

Exploring Phonological Awareness Skills in Children With Intellectual Disability

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Abstract

The phonological awareness skills of 7- to 8-year-old children with intellectual disability (ID) were compared to those of 4- to 5-year-old typically developing children who were matched for early reading skills, vocabulary, and gender. Globally, children with ID displayed a marked weakness in phonological awareness. Syllable blending, syllable segmentation, and first phoneme detection appeared to be preserved. In contrast, children with ID showed a marked weakness in rhyme detection and a slight weakness in phoneme blending. Two school years later, these deficits no longer remained. Marked weaknesses appeared in phoneme segmentation and first/last phoneme detection. The findings suggest that children with ID display an atypical pattern in phonological awareness that changes with age. The implications for practice and research are discussed.

Key Words: *developmental disabilities; intellectual disability; early reading skills; phonological awareness*

In typically developing children, phonological awareness is a foundational skill for learning to read (Ehri et al., 2001; Melby-Lervåg, Lyster, & Hulme, 2012). Many cases of reading difficulties in children, youth, and adults can be traced to poor phonological awareness skills (Goswami & Bryant, 1990; Lyon, Shaywitz, & Shaywitz, 2003). In children and adolescents with intellectual disability (ID), there is increasing evidence that phonological awareness also plays a significant role in reading (Adlof, Klusek, Shinkareva, Robinson, & Roberts, 2015; Barker, Sevcik, Morris, & Rowski, 2013; Laing, Hulme, Grant, & Karmiloff-Smith, 2001; Lemons & Fuchs, 2010; Sermier Dessemontet & de Chambrier, 2015; Soltani & Roslan, 2013; Wise, Sevcik, Rowski, & Morris, 2010). However, knowledge on the strengths and weaknesses in phonological awareness in children with ID is very limited and focuses mainly on children with Down syndrome or Williams syndrome (Menghini, Verucci, & Vicari 2004; Nass, 2016; Steele, Scerif, Cornish, & Karmiloff-Smith, 2013). Moreover, the evolution of their phonological awareness skills over time

remains unclear. Studies conducted with children with an unspecified etiology within a narrow age range are lacking. The purpose of the present study is to explore the phonological awareness profile of primary school pupils with ID with an unspecified etiology and its evolution over time. Acquiring this information is critical for understanding their developmental profile in phonological awareness, and for planning interventions or training programs tailored to the range of skills shown by these children and their specific strengths and weaknesses.

Phonological Awareness and Reading

Decoding skills are necessary for reading and understanding various written texts (Catts, Herrera, Corcoran Nielsen, & Sittner Bridges, 2015; Hoover & Gough, 1990). To acquire decoding skills in an alphabetic language, children need to understand how written units represent phonological units in spoken words. They also need to recognize, discriminate, and manipulate the sounds of their spoken language; in other words, they need to develop phonological awareness skills

(Goswami & Bryant, 1990; Plaza & Cohen, 2007). The contribution of phonological awareness to decoding skills is well established in typically developing children (Castles & Coltheart, 2004; Vellutino, Tunmer, Jaccard, & Chen, 2007). Its effect appears to be universal across different alphabetic languages (Melby-Lervåg et al., 2012). Moreover, phonics instruction encompassing explicit phonological awareness instruction is widely recognized as an evidence-based practice for teaching typically developing children to read (National Institute of Child Health and Human Development [NICHD], 2000). Phonics instruction encompassing explicit phonological awareness instruction was also found to have a positive effect on the development of reading skills in children with ID (Allor, Mathes, Roberts, Cheatham, & Otaiba, 2014; Bradford, Shippen, Alberto, Houchins, & Flores, 2006; Browder, Ahlgrim-Delzell, Courtade, Gibbs, & Flowers, 2008; Browder, Ahlgrim-Delzell, Flowers, & Baker, 2012; Conners, Rosenquist, Sligh, Atwell, & Kiser, 2006; Flores, Shippen, Alberto, & Crowe, 2004; Fredrick, Davis, Alberto, & Waugh, 2013).

