on moderating factors of EF in general, see Marton 2016). It was beyond the scope of the current study to investigate such factors, but future work, both in the context of typical development as well as in the context of developmental disabilities, is recommended to do so to offer more clarity on the nature, breadth, and relevancy of cognitive advantages of bilingualism. Such research could consider the impact of home language maintenance and proficiency, as well as the relative balance between both languages and switching frequency (see, e.g., Kuzyk et al. 2020; Verhagen et al. 2020).

Our findings, furthermore, demonstrated higher mixing costs for children with DLD than for TD children. Children with DLD had lower accuracy scores on repeat trials of the task-switching block than TD children, whereas there were no differences between the groups on trials in the single-task blocks. No differences between the groups emerged in terms of switching costs. The higher mixing costs confirm earlier meta-analytical findings of poorer switching ability of children with DLD (Aljahlan and Spaulding 2021; Pauls and Archibald 2016) and thereby correspond to our hypothesis. Moreover, this finding highlights the view that problems of children with DLD extend beyond the linguistic domain (Botting and Marshall 2017; Kapa and Plante 2015). We did not find any interactions between bilingualism and DLD in our task-switching paradigm. Thus, bilingualism did not differently affect the switching skills of children with and without DLD, and DLD did not have a differential impact on monolinguals and bilinguals. As the first investigation of this interaction in the domain of switching, the current study supports results from previous work on other EF components (see Boerma and Blom 2020) and attention skills (Ebert et al. 2019).

Next to studying both the independent and interaction effects of bilingualism and DLD on nonverbal switching performance, the present study explored what could be driving the observed group effects. We performed a mediation analysis with response inhibition and sustained attention skills as mediators to further elucidate the higher mixing costs of the children with DLD on the nonverbal switching task. Response inhibition and sustained attention accounted for more than 45% of the relation between DLD and mixing costs. This finding supports our expectations and previous work which considers switching to be a complex EF component that builds on lower-level cognitive processes, such as response inhibition and sustained attention (Dajani and Uddin 2015; Garon et al. 2008).

Comparing the individual mediators, we found that the effect of DLD on mixing costs was particularly driven by children's ability to sustain their attention. This agrees with our predictions based on Braver et al. (2003), as mixing costs are thought to reflect the ability to maintain one's attention to keep multiple tasks active. Response inhibition was thought to more strongly reflect switching costs (Druey and Hübner 2008; Vandierendonck et al. 2010). Although response inhibition is also weak in children with DLD, sustained attention deficits may be more severe (Kapa et al. 2017), possibly explaining why children with DLD were found to have higher mixing costs than TD children while switching costs were not different between the groups. In addition, the important role of sustained attention in our data substantiates the hypothesis that attention processes are the foundation for more complex EF skills (Garon et al. 2008), such as switching, and suggests cascading effects for children with poorly developed attention skills, such as children with DLD. These cascading effects have previously been shown to affect the language skills of children with DLD (Boerma et al. 2017; Blom and Boerma 2016), and are now also shown to be implicated in their EF development.

These findings were observed in an experimental setting, and it is important to consider what their implications may be for the daily lives of children with DLD. We showed that it is not necessarily problematic for children with DLD to frequently switch between tasks, as reflected by their switching costs, which were not different from TD children. Instead, it seems particularly difficult for children with DLD to maintain their attention on multiple tasks and thereby accurately satisfy these tasks' goals, as reflected by the relatively high mixing costs. It can be hypothesized that this difficulty affects, for example, academic achievement, including reading development. When learning to read, a child needs to be able to sustain his/her attention on both the phonological form of the word or text as well as on the meaning. Indeed, previous studies indicate that switching ability is implicated in literacy (Lubin et al. 2016; Yeniad et al. 2013), although this has not yet been confirmed in children with DLD. Future studies are needed to translate findings from experimental EF tasks to the real-life challenges, such as learning to read, of children with DLD. Moreover, these studies could investigate the relations with real-life language switching experience in bilinguals, both in terms of addressing speakers of different languages as well as code-switching among other bilingual speakers, and nonverbal switching ability as measured by an experimental task (see, e.g., Hartanto and Yang 2020). Such experience may be an important factor in explaining variability in nonverbal switching ability and, in turn, in explaining the presence or absence of a bilingual advantage.

