Differences in phonological awareness performance

Are there positive or negative effects of bilingual experience?

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Children who have knowledge of two languages may show better phonological awareness than their monolingual peers (e.g. Bruck & Genesee, 1995). It remains unclear how much bilingual experience is needed for such advantages to appear, and whether differences in language or cognitive skills alter the relation between bilingualism and phonological awareness. These questions were investigated in this cross-sectional study. Participants ($n = 294$; 4–7 year-olds, in the first three grades of primary school) were Dutch-speaking pupils attending mainstream monolingual Dutch primary schools or early-English schools providing English lessons from grade 1, and simultaneous Dutch-English bilinguals. We investigated phonological awareness (rhyming, phoneme blending, onset phoneme identification, and phoneme deletion) and its relation to age, Dutch vocabulary, English vocabulary, working memory and short-term memory, and the balance between Dutch and English vocabulary. Small significant ($\alpha < .05$) effects of bilingualism were found on onset phoneme identification and phoneme deletion, but post-hoc comparisons revealed no robust pairwise differences between the groups. Furthermore, effects of bilingualism sometimes disappeared when differences in language or memory skills were taken into account. Learning two languages simultaneously is not beneficial to – and importantly, also not detrimental to – phonological awareness.

Keywords: early-English education, bilingualism, phonological awareness, vocabulary, memory

https://doi.org/10.1075/lab.18082.gor | Published online: 29 October 2019
Linguistic Approaches to Bilingualism 11:3 (2021), pp. 418–451. ISSN 1879-9264 | E-ISSN 1879-9272

1. Introduction

Well-developed phonological awareness skills are a precursor for literacy skills (Sodoro, Allinder, & Rankin-Erickson, 2002). Phonological awareness competence is therefore a topic of interest in research as well as in educational practice. Phonological awareness development starts before children enter preschool, continues during preschool, but develops especially quickly once literacy instruction begins (Anthony & Francis, 2005). Many schools in Europe have lowered the starting point of early foreign language instruction to kindergarten – exactly the point in time that phonological awareness skills are developing. An important question is whether early foreign language education has an influence – positive or negative – on phonological awareness performance. That question is addressed here for children in the Netherlands with foreign language instruction in English.

Despite its ever-increasing popularity, many parents and teachers have concerns that foreign language education may negatively influence pupils' development of Dutch, or both Dutch and English (Goorhuis-Brouwer & de Bot, 2010). Previous research has however suggested that children who are exposed to two languages may in fact show better phonological awareness than their monolingual peers (e.g. Bruck & Genesee, 1995; Marinova-Todd, Zhao, & Bernhardt, 2010), although not all studies confirm this (e.g. Bialystok, Majumder, & Martin, 2003; Janssen, Segers, McQueen, & Verhoeven, 2015). Contrary to educators' concerns, it could be assumed that foreign language instruction may benefit children's phonological awareness. In the present cross-sectional study, we investigated whether Dutch children enrolled in an early-English school differ from their monolingually educated peers in their phonological awareness of Dutch, and if the performance of English learners resembles that of simultaneous English-Dutch bilingual children who are highly proficient in both languages.

1.1 Development of phonological awareness in monolinguals and bilinguals

Phonological awareness is the ability to detect and manipulate the different sounds in a language, and to focus on the phonological structure of spoken language instead of on the meaning of the words (Sodoro et al., 2002). The development of phonological awareness generally follows a fixed pattern in which children become sensitive to smaller and smaller word units: they first learn to detect and manipulate syllables, then onsets and rimes (the second part of syllable, starting with the vowel), and finally individual phonemes (Anthony & Francis, 2005), although the nature of the task also influences children's performance on larger and smaller units (Savage, Blair, & Rvachew, 2006).

The speed with which the development of phonological awareness takes place appears to differ according to the linguistic complexity of the language spoken. Language features like the saliency of syllables, the saliency and complexity of onsets, and the proportion of rime neighbours, are related to children's ability to detect syllables, their onset and phoneme awareness, and their ability to separate onset from rime (onset-rime awareness), respectively (Anthony & Francis, 2005). For example, native speakers of a language with simple syllable structures are likely to develop syllable awareness more quickly than speakers of a language with more complex syllable structure (Anthony & Francis, 2005).

1.2 Phonological awareness advantages for dual language learners

Researchers have suggested that the development of phonological awareness may be different for children having experience with two languages, compared to when children only learn one language. Rubin and Turner (1989) compared English-speaking pupils in French immersion classrooms to monolingual English pupils. The immersion pupils performed better than monolinguals on an English syllable deletion task and a phoneme deletion task. The authors hypothesized that this heightened phonological awareness could either be a general advantage because pupils constantly and explicitly had to analyse a second language (L2), could be specific to learning French, or both. If it was specific to learning French, other language combinations should lead to advantages in other domains of phonological awareness (Rubin & Turner, 1989).

Later studies on phonological awareness in monolingual and immersion or bilingual pupils have provided evidence for both language-general and language-specific advantages. Marinova-Todd et al. (2010), for example, found that Mandarin-English bilinguals outperformed Mandarin monolinguals on a Mandarin tone discrimination task, and outperformed English monolinguals on an English phonemic awareness test. The authors argued that the bilinguals' performance cannot be explained by having knowledge of English and Mandarin, respectively, and must be an effect of bilingualism more generally.

Other studies provide arguments for advantages due to specific language combinations. Bruck and Genesee (1995), for example, found that English pupils in French immersion kindergarten performed better than monolingual English pupils on onset-rime awareness and syllable counting tasks. They reasoned this was due to syllables being more salient in French than English (Bruck & Genesee, 1995). Bialystok et al., (2003; study III) found that Spanish-English bilinguals showed an advantage over English monolingual children on a phoneme segmentation task, but Chinese-English bilinguals scored significantly lower than the two other groups. Two possible reasons were provided for the advantage shown by the

Spanish-English bilinguals, the first being that English and Spanish have a more similar sound structure than English and Chinese, which may provide easy access to the phonological structure of the languages.

The second reason was that the simple phonological structure of Spanish promotes phonological awareness, which may in turn enhance children's phonological awareness in English (Bialystok et al., 2003). Loizou and Stuart (2003) also reasoned that having knowledge of an additional language with a more simple phonological structure may help phonological awareness in the first language (L1). They found that English-Greek bilinguals growing up in the United Kingdom outperformed English monolinguals on phonological awareness tasks, but Greek-English bilinguals growing up in Greece did not show an advantage over Greek monolinguals. They reasoned that English-Greek bilinguals had an L2 (Greek) that was phonologically simpler than their L1 (English), which would make them phonologically aware more easily and rapidly. As for the Greek-English children it was the other way around, they would not show such a benefit (Loizou & Stuart, 2003).

Other studies, however, have yielded findings that support the opposite reasoning. For example, a study revealed that nine-year-old Chinese children who received 80 minutes of English lessons per week showed better performance on Chinese Pinyin phonological awareness tasks than monolingual children. However, in contrast to what Bialystok et al. (2003) and Loizou and Stuart (2003) reasoned, Chen et al. argued that the L2 learners had an advantage because English is phonologically *more* complex than Chinese (Chen, Xu, Nguyen, Hong, & Wang, 2010).