Longitudinal Development of Phonological Awareness in Typically Developing Children

Phonological awareness skills can be differentiated by the task that is performed, for example, detection, segmentation, or blending (Anthony & Francis, 2005; Ziegler & Goswami, 2005). They can also be distinguished by the size of the sound units that are manipulated (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003). Even if all phonological tasks are not equivalent in complexity (Castles & Coltheart, 2004), phonological awareness appears to emerge in an ordered developmental progression in European languages (Anthony & Francis, 2005; Ziegler & Goswami, 2005). Children become increasingly sensitive to smaller parts of words, as they grow older. Three- to 4-year-old children can easily detect and manipulate syllables because syllables are acoustically separable and correspond to an articulation in speech. Four- to 5-year-old children can detect intrasyllabic units, i.e., onsets and rhymes. Five- to 6-year-old children begin to detect smaller sound units, i.e., phonemes (Anthony et al., 2003; Ziegler & Goswami, 2005). Phonemic awareness is more complex than syllabic and intrasyllabic awareness because phonemes are smaller sound units that are

thoroughly co-articulated in words (Anthony & Francis, 2005). The relationship between phonemic awareness and learning to read is reciprocal (Castles & Coltheart, 2004). On the one hand, phonemic awareness training has a positive effect on reading acquisition (NICHD, 2000). On the other hand, phonemic awareness develops quickly once literacy instruction begins because learning letter names or letter sound correspondences alerts children to the phonemes that constitute words (Catts et al., 2015; Lerner & Lonigan, 2016).

Phonological Awareness Skills in Children With Intellectual Disability

Findings from several studies indicate that phonological awareness is an area of weakness in children with Down syndrome, Williams syndrome, or Fragile X syndrome compared to typically developing children matched for verbal mental age, language skills, or reading skills (Adlof et al., 2015; Laing et al., 2001; Lemons & Fuchs, 2010; Menghini et al., 2004; Næss, 2016). The findings from a meta-analysis indicate that rhyme awareness in particular is a marked weakness in children with Down syndrome (Næss, 2016). Some phonemic awareness tasks appear to be less problematic for these children than rhyme awareness. Indeed, in several studies it was found that children with Down syndrome achieved higher scores in first phoneme detection than in rhyme detection (Cardoso-Martins, Michalick, & Pollo, 2002; Snowling, Hulme, & Mercer, 2002; van Bysterveldt & Gillon, 2014). This suggests that children with Down syndrome display an atypical profile in phonological awareness skills. This atypical pattern was also observed in some studies conducted with children with Williams syndrome (Menghini et al., 2004; Steele et al., 2013).

Studies investigating the phonological awareness skills of children with ID with an unspecified or mixed etiology are scarce. Channell, Loveall, and Conners (2013) compared the reading-related skills of 12- to 19-year-old youths with ID with mixed etiology to those of younger typically developing children who were matched for verbal mental age. Phonological awareness and phonological memory were found to be weaknesses in youths with ID. Van Tilborg, Segers, von Balkom, and Verhoeven (2014) also found that 6- to 8-year-old children with ID with mixed etiology underperformed younger typically developing children who were at the same phase of literacy acquisition

(partial-alphabetic stage). To date, studies on the profile of phonological awareness skills of children with ID with an unspecified etiology are lacking.