In addition, future research is necessary to learn more about the development of switching ability in children with DLD. The current study was longitudinal, which enabled us to better understand the causal mechanisms of poor switching ability, but we could only use our switching data from one time point when children were 7 to 8 years old. One year earlier, the switching task was still too complex for many children, especially for the children with DLD. While this is in and of itself informative, as other studies with only TD children were able to use data from 6-year-old children with a similar task-switching paradigm (Barac and Bialystok 2012), it did not allow us to measure switching ability at this younger age nor switching development over time. Additionally, the complexity of the task complicated our analyses with reaction times, as a relatively large proportion of data points (i.e., incorrect responses) had to be excluded. Future longitudinal work with children with DLD needs to take into account that, particularly when tapping into such complex skills as switching, tasks should be age-appropriate for all participants, including the children with DLD. Moreover, in work with older children, the inclusion of more trials in the switching task could be considered to increase reliability.

In conclusion, our findings do not point to performance differences between monolingual and bilingual children on a nonverbal cued switching task and indicate that the effect of bilingualism on nonverbal switching is not different for children with and without DLD. The absence of a bilingual advantage in the current study is in line with previous work which indicates that such advantages are not robust and may depend on many moderating factors. Future research is necessary to study such factors, also in the context of developmental disabilities. Additionally, our findings show that the presence of two different tasks resulted in higher performance costs for children with DLD, either monolingual or bilingual, relative to TD children. Sustained attention was a driving factor behind this effect of DLD. These results strengthen the view that attention processes are essential for the development of complex skills, such as switching, and further highlight the importance of sustained attention in the development of children with DLD.

Author Contributions: Conceptualization, T.B., M.v.W. and E.B.; formal analysis, T.B.; funding acquisition, E.B.; investigation, T.B.; methodology, T.B. and E.B.; supervision, E.B.; writing—original draft, T.B. and M.v.W.; writing—review and editing, T.B., M.v.W. and E.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research is funded by a VIDI-grant awarded to Elma Blom by the Netherlands Organization for Scientific Research (NWO; grant number 016.124.369).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Standing Ethical Assessment Committee of the Faculty of Social and Behavioral Sciences at Utrecht University (date of approval: 16 April 2013).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to consent restrictions.

Acknowledgments: This work is part of the research program 'Cognitive development in the context of emerging bilingualism: Cultural minority children in the Netherlands'. We thank Mona Timmermeister for designing the switching task. We are grateful for the participation of all children, parents, and schools.

Conflicts of Interest: The authors declare no conflict of interest.

Notes

[1] We explored the possibility of comparing the first single-task block with the second single-task block in wave 2. This still required the exclusion of 10 children. The results showed that the groups of children were not differently affected by the shift from the first to the second single-task block.

References

Adesope, Olusola O., Tracy Lavin, Terri Thompson, and Charles Ungerleider. 2010. A systematic review and meta-analysis of the cognitive correlates of bilingualism. *Review of Educational Research* 80: 207–45. [CrossRef]

Aljahlan, Yara, and Tammie J. Spaulding. 2021. Attentional shifting in children with developmental language disorder: A meta-analysis. *Journal of Communication Disorders* 91: 106105. [CrossRef] [PubMed]

Antoniou, Kyriakos, Kleanthes K. Grohmann, Maria Kambanaros, and Napoleon Katsos. 2016. The effect of childhood bilectalism and multilingualism on executive control. *Cognition* 149: 18–30. [CrossRef] [PubMed]

Archibald, Lisa M. D., and Susan E. Gathercole. 2006. Short-term and working memory in specific language impairment. *International Journal of Language & Communication Disorders* 41: 675–93. [CrossRef]

Barac, Raluca, and Ellen Bialystok. 2012. Bilingual effects on cognitive and linguistic development: Role of language, cultural background, and education. *Child Development* 83: 413–22. [CrossRef] [PubMed]

Barkley, Russell A. 2012. *Executive Functions: What They Are, How They Work, and Why They Evolved*. New York: Guilford Press.