1.3 Other factors that may influence phonological awareness performance

Not all studies show positive effects of learning two languages on phonological awareness performance. The table in the electronic supplement provides an overview of prior studies on this topic. Most of these 19 studies show at least some advantages for dual language learners. Four studies found only disadvantages for the bilingual group (Bialystok et al., 2003, study II; Janssen, Segers, McQueen, & Verhoeven, 2017; Janssen, et al., 2015; Lesniak, Myers, & Dodd, 2014). Contrary to most of the other 15 studies, in three of these studies (Janssen et al., 2015, 2017; Lesniak et al., 2014) the bilinguals were sequential bilinguals from low socio-economic backgrounds, who mainly spoke another language at home than at school. In two of these studies, the (Dutch) monolingual and (Dutch-Turkish) bilingual pupils' knowledge of the school language (Dutch) was investigated (Janssen et al., 2015, 2017). The bilingual group appeared to have a significantly smaller vocabulary in Dutch. This suggest that other factors, like vocabulary knowledge, may influence phonological awareness as well as the relation between bilingualism and phonological awareness. This may explain why studies on bilingual advantages in phonological awareness show mixed results. Indeed, both for Dutch monolingual and Dutch-Turkish bilingual pupils, Dutch vocabulary level was positively correlated with performance on Dutch rhyme (matching words that sound the same) awareness and phoneme blending tasks (Janssen et al., 2017). The vocabulary in the other language may play a role as well: research has shown that Spanish-English bilingual children's Spanish vocabulary level was positively correlated with their performance on English phonological awareness tasks (Atwill, Blanchard, Gorin, & Burstein, 2007).

A meta-analysis on studies investigating the phonological awareness skills of bilingual children showed that learner-specific characteristics other than vocabulary knowledge influence phonological awareness performance (in English in this study) (Branum-Martin, Tao, Garnaat, Bunta, & Francis, 2012). One of these characteristics is children's age. A longitudinal study showed that monolingual English children performed significantly better on a rhyme matching task when at 50 months of age than at 46 months (Carroll, Snowling, Stevenson, & Hulme, 2003). Although it is known that older children generally perform better on phonological awareness tasks than younger children, researchers do not always take age into account when assessing bilingual children's phonological awareness (Branum-Martin et al., 2012).

Branum-Martin et al. (2012) suggested that other learner characteristics, such as cognitive skills, may play a role in phonological awareness performance as well, but due to lack of information in the studies included in their meta-analysis this could not be investigated. Confirming this suggestion, Bialystok et al. (2003) found a significant correlation between monolinguals' and bilinguals' working memory and phonological awareness skills. As most previous studies did not investigate individual differences in learner-specific variables, it remains unknown to what extent they influenced differences between monolinguals and bilinguals in phonological awareness.

External factors may influence pupils' phonological awareness performance too. One possible factor is the start of reading instruction (Bruck & Genesee, 1995). Literacy instruction may help monolinguals to catch up with the dual language learners if both groups learn to read and write in the same language. At least two studies provide evidence for this. Bruck and Genesee (1995) found that English pupils in French immersion had an advantage over monolingual English pupils before, but not after literacy instruction had started. Reder, Marec-Breton, Gombert, and Demont (2013) found that French pupils in partial immersion education did not differ from French monolingual pupils in phonological awareness abilities. It was argued that since both groups already received literacy instruction in French, pupils were already paying attention to the phonologic structure of the language.

Another factor may be the amount of exposure to the additional language. Research suggested that even limited exposure to that language may influence pupils' phonological awareness skills in the other language, but that more exposure to the additional language is related to bigger influences. Chen et al. (2010) showed that pupils who received English instruction for 80 minutes per week outperformed their peers from a monolingual programme on onset and rime awareness tasks in Pinyin Chinese. In a longitudinal follow-up study, pupils following an intensive English programme (over 10 hours per week) outperformed the pupils in the regular programme (80 minutes per week) on Chinese phonological awareness, but only by the end of grade two (Chen et al., 2010), suggesting that a certain proficiency level must be reached before more proficient language learners start to outperform less proficient learners. In another study (Kang, 2012), Korean pupils attending English immersion kindergarten obtained higher scores on English and Korean phonological awareness tasks than Korean peers who got 15 minutes of English lessons per day. In both groups, English phonological awareness predicted Korean phonological awareness and vice versa, indicating that a small amount of L2 instruction may already influence pupils' phonological awareness in their native language.

However, no study directly compared L2 learners and simultaneous bilinguals or included a measure a measure of relative proficiency in both languages. It remains unknown how little bilingual exposure is needed before dual language learners start to outperform their monolingual peers, or whether more balanced knowledge of two languages is associated with greater advantages.

In summary, bilingual children and L2 learners may have better phonological awareness skills than monolingual children, because they have to analyse an additional language. Language characteristics may foster pupils' performance on some phonological awareness tasks that are representative for the features of some languages but not others. In addition, environmental factors (such as literacy instruction or amount of exposure to the additional language), and differences in linguistic and/or cognitive development may influence the relation between bilingual experience and phonological awareness. It remains unknown how little or much bilingual experience is needed for differences in phonological awareness to show, and how individual differences between dual language learners may modulate the relation between bilingual experience and phonological awareness. The present study addresses those questions for Dutch-English dual language learners.

1.4 Context of the current study

Dutch primary schools have a monolingual (Dutch) curriculum. English lessons are usually not given until the penultimate grade when children are around ten years old. Just like in many other European countries, primary schools have begun to lower the starting age of English lessons (Enever et al., 2011). One in five Dutch primary schools provide English lessons from the moment that children enter school at the age of four. Unlike the participants in previous studies, who were instructed for at least 80 minutes per week in English or attended immersion classes, Dutch pupils in early-English school usually do not get more than 60 minutes of English per week (Jenniskens, Leest, Wolbers, Bruggink, Dood, & Krikhaar, 2017). It remains unknown whether this limited experience influences phonological awareness and, if so, whether that influence is comparable to that of children with more language experience (and probably more balanced knowledge of two languages), namely children who are raised as simultaneous bilinguals.

1.5 Research aims and hypotheses

The aim of this study was: (1) to investigate whether bilingualism helps phonological awareness, (2) to examine, if so, how much bilingual experience is needed for them to emerge, and, as the previous literature provides a contradictory picture, (3) to investigate whether individual developmental differences alter the relation between bilingualism and phonological awareness. To answer these questions, we compared phonological awareness skills of three groups of children: functionally monolingual Dutch pupils, Dutch pupils enrolled in early-English schools, and Dutch-English bilingual children. We included children from the first three grades of primary school.

Despite the fact that many of the previous studies showed mixed results, most studies showed a bilingual advantage on a number of tasks, which is likely due to the pressure of having to analyse more than one language phonologically. Our first hypothesis was thus that early-English education helps the acquisition of phonological awareness. Previous research showed that pupils with more L2 exposure outperformed pupils with less exposure (Chen et al., 2010; Kang, 2012). Our second hypothesis therefore was that more bilingual experience would be associated with greater phonological awareness skills. We expected the English learners to outperform the functionally monolingual pupils, and the bilingual children to outperform both other groups. In line with previous findings (Bruck & Genesee, 1995; Reder et al., 2013), we expected these advantages to be apparent for children in the first two but not the third grade of primary school, as a consequence of children's experience with formal reading instruction.

Our third hypothesis was that possible relations between bilingualism and phonological awareness would be affected by individual differences in language balance and memory. We incorporated various measures which have previously been shown to be related to phonological awareness: (within-grade) age differences (Branum-Martin et al., 2012; Carroll et al., 2003), working memory (Bialystok et al., 2003), short-term memory (Sodoro et al., 2002), vocabulary knowledge in the L1 (Janssen et al., 2017), and the L2 (Atwill et al., 2007). Since it has been argued that especially childhood bilingualism cannot be defined as a simple categorical variable, because proficiency can vary in the two languages of a bilingual child (Luk & Bialystok, 2013), we also included a measure of language balance. A child who has equal proficiency in both languages is a balanced bilingual, one who is more proficient in one language than the other is unbalanced. We operationalised language balance as the ratio between Dutch and English vocabulary development. Given that in previous work (Goriot, Broersma, McQueen, Unsworth, & van Hout, 2018) we found that lexical balance may be a more important predictor for individual differences between children than grouping children in a monolingual or bilingual group, we expected lexical balance to be positively related to phonological awareness.