Longitudinal Development of Phonological Awareness in Children With ID

Intervention studies show that preschool, primary school, and secondary school pupils with Down syndrome make significant progress in phonological awareness skills, particularly in syllable and phoneme awareness, if they benefit from explicit instruction in phonological awareness (Baylis & Snowling, 2012; Cologon, Cupples, & Wyver, 2011; Goetz et al, 2007; van Bysterveldt, Gillon, & Moran, 2006). However, the findings on the persistence of a deficit in rhyme awareness among these children over time are contradictory. The mean scores in several phonological awareness tasks provided in the study by Hulme et al. (2012) suggests that 10-year-old children with Down syndrome tended to stagnate in rhyme matching over the 2 years of the longitudinal study. Additionally, Baylis and Snowling (2012) found nonsignificant gains in rhyme awareness after a 10-week phonologically based literacy program in 9- to 14-year-old children with Down syndrome despite an emphasis on rhyme units during the intervention and significant progress in syllable and phoneme awareness. In contrast, the findings from the longitudinal study conducted by Næss (2016) suggest that the rhyme deficit initially observed in 6-year-old children with Down syndrome, in comparison to 3-year-old typically developing children matched for mental age, is temporary. The children with Down syndrome catch up with the group of typically developing children after 1 year. This deficit in rhyme awareness is often interpreted as being related to the specific memory profile of children with Down syndrome and, more specifically, to their poor short-term verbal memory (Næss, 2016). Children with Down syndrome also have a specific language profile with a marked weakness in expressive language (Martin, Klusek, Estigarribia, & Roberts, 2009). Because oral language predicts phonological awareness development (Cooper, Roth, Speece, & Schatschneider, 2002), their pattern of phonological awareness development may not be generalized to children with ID with an unspecified etiology.

Studies on the longitudinal development of phonological awareness skills among children with ID with an unspecified etiology with a control group of typically developing children matched for reading skills are lacking. To date, no conclusions can be drawn on the pattern of development of the phonological awareness skills of children with ID with an unspecified etiology during the early stages of reading acquisition.

Present Study

Our study aims at identifying strengths and weaknesses in phonological awareness displayed by primary school pupils with ID with an unspecified etiology in comparison to typically developing pupils matched for gender, early reading skills (letter/sound knowledge, nonword reading, and word reading), and expressive vocabulary. Moreover, it aims at exploring their evolution in phonological awareness skills across 2 school years. Specifically, the following research questions were investigated:

1. Do children with ID with an unspecified etiology display lower phonological awareness skills than typically developing children matched for gender, early reading skills, and expressive vocabulary?
2. Does the progress made by children with ID in phonological awareness over 2 school years differ from the progress made by matched typically developing children?
3. Do the scores of children with ID in syllabic, rhyme, and phonemic awareness tasks differ from those of matched typically developing children?

Method

Participants

For the purpose of this study, the data collected in a longitudinal study on the effects of inclusion on the academic achievement of children with ID (Sermier Dessemontet, Bless, & Morin, 2012) were merged with the data from a study conducted on the effects of multiage classrooms on the academic achievement of typically developing children (Moser & Bayer, 2010). The same test of literacy skills was used in both studies (Moser & Berweger, 2007). The initial sample of the first study comprised 79 Swiss German children with ID with mixed etiology. Their literacy skills were

assessed at the beginning of the school year, when they were 6 to 8 years old (1st and 2nd grade), and 2 school years later, when they were 8 to 10 years old. In the second study, the initial sample comprised 972 Swiss German typically developing children. Their literacy skills were assessed at the beginning of kindergarten, when they were 4 to 5 years old, and 2 school years later, when they were 6 to 7 years old. Informed consent was obtained for every participant. The present study is a secondary analysis of these two data sets that were merged together and focuses on the participants' development in phonological awareness.

The inclusion criteria for children with ID for the present study were the following: (1) being between 6 and 8 years old at Time 1; (2) having been diagnosed with ID; (3) having an IQ between 40 and 75; (4) having an unspecified etiology; and (5) speaking German as their first language or sufficiently mastering German as their second language (understanding instructions in German and communicating in German about everyday life). Moreover, our exclusion criteria included having uncorrected hearing and visual impairments, and being nonverbal. The inclusion criteria for the typically developing children for the present study were the following: (1) being between 4 and 5 years old at Time 1; (2) having an IQ between 80 and 120; and (3) speaking German as their first language. This last criterion was important for typically developing children due to their age. At Time 1, they began kindergarten. The majority of the typically developing children who did not speak German as their first language did not speak it at all. Indeed, when children are non-native German speakers, kindergarten is very often their first exposure to German. In contrast, the few children with ID, who spoke German as a second language, had been taught in German for at least 1 school year.