Best, John R., and Patricia H. Miller. 2010. A developmental perspective on executive function. *Child Development* 81: 1641–60. [CrossRef]

Bialystok, Ellen, and Fergus I. M. Craik. 2010. Cognitive and linguistic processing in the bilingual mind. *Current Directions in Psychological Science* 19: 19–23. [CrossRef]

Blom, Elma, and Tessel Boerma. 2016. Why do children with language impairment have difficulties with narrative macrostructure? *Research in Developmental Disabilities* 55: 301–11. [CrossRef]

Blom, Elma, Roni Berke, Nehama Shaya, and Esther Adi-Japha. 2021. Cognitive flexibility in children with Developmental Language Disorder: Drawing of nonexistent objects. *Journal of Communication Disorders* 93: 106137. [CrossRef]

Boerma, Tessel, and Elma Blom. 2020. Effects of developmental language disorder and bilingualism on children's executive functioning: A longitudinal study. *Research in Developmental Disabilities* 107: 103782. [CrossRef]

Boerma, Tessel, Paul Leseman, Frank Wijnen, and Elma Blom. 2017. Language proficiency and sustained attention in monolingual and bilingual children with and without language impairment. *Frontiers in Psychology* 8: 1241. [CrossRef] [PubMed]

Borella, Erika, Barbara Carretti, and Santiago Pelegrina. 2010. The specific role of inhibition in reading comprehension in good and poor comprehenders. *Journal of Learning Disabilities* 43: 541–52. [CrossRef] [PubMed]

Botting, Nicola, and Chloë Marshall. 2017. Domain-specific and domain-general approaches to developmental disorders. In *The Wiley Handbook of Developmental Psychopathology*. Edited by Luna C. Centifanti and David M. Williams. Oxford: Wiley Blackwell, pp. 139–159. [CrossRef]

Braver, Todd S. 2012. The variable nature of cognitive control: A dual mechanisms framework. *Trends in Cognitive Sciences* 16: 106–13. [CrossRef] [PubMed]

Braver, Todd S., Jeremy R. Reynolds, and David I. Donaldson. 2003. Neural mechanisms of transient and sustained cognitive control during task switching. *Neuron* 39: 713–26. [CrossRef]

Brown, Thomas E., and Jeanne M. Landgraf. 2010. Improvements in executive function correlate with enhanced performance and functioning and health-related quality of life: Evidence from 2 large, double-blind, randomized, placebo-controlled trials in ADHD. *Postgraduate Medicine* 122: 42–51. [CrossRef]

Centraal Bureau voor de Statistiek. 2021. Bevolking; Generatie, Geslacht, Leeftijd en Herkomstgroepering. Available online: www.cbs.nl (accessed on 12 April 2022).

Conti-Ramsden, Gina, and Nicola Botting. 1999. Classification of children with specific language impairment: Longitudinal considerations. *Journal of Speech, Language, and Hearing Research* 42: 1195–204. [CrossRef]

Cragg, Lucy, and Nicolas Chevalier. 2012. The processes underlying flexibility in childhood. *Quarterly Journal of Experimental Psychology* 65: 209–32. [CrossRef]

Dajani, Dina R., and Lucina Q. Uddin. 2015. Demystifying cognitive flexibility: Implications for clinical and developmental neuroscience. *Trends in Neurosciences* 38: 571–78. [CrossRef] de Bruin, Angela, Barbara Treccani, and Sergio Della Sala. 2015. Cognitive advantage in bilingualism: An example of publication bias? *Psychological Science* 26: 99–107. [CrossRef]

Diamond, Adele. 2013. Executive functions. *Annual Review of Psychology* 64: 135–68. [CrossRef]

Druey, Michel D., and Ronald Hübner. 2008. Response inhibition under task switching: Its strength depends on the amount of task-irrelevant response activation. *Psychological Research* 72: 515–27. [CrossRef] [PubMed]

Duñabeitia, Jon Andoni, Juan Andrés Hernández, Eneko Antón, Pedro Macizo, Adelina Estévez, Luis J. Fuentes, and Manuel Carreiras. 2014. The inhibitory advantage in bilingual children revisited. *Experimental Psychology* 61: 234–51. [CrossRef] [PubMed]

Ebert, Kerry Danahy, and Kathryn Kohnert. 2011. Sustained attention in children with primary language impairment: A meta-analysis. *Journal of Speech, Language, and Hearing Research* 54: 1372–84. [CrossRef]

Ebert, Kerry Danahy, Diane Rak, Caitlyn M. Slawny, and Louis Fogg. 2019. Attention in bilingual children with developmental language disorder. *Journal of Speech, Language, and Hearing Research* 62: 979–92. [CrossRef] [PubMed]