This study contributes to knowledge about whether learning two languages influences phonological awareness performance, and, if so, how much bilingual experience is needed before it starts to influence performance. In addition, this study addresses how other differences between learners, like differences in age or memory, may influence the relation between bilingualism and phonological awareness.

2. Method

2.1 Participants

Participants were 294 children (151 boys and 143 girls) The 123 English learners attended one of four schools at which English lessons started from the moment children enter primary school (i.e., kindergarten; age four). These schools had a certificate from an independent organization that they taught at least 60 minutes of English lessons per week, and that those lessons were given by a teacher who had at least B2 level (intermediate) of English in terms of the Common European Framework of Reference. Schools were recruited because they had a certificate for their English education, and had at least three years of experience with teaching English. This way, we ensured that all pupils had had English lessons from the moment they entered primary school.

The functionally monolingual group consisted of 121 children who attended one of five mainstream Dutch primary school in which English education did not start before the penultimate grade. These children were functionally monolingual speakers of Dutch, with some exposure to English via e.g. media and music. Mainstream schools were recruited because they matched the early-English schools in terms of pupil population and average income in the neighbourhood they were located in. In each school (mainstream and early-English), up to approximately 10 children from each of grades 1, 2 and 3 participated. We asked the head teachers to select children who were not exposed to another language at home, and who did not have any speech, language or developmental disorders or hearing or sight problems.

The remaining children ($n = 50$) were Dutch-English bilinguals who were raised bilingually at home, and had at least one parent who was a native speaker of English. Two additional children were tested, but their data were removed since it turned out that they failed to meet this criterion. Bilinguals were recruited via advertisements on webpages for bilingual families. According to parental report, none of the participating bilingual children had any known speech, language, or developmental disorders, or sight or hearing impairments.

Children were in one of three grades (see also Table 1): 93 in grade 1 (kindergarten year 1; 4–5 year-olds), 95 in grade 2 (kindergarten year 2; 5–6 year-olds), and 106 in grade 3 (first year of formal schooling; 6–7 year-olds). Parents of all children gave informed consent for participation. Parents were given a questionnaire about out-of-school exposure to English. Unfortunately, the response rate was only 45.2%.

2.2 Instruments

2.2.1 *Phonological awareness*

Phonological awareness was assessed with several tasks of the *Screeninginstrument Beginnende Geletterdheid* [Diagnostic Instrument for Emergent Literacy] (Vloedgraven, Keuning, & Verhoeven, 2009), a normed instrument to measure phonological awareness performance in Dutch. The reliability coefficients for the tasks range between sufficient (.70) and good (>.80). The specific tasks were dependent on the grade of the participant. For children in grade 1, we assessed rhyming and phoneme blending, for those in grade 2, rhyming, phoneme blending and onset phoneme identification, and for those in grade 3, phoneme blending, onset phoneme identification, and phoneme deletion. All tasks consisted of two practice trials and 15 test trials. In each task, children are presented with three full colour pictures that appear on the screen one-by-one while the pre-recorded name of the picture is played over the computer's speakers. The task is orally presented after the final response alternative appears on the screen (see Figure 1). Scores are computed as the total number of correct responses on the sub-task. For each sub-task, an example is presented below:

2.2.2 *Rhyming*

Children are asked to identify the picture that rhymes with the target, for example: "*Kat, bal, dak; wat rijmt op mat?" ["Cat, ball, roof; what rhymes with mat?"].*

2.2.3 *Phoneme blending*

Children are asked to identify a word based on the individual phonemes of that word. An example is: "*Sport, spons, storm; 's' 'p' 'o' 'r' 't'." [Sport, sponge, storm; 's' 'p' 'o' 'r' 't'].*

2.2.4 *Onset phoneme identification*

Children are asked to indicate which word starts with the same phoneme as the target, for example: *"Nek, maan, hol; de n van neus." ["Neck, moon, cave, the n of nose"].*

2.2.5 *Phoneme deletion*

Children are asked to identify a word after removing one sound from another word. An example item is: *"Net, nek, bed; nest, laat de 's' weg."* ["*Net, neck, bed; nest leave out the 's'"]*

Figure 1. Design of the Diagnostic Instrument for Emergent Literacy. The pictures appear on the screen one-by-one. The task is orally presented after the last picture appears on the screen

2.2.6 *Vocabulary*

English and Dutch vocabulary were assessed with the PPVT-4, and the PPVT-III-NL, respectively (Dunn & Dunn, 2007; Dunn, Dunn, & Schlichting, 2005). The English version consists of 228 items, grouped in 19 sets of 12 items each, in which the child is presented with 4 pictures. The name of the picture is orally presented (in this study a recording by a native speaker was played), and the child has to indicate which picture corresponds to the description. The starting set depends on the age of the child. Administration rules as stated in the manual were followed, which means that the basal set is the lowest set in which a child made maximally one error, and the final set is the highest set in which the child made eight or more errors. The raw score is calculated by subtracting the number of errors from the number of the highest item that the child made. The administration of the PPVT-III (Dutch) is similar to the PPVT-4, except for the fact that the test consists of 204 items and the basal set and ceiling set are determined by the lowest and highest set in which the child makes maximally four and nine or more errors, respectively. The reliability coefficient for the 4 to 7 year-old children is on average .96 for the English version, and .93 for the Dutch version.

2.2.7 *Working memory*

The subtest 'Odd One Out' from the Automated Working Memory Assessment (Alloway, Gathercole, Kirkwood, & Elliott, 2008) was administered. This is a computerised test in which the child is presented with three pictures, surrounded by rectangles. The child has to indicate which of the pictures is the odd one out, and remember its location. After the pictures disappear, only the rectangles remain and the participant has to indicate the location of the odd one out. The test starts with a trial of one sequence of pictures, after which the correct location has to be remembered. After four correct trials, a trial of two sequences of three pictures is presented, and both locations have to be remembered and indicated by the participant. The test stops after the participant responds erroneously to three trials of the same length. The maximum number of sequences is seven. The raw score is calculated as the number of correctly performed trials. The test-retest reliability coefficient is .88.

2.2.8 *Short-term memory*

Short-term memory was examined by a word span task, taken from the subtest *Geheugen* [Memory] in the standardized *Screeningstest voor Taal- en Leesproblemen* [Diagnostic Test for Language and Literacy Problems] (Verhoeven, 2005). The child is presented with a sequence of two pre-recorded monosyllabic words, which she had to repeat in the same order. After two sequences of the same length, the length increases by one word. Testing is stopped after the child responded erroneously to four consecutive trials. The score is calculated as the number of correctly repeated trials.

2.3 Procedure

All children were tested individually; monolingual children and learners of English in a quiet room at their school, bilingual children at their home. For pupils tested at schools, testing was done in two sessions of twenty minutes. The first session included the word span, followed by the Odd One Out and the PPVT-4. The second session included the Screening instrument followed by the PPVT-III

Dutch. For bilingual children, testing consisted of two or three sessions, depending on their age. For them, sessions contained the tasks reported here, as well as other tasks as part of a larger test battery (the results of which are reported in Goriot et al. (2018); crucially, the relative order of the tasks reported on here was the same as for the other groups. For all participants except for three who did the two sessions on the same day, there was always at least one day between the sessions ($M = 5$, $SD = 5$).

2.4 Analyses

We performed four separate ANCOVAs[1] (in SPSS version 23.0) to investigate the effects of Bilingualism, Grade, and Age on performance on each of the four phonological awareness tasks. In the first step, three-way and two-way interactions between all independent variables (Bilingualism, Grade, Age) were included in each model, and removed if they were non-significant. After we established the base models, we investigated the effect of individual differences. We added the covariates (Dutch vocabulary, English vocabulary, lexical balance, short-term memory, and working memory) one-by-one to each base model.