To answer our research questions, the children with ID with an unspecified etiology corresponding to our selection criteria among the sample of the study from Sermier Dessemontet et al. (2012) were paired with typically developing children, which corresponded to our selection criteria among the sample of the study from Moser and Bayer (2010). The matching criteria were gender, early reading skills (letter/sound knowledge, nonword reading, and word reading) at Time 1 (+/–2 points), and expressive vocabulary at Time 1 (+/–3 points). When more than one typically developing child could be

matched with a child with ID, one typically developing child was selected at random from among them. A total of 47 pairs could be formed for Time 1. Three of them were lost at Time 2 because the participants moved to another school. The performances of these 44 remaining pairs were compared at Time 2.

At Time 1, the participants with ID had an average age of 7.7 years ($SD = .4$, Range = 7.0–8.8) and IQs ranging from 50 to 75 ($M = 65.5$, $SD = 7.5$). All participants had been diagnosed as having an ID prior to the study. The majority of them had no comorbid diagnosis. Five were described as having mild motor impairments, three had attention-deficit/hyperactivity disorder (ADHD), and one had an autism spectrum disorder. Of these children, 23 were fully included in general education classrooms with 3 to 6.5 hours per week of support from a special education teacher and 24 were attending special schools for children with ID. The typically developing participants had an average age of 5.0 years at Time 1 ($SD = .4$, Range = 4.3–5.9) and IQs ranging from 80 to 120 ($M = 98.2$, $SD = 10.7$). There were 20 girls and 27 boys in each group. Between Time 1 and Time 2, 29 of the typically developing children were in multiage classrooms with 4- to 8-year-old children, and 15 were in ordinary kindergarten classrooms with 4- to 6-year-old children.

At Time 1, the great majority (89%) of the typically developing children and children with ID obtained scores in early reading skills that indicated that they could name some letters' sound. Four children in each group knew the majority of the letters' sounds and were able to read some monosyllabic nonwords with CV structure. Only one child in each group was able to read monosyllabic and disyllabic nonwords or words with CV or CVCV structure. A one-way between-groups analysis of variance revealed no difference in the early reading skills of children with ID ($M = 11.19$, $SD = 11.37$) and typically developing children ($M = 10.81$, $SD = 11.08$) at Time 1: $F(1, 92) = .03$, $p = .87$. Expressive vocabulary scores ranged from 21 to 71 for typically developing children and from 22 to 70 in children with ID. There was no significant difference in the expressive vocabulary of children with ID ($M = 49.91$, $SD = 12.10$) and typically developing children ($M = 50.23$, $SD = 12.28$) at Time 1: $F(1, 92) = .02$, $p = .90$.

Measures

The Wortgewandt & zahlenstark: Lern- und Entwicklungsstand bei 4- bis 6-Jährigen [Strong literacy and numeracy skills: Academic achievement test for 4- to 6-year-old children] (Moser & Berweger, 2007) was administered to the participants. This standardized comprehensive test of academic achievement was designed to measure the progress of Swiss German children in literacy and numeracy from the beginning of kindergarten (4- and 5-year-old children) to the end of first grade (6- and 7-year-old children). The test, based on the Item Response Theory, was constructed with a sample of over 1000 typically developing children. In the current study, the data collected with three subtests were used: phonological awareness, early reading skills (letter-sound knowledge, nonword reading, word reading, and short sentence reading) and expressive vocabulary (naming pictures of nouns, actions, and adjectives). The test manual indicates that the item difficulty index values ranged from 9% to 99% for the items of the three subtests used in this study (Moser & Berweger, 2007). The items also showed a good discrimination index ($>.30$), with the exception of two very easy letter/sound knowledge items (.18 and .29). These values indicate that the items included in these subtests are appropriate for measuring achievement in a sample of children with heterogeneous skills (Moosbrugger & Kelava, 2007). In a previous study, it was found that almost all the items of these three subtests had appropriate difficulty index values (5% to 95%) and discrimination index values ($>.30$) when used with 6- to 10-year-old children with ID (Sermier Dessemontet & de Chambrier, 2015). The reliability of these subtests with this sample of children with ID was high (Cronbach's $\alpha > .80$).