Farrant, Brad M., Murray T. Maybery, and Janet Fletcher. 2012. Language, cognitive flexibility, and explicit false belief understanding: Longitudinal analysis in typical development and specific language impairment. *Child Development* 83: 223–35. [CrossRef]

Garon, Nancy, Susan E. Bryson, and Isabel M. Smith. 2008. Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin* 134: 31. [CrossRef] [PubMed]

Gathercole, Virginia C. Mueller, Enlli M. Thomas, Ivan Kennedy, Cynog Prys, Nia Young, Nestor Viñas Guasch, Emily J. Roberts, Emma K. Hughes, and Leah Jones. 2014. Does language dominance affect cognitive performance in bilinguals? Lifespan evidence from preschoolers through older adults on card sorting, Simon, and metalinguistic tasks. *Frontiers in Psychology* 5: 11. [CrossRef]

Gonzalez-Barrero, Ana Maria, and Aparna S. Nadig. 2019. Can bilingualism mitigate set-shifting difficulties in children with autism spectrum disorders? *Child Development* 90: 1043–60. [CrossRef]

Green, David W. 1998. Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition* 1: 67–81. [CrossRef]

Green, David W., and Jubin Abutalebi. 2013. Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology* 25: 515–30. [CrossRef]

Gunnerud, Hilde Lowell, Dieuwer ten Braak, Elin Kirsti Lie Reikerås, Enrica Donolato, and Monica Melby-Lervåg. 2020. Is bilingualism related to a cognitive advantage in children? A systematic review and meta-analysis. *Psychological Bulletin* 146: 1059. [CrossRef] [PubMed]

Hartanto, Andree, and Hwajin Yang. 2020. The role of bilingual interactional contexts in predicting interindividual variability in executive functions: A latent variable analysis. *Journal of Experimental Psychology: General* 149: 609. [CrossRef] [PubMed]

Hayes, Andrew F. 2017. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. New York: Guilford Publications.

Henry, Lucy A., David J. Messer, and Gilly Nash. 2012. Executive functioning in children with specific language impairment. *Journal of child Psychology and Psychiatry* 53: 37–45. [CrossRef] [PubMed]

Hilchey, Matthew D., and Raymond M. Klein. 2011. Are there bilingual advantages on nonlinguistic interference tasks? Implications for the plasticity of executive control processes. *Psychonomic Bulletin & Review* 18: 625–58. [CrossRef]

Huizinga, Mariëtte, and Maurits W. van der Molen. 2011. Task switching and shifting between stopping and going: Developmental change in between-trial control adjustments. *Journal of Experimental Child Psychology* 108: 484–503. [CrossRef] [PubMed]

IBM Corp. 2016. *IBM SPSS Statistics for Windows*. Version 24.0. Armonk: IBM Corp.

Iluz-Cohen, Peri, and Sharon Armon-Lotem. 2013. Language proficiency and executive control in bilingual children. *Bilingualism: Language and Cognition* 16: 884–99. [CrossRef]

Im-Bolter, Nancie. 2003. Executive Processes and Mental Attention in Children with Language Impairments. Ph.D. dissertation, York University, Toronto, ON, Canada.

Im-Bolter, Nancie, Janice Johnson, and Juan Pascual-Leone. 2006. Processing limitations in children with specific language impairment: The role of executive function. *Child Development* 77: 1822–41. [CrossRef]

Kapa, Leah L., and Elena Plante. 2015. Executive function in SLI: Recent advances and future directions. *Current Developmental Disorders Reports* 2: 245–52. [CrossRef]

Kapa, Leah L., Elena Plante, and Kevin Doubleday. 2017. Applying an integrative framework of executive function to preschoolers with specific language impairment. *Journal of Speech, Language, and Hearing Research* 60: 2170–84. [CrossRef]

Kuzyk, Olivia, Margaret Friend, Vivianne Severdija, Pascal Zesiger, and Diane Poulin-Dubois. 2020. Are there cognitive benefits of code-switching in bilingual children? A longitudinal study. *Bilingualism: Language and Cognition* 23: 542–53. [CrossRef]

Legare, Cristine H., Michael T. Dale, Sarah Y. Kim, and Gedeon O. Deák. 2018. Cultural variation in cognitive flexibility reveals diversity in the development of executive functions. *Scientific Reports* 8: 16326. [CrossRef] [PubMed]

Leonard, Laurence B. 2014. *Children with Specific Language Impairment*. Cambridge: MIT Press.