3. Results

Table 1 shows the descriptive statistics for all groups. Figure 2a to 2d show the average outcomes for each of the phonological awareness measures for all nine groups (three grades by three bilingual categories). To investigate whether there is an effect of degree of bilingualism on phonological awareness, ANCOVAs with Grade (G1, G2, G3), Bilingual Category (functionally monolingual, early-English, bilingual) and Age in months were performed. Given the fast development of phonological awareness in the age range involved, pupils' age in months may provide information (in addition to grade) about differences in children's performance. Moreover, an ANOVA with Grade and Bilingual Category showed that the three groups differed in age ($F(2,83) = 5.80$, $p = .002$, $\eta_p^2 = .039$, Tukey HSD: functionally monolingual > early-English > bilingual). Appendix A shows the correlations between phonological awareness measures, vocabulary, memory, and age, for each of the three bilingual categories.

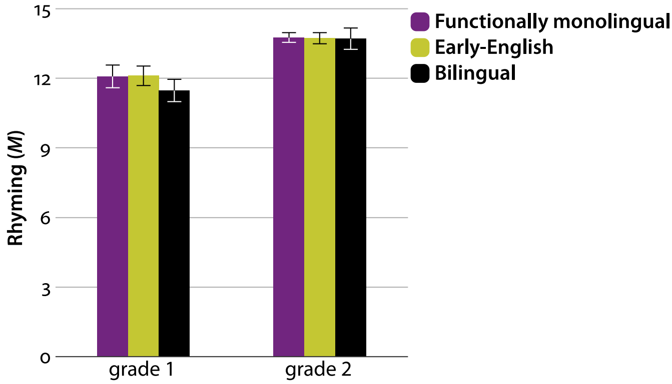
One ANCOVA for each phonological awareness measure was conducted. Table 2 shows the resulting base models, which were used for all further analyses.

1. We are aware of the multilevel structure of the data. We also performed multilevel analyses with School as a random factor. AN(C)OVAs and multilevel results did not differ. In such cases the analyses with the most simple structure should be reported (Tabachnick & Fidell, 2007).

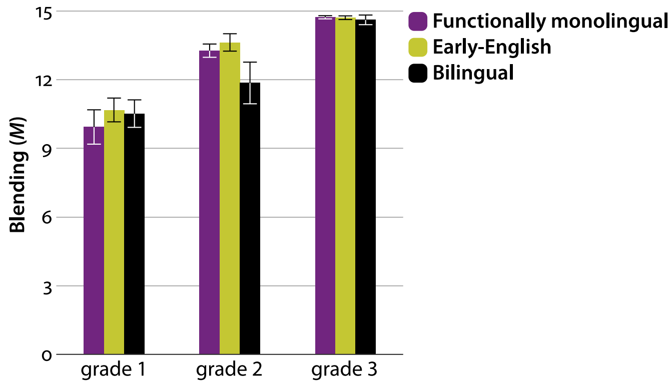
Table 1. Descriptive statistics for Age and the phonological awareness measures for all groups

			Grade 1 (4–5 year-olds)			Grade 2 (5–6 year-olds)			Grade 3 (6–7 year-olds)		
			Functionally monolingual	Early-English	Bilingual	Functionally monolingual	Early-English	Bilingual	Functionally monolingual	Early-English	Bilingual
Number of participants		*N*	32	38	23	41	40	14	48	45	13
Age (in years)		*M*	5.0	4.9	4.8	6.0	5.8	5.8	6.9	6.8	6.8
		(SD)	(0.4)	(0.3)	(0.4)	(0.3)	(0.4)	(0.5)	(0.3)	(0.5)	(0.5)
Home exposure to English media (average hours per week)		*N*	10	16	14	16	17	10	19	21	10
		M	0.79	0.80	3.26	0.55	0.81	2.09	0.65	0.87	2.65
		(SD)	(1.13)	(0.57)	(1.80)	(0.56)	(0.68)	(2.23)	(0.74)	(0.83)	(1.90)
% exposure to English at home (from parents, either native or non-native speaker of English)[a]		*N*			14			10			9
		M		–	.67	–	–	.49	–	–	.47
		(SD)			(.21)			(.18)			(.18)
Phonological awareness (max. score of 15 on each task)	Rhyming	*M*	12.09	12.11	12.09	13.76	13.73	–	–		–
		(SD)	(2.77)	(2.59)	(2.77)	(1.36)	(1.50)				
	Phoneme blending	*M*	9.94	10.68	9.94	13.27	13.63	13.71	14.73	14.71	14.62
		(SD)	(4.26)	(3.21)	(4.26)	(1.87)	(2.42)	(1.73)	(0.49)	(0.55)	(0.77)
	Onset phoneme	*M*	–	–	–	12.36	13.08	11.86	14.60	14.42	14.15
		(SD)				(2.34)	(2.70)	(3.42)	(0.68)	(0.94)	(1.07)
	Phoneme deletion	*M*	–	–	–	–	–	12.36	9.14	10.33	9.40
		(SD)					(3.91)	(3.58)	(3.17)	(4.30)	

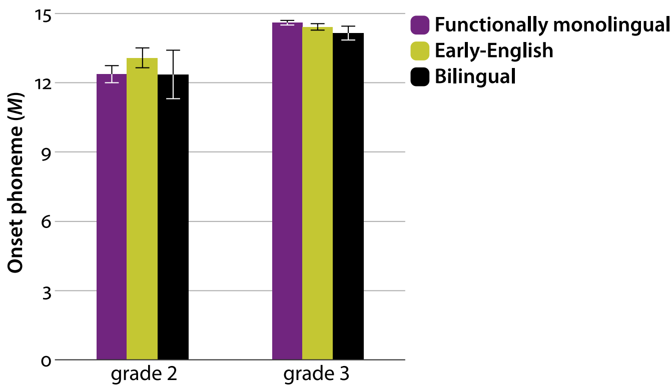
a. Computed as the percentage of time per week spent with the English-speaking parent(s).



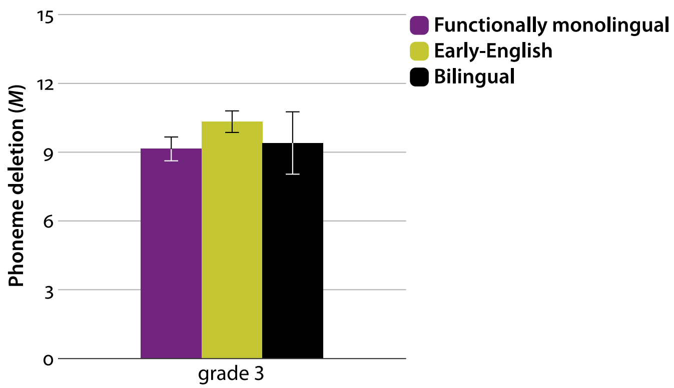
a. Rhyming



b. Phoneme blending



c. Onset phoneme



d. Phoneme deletion

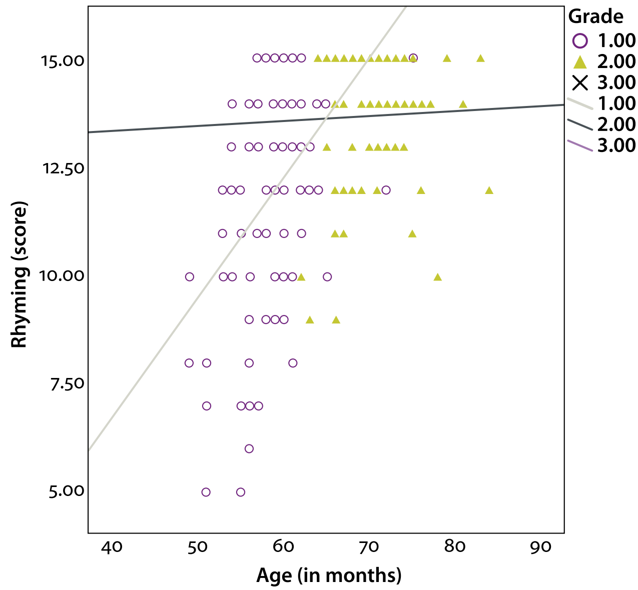
Figure 2. Scores on the phonological awareness tasks, by Grade and Bilingual status with *SE*s