The standardized subtest of phonological awareness comprises nine phonological awareness tasks: syllable blending, syllable segmentation, rhyme detection, first phoneme blending, phoneme blending, first phoneme detection, last phoneme detection, phoneme segmentation, and phoneme substitution. Only the six first tasks were administered at Time 1. Indeed, last phoneme detection, phoneme segmentation, and phoneme substitution were too complex for 4-year-old typically developing children who were beginning kindergarten. All nine tasks were administered at Time 2. Only common and frequent words were used in each task. Each task began with two to three trials with corrective

feedback when needed to ensure that the children understood the instructions. After these trials, no further feedback was given to the participants. For standardization purposes, a compact disc with recorded words was used. Each task is described more precisely hereafter.

Syllable blending task (6 items). The children had to blend two to three syllables to form a word, for example, /tRau - bæ/ (Traube - grape) → /tRaubæ/, and point to the picture corresponding to the word they said from among three or four pictures.

Syllable segmentation task (8 items). The administrator showed a picture of each word while it was named. The children had to segment orally named words containing two to four syllables, for example, /kRokodil/ → /kRo - ko - dil/ (Krokodil - crocodile).

Rhyme detection task (6 items). The children had to point to the two orally named pictures that rhymed with one another from among three named pictures, for example, /bajn - stajn - glas/ (Bein- leg, Stein - stone, Glas - glass).

First phoneme blending task (5 items). The children had to blend the first phoneme of a word and its continuation, for example, /t - uRm/ (Turm - tower) → /tuRm/, and point to the picture that corresponded to the word they said from among three or four pictures.

Phoneme blending task (8 items). The children had to blend phonemes to form six monosyllabic words, for example, /b - u - x/ (Buch - book), and two bisyllabic words, for example, /i - g - ə - l/ (Igel - hedgehog). They were to give the answer orally and point to the picture corresponding to the word they said from among three or four pictures.

First phoneme detection task (8 items). The test administrator showed a picture of each word while it was named. The children had to name the first phoneme of words that were named, for example, /fingəR/ (Finger - finger) → /f/.

Last phoneme detection task (8 items). The test administrator showed a picture of each word while it was named. The children had to name the last phoneme of words that were named, for example, /ʃa:f/ (Schaf - sheep) → /f/.

Phoneme segmentation task (6 items). The test administrator showed a picture of each word while it was named. The children had to segment five monosyllabic words, and one disyllabic word in phonemes, for example, /bɛR/ → /b - ε - R/ (Bär - bear).

Phoneme substitution task (6 items). The children had to replace the phoneme /a/ with the phoneme /i/ in named words, for example, /bal/ (Ball - ball) → /bil/. Four words contained only one phoneme /a/, and two words contained two phonemes /a/. Most words became nonwords once the phoneme /a/ was replaced by /i/.

The percentages of success were computed for each of these tasks. The reliability of each task of phonological awareness at Time 1 and Time 2 with our sample was satisfactory (Cronbach's $\alpha = .71$ to $.95$). The composite score of phonological awareness at Time 1 and Time 2 is the average of the percentage of success of the nine tasks. The reliability of the composite score of phonological awareness at Time 1 and Time 2 with our sample was high (Cronbach's $\alpha > .90$).