Lubin, Amélie, Emmanuelle Regrin, Laetitia Boulc'h, Sébastien Pacton, and Céline Lanoë. 2016. Executive functions differentially contribute to fourth graders' mathematics, reading, and spelling skills. *Journal of Cognitive Education and Psychology* 15: 444–63. [CrossRef]

Lukács, Ágnes, Enikő Ladányi, Kata Fazekas, and Ferenc Kemény. 2016. Executive functions and the contribution of short-term memory span in children with specific language impairment. *Neuropsychology* 30: 296. [CrossRef] [PubMed]

Martin-Rhee, Michelle M., and Ellen Bialystok. 2008. The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition* 11: 81–93. [CrossRef]

Marton, Klara. 2016. Executive control in bilingual children: Factors that influence the outcomes. *Linguistic Approaches to Bilingualism* 6: 575–89. [CrossRef]

Miyake, Akira, Naomi P. Friedman, Michael J. Emerson, Alexander H. Witzki, Amy Howerter, and Tor D. Wager. 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. [CrossRef]

Noterdaeme, Michele, Hedwig Amorosa, Katrin Mildenberger, Stefan Sitter, and Falk Minow. 2001. Evaluation of attention problems in children with autism and children with a specific language disorder. *European Child & Adolescent Psychiatry* 10: 58–66. [CrossRef]

Paap, Kenneth R., Hunter A. Myuz, Regina T. Anders, Morgan F. Bockelman, Roman Mikulinsky, and Oliver M. Sawi. 2017. No compelling evidence for a bilingual advantage in switching or that frequent language switching reduces switch cost. *Journal of Cognitive Psychology* 29: 89–112. [CrossRef]

Paap, Kenneth R., Regina Anders-Jefferson, Lauren Mason, Katerinne Alvarado, and Brandon Zimiga. 2018. Bilingual advantages in inhibition or selective attention: More challenges. *Frontiers in Psychology* 9: 1409. [CrossRef]

Park, Jisook, Carol A. Miller, Teenu Sanjeevan, Janet G. van Hell, Daniel J. Weiss, and Elina Mainela-Arnold. 2019. Bilingualism and attention in typically developing children and children with developmental language disorder. *Journal of Speech, Language, and Hearing Research* 62: 4105–18. [CrossRef]

Pauls, Laura J., and Lisa M. D. Archibald. 2016. Executive Functions in Children With Specific Language Impairment: A Meta-Analysis. *Journal of Speech, Language, and Hearing Research* 59: 1074–86. [CrossRef] [PubMed]

Peristeri, Eleni, Eleni Baldimtsi, Margreet Vogelzang, Ianthi Maria Tsimpli, and Stephanie Durrleman. 2021. The cognitive benefits of bilingualism in autism spectrum disorder: Is theory of mind boosted and by which underlying factors? *Autism Research* 14: 1695–709. [CrossRef] [PubMed]

Poarch, Gregory J., and Andrea Krott. 2019. A bilingual advantage? An appeal for a change in perspective and recommendations for future research. *Behavioral Sciences* 9: 95. [CrossRef] [PubMed]

Prior, Anat, and Brian MacWhinney. 2010. A bilingual advantage in task switching. *Bilingualism: Language and Cognition* 13: 253–62. [CrossRef]

Rice, Mabel L., and Kenneth Wexler. 1996. Toward tense as a clinical marker of specific language impairment in English-speaking children. *Journal of Speech, Language, and Hearing Research* 39: 1239–57. [CrossRef] [PubMed]

Rothbart, Mary K., and Michael I. Posner. 2001. Mechanism and variation in the development of attentional networks. In *Handbook of Developmental Cognitive Neuroscience*. Edited by Charles A. Nelson and Monica Luciana. Cambridge: MIT Press, pp. 353–363.

Scarborough, Hollis S., and Wanda Dobrich. 1990. Development of children with early language delay. *Journal of Speech, Language, and Hearing Research* 33: 70–83. [CrossRef]

Schlichting, L. 2005. *Peabody Picture Vocabulary Test-III-NL*. Dutch version. Amsterdam: Harcourt Assessment B.V.