There was a main effect of Age, and a main effect of Grade for Rhyming, Phoneme Blending, and Onset Phoneme identification. The effect of Age also differed with Grade, resulting in significant interaction effects. Figures 3a to 3c show that the children in the higher grades were at ceiling for the phonological awareness tasks. Therefore age was a relevant predictor of phonological awareness only in the younger groups. For Onset Phoneme Identification and Phoneme Deletion, there were main effects of Age, and Bilingual Category, and interaction effects between the two. Figures 4a and 4b show that there is a stronger relation between Age and performance on the two tasks for bilingual children than for functionally monolingual and English learners, especially for Phoneme Deletion.

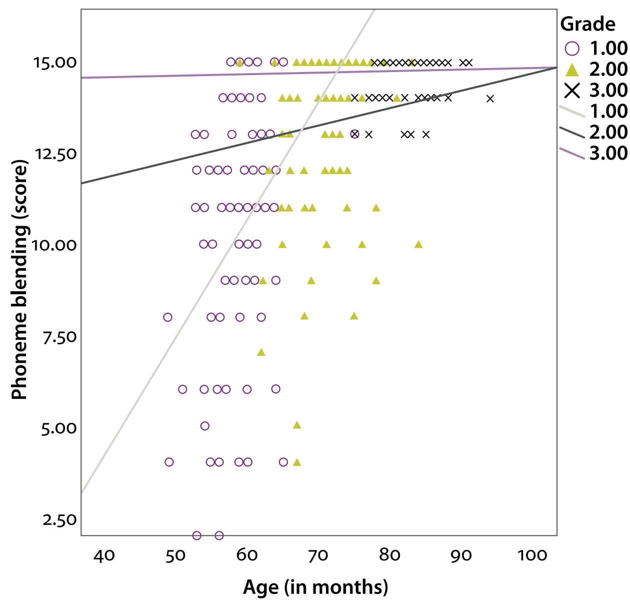
Table 2. ANOVAs with Grade, Age and Bilingual Category as independent variables and the four phonological awareness tasks as dependent variables

	Rhyming				Phoneme blending				Onset phoneme identification				Phoneme deletion			
	df	*F*	η_p^2	Post hoc	*df*	*F*	η_p^2	Post hoc	*df*	*F*	η_p^2	Post hoc	*df*	*F*	η_p^2	Post hoc
Bilingual Category	2	0.21			2	1.81			2	3.48*	.036	No diffs.	2	4.32*	.082	No diffs.
Grade	1	17.19***	.088		2	12.29***	.081		1	5.96*	.031			–		
Grade x Bilingual Category	2	0.18			4	1.57			2	2.39				–		
Age	1	20.13***	.102		1	17.58***	.059		1	7.23**	.037		1	4.64*	.046	
Age x Bilingual Category	2	–			2	–			2	3.32*	.024		2	4.33*	.082	
Age x Grade	1	16.77***	.086		2	11.02***	.073		1	5.30*	.027			–		
Error	176				278				189				97			
R^2	.273				.428				.220				.073			

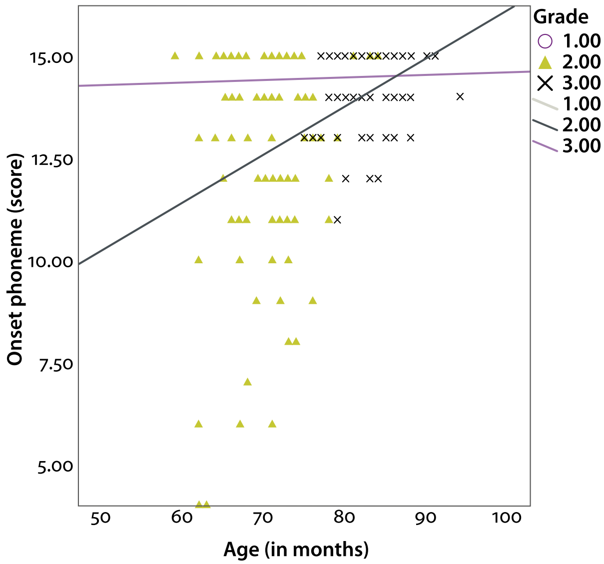
* $p < .05$. ** $p < .01$. *** $p < .001$.



a. Rhyming

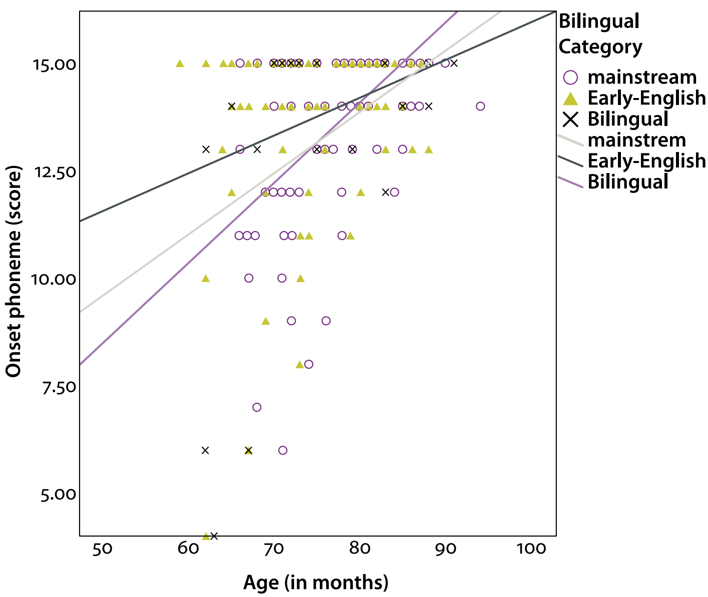


b. Phoneme blending

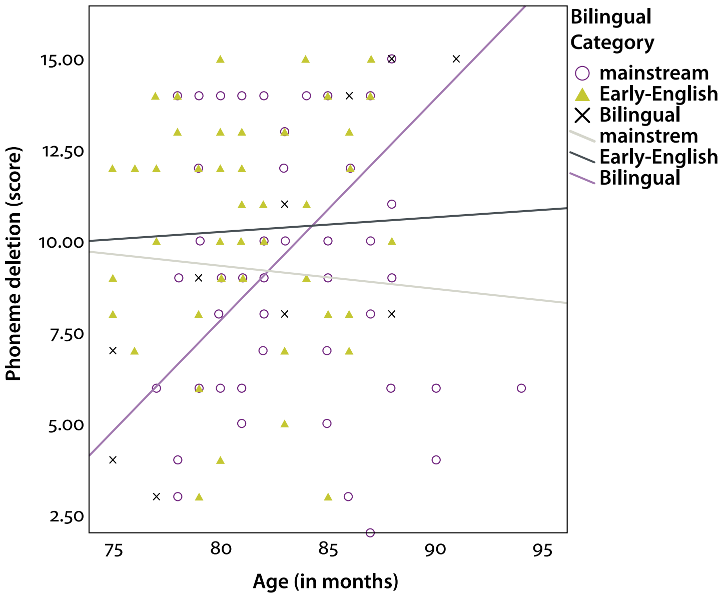


c. Onset phoneme

Figure 3. Relation between Age and Rhyming scores (a), Age and Blending scores (b), and Age and Onset phoneme scores (c) for the different grades



a. Onset phoneme



b. Phoneme deletion

Figure 4. Relation between Age and Onset phoneme scores (a) and Age and Phoneme deletion scores (b) for the different groups

3.1 Including covariates in the model

We checked whether individual differences in Dutch Vocabulary, English vocabulary, short-term memory, or working memory significantly contributed to phonological awareness, and if these variables changed the relation between bilingual category and phonological awareness. For reasons outlined in the introduction, a measure of lexical balance was also included. In line with our previous study (Goriot et al., 2018), lexical balance was calculated as follows: $\ln\left(\frac{\text{English vocabulary}}{\text{Dutch vocabulary}}\right)$. A score of 0 means someone is perfectly balanced, a negative score indicates a greater proficiency in Dutch than in English, a positive score greater proficiency in English than in Dutch. Table 3 shows the descriptive statistics for the covariate measures.

To check whether the groups differed in any of the covariate measures, ANCOVAs were performed with Grade, Bilingual Category and Age as factors. The two-way interactions between Age and Grade and Age and Bilingual Category were included if they were significant. Table 4 shows the results. For all phonological awareness measures, there were effects of Age: older pupils generally obtained higher scores. For short-term memory, there was a main effect of Bilingual Category, with bilinguals obtaining better scores than functionally monolingual pupils, and the English learners not differing from the two other groups. For Dutch vocabulary there were no significant differences between the bilingual groups. For English vocabulary and balance, there was a main effect of Bilingual Category: Bilingual pupils had higher scores on the English vocabulary task and a higher lexical balance score than English learners, who in turn had higher scores than the functionally monolingual pupils.

Next, for each of the four phonological awareness measures, we added each covariate (Dutch vocabulary, English vocabulary, lexical balance, short-term memory, or working memory) to the base model. If there was a significant effect of the covariate, we checked if there were any significant two-way interactions between the covariate and the fixed effects. If not, these interactions were removed from the analysis. Table 5 shows the results. For Rhyming, adding the covariates to the model did not change the pattern of results that we found in the base model. There were always significant effects of Grade, Age, and the interaction between Grade and Age, Bilingual Category was never significant. All covariates except Balance significantly contributed to the Rhyming scores. For Phoneme Blending we found that same pattern of results, except that among the covariates only Dutch vocabulary and Short-term memory showed a significant effect on Phoneme Blending scores.

For Onset Phoneme and Phoneme Deletion, the results were more complex. For Onset Phoneme, adding English vocabulary, Balance, or Short-term memory to the model did not change the pattern of results found in the base model: there were significant effects of Bilingual Category, Grade, Age, and interactions between Bilingual Category and Age, and Grade and Age. Short-term memory also showed a significant effect. The effects of Bilingual Category became non-significant when adding either Dutch vocabulary or Working memory to the model. Neither Dutch vocabulary nor Working memory was significant.

For Phoneme Deletion, adding Dutch vocabulary showed the same results as in the base model: there were significant effects of Bilingual Category, Age, and the interaction between the two. Dutch vocabulary was also significant. The main effect of Age become non-significant when adding English vocabulary, Balance or Short-term memory to the model, while none of these covariates showed a significant effect. Adding Working memory to the base model resulted in a significant effect of Working memory, while all the other effects were non-significant.

In summary, phonological awareness skills seem to be related to various individual differences in language and memory skills. Especially Dutch vocabulary and short-term memory seem to play an important role, as there were significant effects of these variables for three of the four phonological awareness skills. When any effects of bilingualism were found, they were small and unstable. Despite the main effect of Bilingual Category, pairwise comparisons between the three groups

Table 3. Descriptive statistics for the covariates

		Grade 1 (4–5-year-olds)			Grade 2 (5–6-year-olds)			Grade 3 (6–7-year-olds)		
		Functionally monolingual	**Early-English**	**Bilingual**	**Functionally monolingual**	**Early-English**	**Bilingual**	**Functionally monolingual**	**Early-English**	**Bilingual**
Dutch vocabulary (raw score, max. 204)	*M*	74.66	75.08	65.22	86.05	86.43	86.64	95.38	96.91	93.38
	(SD)	(13.75)	(10.24)	(16.26)	(9.08)	(9.64)	(13.41)	(8.22)	(9.18)	(11.2)
English vocabulary (raw score, max. 228)	*M*	18.43	22.13	81.57	23.15	30.73	96.64	33.83	41.49	108.15
	(SD)	(9.48)	(9.03)	(19.25)	(13.50)	(11.62)	(24.05)	(16.40)	(15.12)	(17.37)
Lexical balance	*M*	−1.52	−1.35	0.22	−1.51	−1.11	0.09	−1.15	−0.90	0.14
	(SD)	(0.50)	(0.63)	(0.36)	(0.70)	(0.44)	(0.23)	(0.48)	(0.32)	(0.16)
Nonverbal working memory (accuracy, max. 36)	*M*	9.28	10.45	9.00	13.07	12.75	14.80	17.38	16.91	17.10
	(SD)	(2.65)	(3.78)	(3.01)	(4.41)	(2.87)	(3.36)	(3.00)	(4.42)	(4.9)
Short-term memory (accuracy, max. 12)	*M*	2.81	3.34	3.10	3.66	3.60	4.79	3.88	3.89	5.23
	(SD)	(1.38)	(1.51)	(1.61)	(1.28)	(1.17)	(2.45)	(1.35)	(1.25)	(1.42)

Table 4. ANCOVAs with covariates as dependent variables

	Dutch vocabulary				English vocabulary				Balance				Working memory				Short-term memory			
	df	*F*	η_p^2	Post hoc	*df*	*F*	η_p^2	Post hoc	*Df*	*F*	η_p^2	Post hoc	*df*	*F*	η_p^2	Post hoc	*df*	*F*	η_p^2	Post hoc
Bilingual Category	2	2.57			2	479.47^{***}	.773	M<EE<B	2	7.23^{**}	.049	M<EE<B	2	0.87			2	9.72^{***}	.065	M<B
Grade	2	4.09^{*}	.028		2	0.12			2	2.95			2	6.53^{**}	.046		2	5.18^{**}	.036	
Grade x Bilingual Category	4	1.84			4	0.99			4	0.73			4	1.23			4	2.43^{*}	.034	
Age	1	27.22^{***}	.088		1	24.27^{***}	.079		1	5.80^{*}	.020		1	5.14^{*}	.019		1	10.85^{**}	.038	
Age x Bilingual Category		–				–			2	3.51^{*}	.025		2	–			2	–		
Age x Grade		–				–			2	3.26^{*}	.023		2	–			2	5.27^{**}	.037	
R^2	.492				.776				.582					.415				.166		

* $p<.05$. ** $p<.01$. *** $p<.001$.