Schneider, Walter, Amy Eschman, and Anthony Zuccolotto. 2002. *E-Prime User's Guide*. Pittsburgh: Psychology Software Tools Inc.

Smolak, Erin, Karla K. McGregor, Tim Arbisi-Kelm, and Nichole Eden. 2020. Sustained attention in developmental language disorder and its relation to working memory and language. *Journal of Speech, Language, and Hearing Research* 63: 4096–108. [CrossRef]

Stichting Siméa. 2014. Indicatiecriteria: Auditief en/of Communicatief Beperkte Leerlingen. Available online: http://www.simea.nl/dossiers/passend-onderwijs/brochures-po/simea-brochure-indicatiecriteria-juni-2014.pdf (accessed on 3 December 2021).

Stichting Siméa. 2016. Handreiking Meertaligheid TOS. Available online: http://www.simea.nl/dossiers/si166289-simea-handreiking-meertaligheid-tos.pdf (accessed on 3 December 2021).

Timmermeister, Mona, Paul Leseman, Frank Wijnen, and Elma Blom. 2020. No bilingual benefits despite relations between language switching and task switching. *Frontiers in Psychology* 11: 1832. [CrossRef]

Tomblin, J. Bruce, Nancy L. Records, Paula Buckwalter, Xuyang Zhang, Elaine Smith, and Marlea O'Brien. 1997. Prevalence of specific language impairment in kindergarten children. *Journal of Speech, Language, and Hearing Research* 40: 1245–60. [CrossRef]

Tuller, Laurice. 2015. Clinical use of parental questionnaires in multilingual contexts. In *Methods for Assessing Multilingual Children: Disentangling Bilingualism from Language Impairment*. Edited by Sharon Armon-Lotem, John H. A. L. de Jong and Natalia Meir. Bristol: Multilingual Matters, pp. 301–30.

van den Noort, Maurits, Esli Struys, Peggy Bosch, Lars Jaswetz, Benoît Perriard, Sujung Yeo, Pia Barisch, Katrien Vermeire, Sook-Hyun Lee, and Sabina Lim. 2019. Does the bilingual advantage in cognitive control exist and if so, what are its modulating factors? A systematic review. *Behavioral Sciences* 9: 27. [CrossRef]

Van der Lely, Heather K. J. 2005. Domain-specific cognitive systems: Insight from Grammatical-SLI. *Trends in Cognitive Sciences* 9: 53–59. [CrossRef] [PubMed]

Vandierendonck, André, Baptist Liefooghe, and Frederick Verbruggen. 2010. Task switching: Interplay of reconfiguration and interference control. *Psychological Bulletin* 136: 601. [CrossRef] [PubMed]

Verhagen, Josje, Elise de Bree, and Sharon Unsworth. 2020. Effects of bilingual language use and language proficiency on 24-month-olds' cognitive control. *Journal of Cognition and Development* 21: 46–71. [CrossRef]

Verhoeven, Ludo, and Anne Vermeer. 2001. *Taaltoets Alle Kinderen (TAK)*. Arnhem: Cito.

Vissers, Constance, Sophieke Koolen, Daan Hermans, Annette Scheper, and Harry Knoors. 2015. Executive functioning in preschoolers with specific language impairment. *Frontiers in Psychology* 6: 1574. [CrossRef]

Ware, Anna T., Melissa Kirkovski, and Jarrad A. G. Lum. 2020. Meta-analysis reveals a bilingual advantage that is dependent on task and age. *Frontiers in Psychology* 11: 1458. [CrossRef]

Wechsler, David, and Jack A. Naglieri. 2008. Wechsler Nonverbal Scale of Ability. Available online: http://www.pearsonclinical.nl/wnv-nl-wechsler-non-verbal (accessed on 3 December 2021).

Yeniad, Nihal, Maike Malda, Judi Mesman, Marinus H. Van IJzendoorn, and Suzanne Pieper. 2013. Shifting ability predicts math and reading performance in children: A meta-analytical study. *Learning and Individual Differences* 23: 1–9. [CrossRef]

Zelazo, Philip David. 2006. The Dimensional Change Card Sort (DCCS): A method of assessing executive function in children. *Nature Protocols* 1: 297–301. [CrossRef]