Table 5. ANCOVAs on the phonological awareness data for each covariate

Covariate	Rhyming		Phoneme blending		Onset phoneme identification		Phoneme deletion	
	Significant effects	R^2	Significant effects	R^2	Significant effects	R^2	Significant effects	R^2
Base model	Grade Age Grade x Age	.273	Grade Age Grade x Age	.435	Bilingual [no sign. comparisons] Grade Age Bilingual x Age Grade x Age	.220	Bilingual [no sign. comparisons] Age Bilingual x Age	.073
Dutch vocabulary	Grade Age Grade x Age Dutch	.325	Grade Age Grade x Age Dutch	.453	Grade Age Grade x Age	.228	Bilingual [no sign. comparisons] Age Bilingual x Age Dutch	.128
English vocabulary	Grade Age Grade x Age English	.291	Grade Age Grade x Age	.430	Bilingual [no sign. comparison] Grade Age Bilingual x Age Grade x Age	.219	Bilingual [no sign. comparisons] Bilingual x Age	.096
Balance	Grade Age Grade x Age	.281	Grade Age Grade x Age	.426	Bilingual [no sign. comparison] Grade Age Bilingual x Age Grade x Age	.216	Bilingual [no sign. comparisons] Bilingual x Age	.071
Working memory (WM)	Grade Age Grade x Age WM	.292	Grade Age Grade x Age	.434	Grade Age Grade x Age	.212	WM	.141
Short-term memory (STM)	Grade Age Grade x Age STM	.295	Grade Age Grade x Age STM	.437	Bilingual [no sign. comparison] Grade Age Bilingual x Age Grade x Age STM	.266	Bilingual [no sign. comparisons] Bilingual x Age	.081

were never significant, meaning that the scores of the three groups did not significantly differ from each other. Moreover, some effects of Bilingual Category disappeared when covariates were taken into account.

4. Discussion and conclusion

This study aimed to investigate, first, whether bilingualism positively affects the performance on a phonological awareness task, second, how much or how little bilingual experience is needed in order for performance differences to occur, and third, whether the relation between bilingualism and phonological awareness is affected by individual differences in children's linguistic and cognitive skills. Participants were native Dutch pupils from mainstream Dutch primary schools and early-English schools, as well as Dutch-English bilingual children. Differences in phonological awareness between the three groups were restricted to certain tasks, were small when they appeared, did not obtain for children in all grades, and occasionally disappeared when taking individual differences into account.

The majority of previous studies have shown positive effects of bilingual experience on phonological awareness (see electronic supplement). Our first hypothesis was therefore that bilingual experience would help phonological awareness skills. Previous research suggested that the amount of exposure to an additional language is positively related to phonological awareness performance. Consequently, our second hypothesis was that English learners would show more advanced phonological awareness than functionally monolingual pupils, but not as advanced as simultaneous bilinguals. Both hypotheses have to be rejected. For rhyming and phoneme blending, we found no differences between groups. For onset phoneme identification and phoneme deletion, there were small main effects of bilingualism, but pairwise comparisons revealed no significant differences between the three groups.

In our main analyses, we found interaction effects of bilingualism and age, both for onset phoneme identification and phoneme deletion. For all three groups there was a positive relation between onset phoneme identification and age, such that older pupils had better scores on this task. This relation was stronger for simultaneous bilinguals than for functionally monolingual and English learners. For simultaneous bilinguals only, there was also a positive relation between age and scores on the phoneme deletion task. This shows that for simultaneous bilinguals, age is a positive predictor of phonological awareness scores, even after having attended primary school for two or three years. It has been suggested that age plays a role in monolingual and bilingual children's phonological awareness performance (Branum-Martin et al., 2012; Carroll et al., 2003). Previous research also showed that Dutch-Turkish but not monolingual Dutch children's age, correlated positively with their scores on an onset phoneme identification task (Janssen et al., 2017). It may be that age is a proxy for length of exposure to Dutch. Consequently, because bilingual children on the whole have less exposure to Dutch than their monolingual peers, the effect of exposure may pertain longer in the bilingual group than in the native Dutch children.

Based on previous findings (Bruck & Genesee, 1995; Reder et al., 2013), we expected to find an effect of bilingualism especially in the first two years of primary school, but not in the third, when literacy instruction starts. Contrary to our expectations, we found a small effect of bilingualism for the two phonological awareness tasks performed by pupils in grade 2 and 3 (who are starting to develop their literacy skills), whereas we found no such effect on the two tasks performed by mostly illiterate pupils in grades 1 and 2. This may seem surprising, but we are not the first to find such an effect: previous studies (Bialystok, Luk, & Kwan, 2005; Bialystok et al., 2003; Chen et al., 2010) also showed effects of bilingualism on phonological awareness in children who already started literacy instruction. Unlike those previous studies, however, we did not find any differences between groups of children who differed in bilingual experience.

Several reasons may account for the lack of a positive significant effect of bilingualism. First, previous research has suggested that children who learn an L2 may profit from learning a language that is either phonologically more complex (Chen et al., 2010) or less complex than their L1 (Loizou & Stuart, 2003). English and Dutch have comparable levels of phonological complexity (Schepens, 2015), and children in our study may not have profited from learning English and Dutch.

Another possible reason may be that the children in this study were not proficient enough in their L2. Previous research (Kang, 2012) has suggested that for phonological awareness to accelerate, children should have a certain level of L2 proficiency. The English learners in this study had significantly higher English vocabulary scores than the functionally monolinguals, but it may still have been too low for phonological awareness advantages to be detectable. This explanation seems unlikely, however, given that the bilinguals' proficiency in both languages was high, and yet they did not show any systematic phonological awareness advantages either.

A more plausible reason for the absence of an effect of bilingualism can be found in the children's level of literacy in both languages. Unfortunately, it is unknown what children's level of literacy was in either language. It may be that children from the functionally monolingual or early-English schools were exposed to more literacy activities at home, and/or had a higher levels of literacy than the bilingual children. This may in turn have enhanced their phonological awareness skills (Lerner & Lonigan, 2016). Future research should therefore investigate children's literacy activities at home, and how this exposure may influence the relation between bilingualism and phonological awareness.

Our third hypothesis was that the relation between bilingualism and phonological awareness would be influenced by individual differences in children's language and cognitive skills. We expected positive relations between vocabulary skills and phonological awareness, and memory skills and phonological awareness. This hypothesis was confirmed only for Dutch vocabulary and working memory. For onset phoneme identification and phoneme deletion the main effect of bilingualism disappeared when including working memory. For onset phoneme identification, it also happened when including Dutch vocabulary.

Other covariates showed a significant relation with phonological awareness measures, but did not alter the effects found before including the covariate. Dutch vocabulary showed a significant effect on rhyming, phoneme blending, and phoneme deletion. This is in line with previous research showing that vocabulary development in the language of testing is related to scores on the phonological awareness task (Janssen et al., 2017; Sodoro et al., 2002). English vocabulary only showed a significant relation with rhyming. Given that we measured phonological awareness skills in Dutch, which is the stronger language for at least early-English and functionally monolingual pupils, this result is not remarkable. If pupils have a low proficiency level in one language, proficiency in that language may not influence their phonological awareness in the other language. Indeed, research showed that for proficient speakers of Spanish who were learning English, Spanish vocabulary scores correlated with performance on the English phonological awareness task. This was not the case for low-proficient Spanish speakers (Atwill et al., 2007). For Dutch native pupils, it may be the case that when measuring phonological awareness in English, Dutch plays a larger role in performance on the English task.

To reflect the observation that bilingualism is a continuous rather than a categorical variable (Luk & Bialystok, 2013), we also included lexical balance as a covariate. Previous research has shown that the balance between children's proficiency levels in their two languages, as a continuous measure of bilingualism, is related to executive functioning skills (Blom, Küntay, Messer, Verhagen, & Leseman, 2014; Goriot et al., 2018). In Goriot et al., language balance was positively related to children's executive functioning performance, whereas no significant group differences between functionally monolinguals and English learners existed. This led us to investigate whether a similar relation exists between language balance and phonological awareness performance. Contrary to our expectations, language balance operationalised at the lexical level was not significantly related to phonological awareness in this study. The reason for this may be that the nature of the mechanisms that seem to be related to executive functioning and phonological awareness in bilinguals, are different. For executive functions, it has been hypothesized that managing ongoing linguistic competition between two languages places demands on the executive function system, which enhances the development of this system (Green & Abutalebi, 2013). Since bilingual children's phonological awareness performance seems not to be related to competition in language activation, it may be that lexical balance does not play a role in phonological awareness performance.

We also included measures of short-term and working memory. Previous research has shown that memory skills are related to phonological awareness skills (Janssen et al., 2017). In line with some previous studies which have suggested that bilinguals show advantages in memory relative to their monolingual peers (Barac, Bialystok, Castro, & Sanchez, 2014), we found that bilinguals performed better on the short-term memory task than functionally monolingual pupils, whereas English learners' scores did not differ from either of the two other groups. Short-term memory performance showed a significant and positive relation with rhyming, phoneme blending, and onset phoneme identification. We found no differences between the three groups on working memory, which is in line with the inconsistent findings from previous research (for an overview, see Barac et al., 2014). Despite the absence of group differences, working memory was significantly and positively related to rhyming and phoneme deletion. In the latter case, it was even the only variable in the model that was significant. Future research should therefore take working memory skills into account when assessing phonological awareness, and especially when assessing phoneme deletion skills.

We found significant and large effects of grade and age. This is in line with previous research (Chen, Wu, & Shu, 2004, and Janssen et al., 2017, respectively). Clear objectives are formulated for the Dutch educational system about what children in a certain grade should know with respect to phonological awareness (SLO, 2006), and teachers usually pay great attention to these skills. Children in grade 1 (first year of kindergarten), for example, should be able to separate both words in a compound word, whereas children in grade 2 (second year of kindergarten) should be able to identify the different sounds in one word. It is thus not surprising that children in higher grades perform better than children in lower grades. We also found an interaction effect between grade and age. In the Netherlands, pupils enter primary school as soon as they turn 4, irrespective of the time of year in which their birthday takes place. All 4-year-olds were thus in grade 1, but some of them had been attending school for a longer period than others at the time of testing and therefore older pupils may have profited more from phonological awareness instruction and/or may have matured more than younger pupils. Consequently, age is, over and above grade, an important variable to take into account when assessing phonological awareness skills, especially in young children.

4.1 Limitations and future research

This study had a cross-sectional design. By including children from different grades, we aimed to investigate phonological awareness skills after one to three years of English education. Although all English learners had been enrolled in early-English education since the start of primary school, their exposure to English may have differed during this period. For example, they may have been educated by different teachers who differ in their proficiency in English. For all three groups, it may be the case that their teachers differed in the attention they paid to teaching phonological awareness skills. It is known that classroom phonological awareness instruction can improve children's phonological awareness (Garson, Gillon, & Boustead, 2013). A longitudinal study could shed light on the different factors influencing children's exposure to an additional language and their linguistic and cognitive skills, and would enable claims about causality.

We asked the head teachers to only select children without any language, speech, or developmental problems. The mainstream Dutch schools were matched to the early-English. There is no reason to assume that speech or reading difficulties are overrepresented in one of these groups. Nevertheless, it is known that a family history of reading problems is a risk factor for literacy difficulties (Health et al., 2014). Future research should take this variable into account.

Especially the oldest children's scores were at ceiling level at most of the tasks, which may be the reason we failed to find any differences between bilingual groups. Future research could include more difficult tasks, like letter naming and letter-sound matching tasks to examine phonological awareness in grade 2 and 3 pupils.

Our aim was to collect equal amounts of data from functionally monolinguals, English learners, and bilinguals, but we were unable to do so. There is a possibility that we may have failed to see differences involving the bilingual group because that group was smaller. In addition, the bilingual children's parents were with very few exceptions all highly educated. The functionally monolinguals and the English learners were from more diverse socio-economic backgrounds. Socio-economic background is positively related to academic achievement (Bradley & Corwyn, 2002). We did not have enough data to take SES into account in the analyses. Although correlation analyses on the available questionnaire data show no relation between parents' educational level and children's scores on the phonological awareness tasks, we cannot rule out the possibility that SES may have influenced our results.

Finally, the focus of this study was on Dutch and English as a language combination. The results of this study do not necessarily hold for speakers of another language combination, especially given the fact that previous studies have suggested that phonological awareness advantages may be related to specific characteristics of languages or language combinations. Future research should investigate whether the conclusions from this study also hold for other language pairs.

4.2 Conclusion

To conclude, we did not find any convincing effect of bilingualism on phonological awareness. Where we found a positive effect of bilingualism, it was small, and the post-hoc pairwise comparisons between groups showed no significant differences between (functionally) monolingual pupils, English learners, and bilinguals. At the same time our study shows that learning two languages has no *negative* effect on phonological awareness skills either. Many parents and teachers have concerns that learning two languages may be detrimental to pupils' development in at least one of those languages (Goorhuis-Brouwer & de Bot, 2010), and previous research has shown that bilingual pupils can perform less well than their monolingual peers on phonological awareness tasks (Lesniak et al., 2014; Janssen et al., 2015; Janssen et al., 2017). We, however, did not find any trace of a negative effect of bilingualism, neither for bilingual Dutch-English children nor for Dutch children learning English as an L2 from a young age. This study shows that children who are learning two languages at the same time have equal phonological awareness skills in the school language as children who grow up with the school language as the only language.

Funding

This research was supported by EP-Nuffic (currently Nuffic), the organisation for internationalisation in Dutch education.

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Appendix A

Tables A1 to A3. Correlations between phonological awareness tasks, vocabulary, memory, and Age, for each of the bilingual categories

Table A1. Correlations for functionally monolinguals

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	Rhyming	1.									
2.	Blending	.562**	1.								
3.	Onset phoneme	.430**	.477**	1.							
4.	Phoneme deletion	–	.107	.209	1.						
5.	Age	.455**	.605**	.484**	−.069	1.					
6.	Dutch vocabulary	.455**	.548**	.299**	.292*	.686**	1.				
7.	English vocabulary	.163	.283**	.187	−.014	.482**	.442**	1.			
8.	Lexical balance	.025	.113	.137	−.065	.298**	.209*	.880**	1.		
9.	Working memory	.495**	.523**	.403**	.233	.651**	.563**	.319**	.211*	1.	
10.	Short-term memory	.385**	.335**	.067	.132	.329**	.271**	.170	.120	.246**	1.

Table A2. Correlations for pupils learning English

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	Rhyming	1.									
2.	Blending	.686**	1.								
3.	Onset phoneme	.448**	.729**	1.							
4.	Phoneme deletion	–	.174	.157	1.						
5.	Age	.420**	.586**	.314**	.045	1.					
6.	Dutch vocabulary	.416**	.524**	.289**	.367*	.664**	1.				
7.	English vocabulary	.454**	.451**	.254*	.185	.581**	.564**	1.			
8.	Lexical balance	.505**	.424**	.175	.319*	.433**	.306**	.818**	1.		
9.	Working memory	.242*	.413**	.180	.426**	.573**	.437**	.433**	.330**	1.	
10.	Short-term memory	.333**	.359**	.344**	.067	.219*	.296**	.196*	.137	.275**	1.

Table A3. Correlations for simultaneous bilinguals

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	Rhyming	1.									
2.	Blending	.492**	1.								
3.	Onset phoneme	.653*	.603**	1.							
4.	Phoneme deletion	–	.699**	.671**	1.						
5.	Age	.601**	.675**	.500**	.815**	1.					
6.	Dutch vocabulary	.666**	.620**	.490**	.806*	.562**	1.				
7.	English vocabulary	.344*	.339*	.248	.377	.725**	.519**	1.			
8.	Lexical balance	−.330*	−.307*	−.140	−.106	−.222	−.477**	.482**	1.		
9.	Working memory	.367	.362*	.241	.336	.709**	.619**	.426**	−.175	1.	
10.	Short-term memory	.401*	.398*	.493**	.399	.501**	.359**	.282	−.085	.278	1.

N.B.: Table B1 to B3:
* p<.05. ** p<.01.

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Publication history

Date received: 30 August 2018
Date accepted: 3 July 2019
Published online: 29 October 2019