Procedure

Information about the typically developing children was collected through their teachers (age, gender, and first language). Their cognitive skills were measured with the Similarities and Matrices subscales of Cattell's Culture Fair Test-1 (Cronbach's $\alpha = 0.81$; Cattell, Weiss, & Osterland, 1997). These subscales were administered to typically developing children by trained collaborators. For children with ID, the directors of the centers and special schools participating in the study communicated the following information about each participant: age, gender, associated impairments, global IQ obtained from the last intelligence test, and etiology. The literacy test was administered individually to the participants in German by trained collaborators in a room provided for the occasion at their respective schools. The administration of the literacy test lasted approximately between 45 minutes and 1 hour.

Analysis

A mixed between-within subjects analysis of variance (Group x Time) was conducted to identify whether there was a difference between the phonological awareness composite scores of children with ID and typically developing children at Time 1 and Time 2 (research question 1) and between their progress from Time 1 to Time 2 (research question 2). Preliminary assumption testing was conducted to check for normality, outliers, and homogeneity of variance. No serious violations were noted.

One-way between-groups multivariate analyses of variance (MANOVAs) were conducted to investigate the differences between typically developing children and children with ID in different phonological awareness tasks (research question 3). Preliminary assumption testing was conducted to check for multivariate normality, linearity, univariate and multivariate outliers, homogeneity of variance, and multicollinearity. For the six variables at Time 1, no serious violations were noted, with the exception of univariate homogeneity of variance for two variables (syllable segmentation and syllable blending). In these cases, the Welsch correction was used. In contrast, serious violations were observed for three of the variables measured at Time 2 due to the strong ceiling effects. Indeed, most of the participants obtained the maximum score in syllable blending at Time 2 ($n = 80/88$), rhyme detection ($n = 71/88$), and first phoneme blending ($n = 70/88$). The participants who did not obtain the maximum score became extreme univariate outliers. With such distributions, removing the outliers would have been irrelevant. Therefore, these three variables were not entered in the MANOVA. Indeed, MANOVAs are known to be very sensitive to outliers, which can produce either a Type I or a Type II error with no way of identifying which is occurring (Tabaschnick & Fidell, 2014). A nonparametric test (Mann-Whitney U-Test) was conducted separately with each of these three variables. With the six remaining variables measured at Time 2, no serious violations were noted, with the exception of the univariate homogeneity of variance for some variables (phoneme blending, phoneme segmentation, and last phoneme detection). In such cases the Welsch correction was used. Taking into account our sample size and the exploratory nature of the present study, the Bonferroni correction was not applied. Indeed, this very conservative correction generates a reduction in power, which increases the risk that real differences between groups may not be detected in studies with smaller samples (Bender & Lange, 2001; Cabin & Mitchell, 2000). More emphasis was placed on effect size in the interpretation of the findings.

Results

Descriptive Data

The scores obtained by children with ID and typically developing children at Time 1 and Time

2 in phonological awareness are presented in Table 1. The scores represent the percentage of successfully solved items. At Time 1, the average scores of typically developing children and children with ID are high ($M > 70$) in syllable blending. The average score is also high in rhyme detection for typically developing children ($M > 70$). In contrast, the average score in rhyme detection is lower for children with ID ($M = 48.94$). Otherwise, the average scores were lower ($M < 70$) for both groups in syllable segmentation, first phoneme blending, phoneme blending, and first phoneme detection.

Two years later, at Time 2, 6- to 7-year-old typically developing children had high scores ($M > 70$) in syllable blending, syllable segmentation, rhyme detection, first phoneme blending, phoneme blending, first phoneme detection, last phoneme detection, and phoneme segmentation. The average score was lower in phoneme substitution ($M = 51.14$). The 9- to 10-year-old children

with ID had high average scores ($M > 70$) in syllable blending, first phoneme blending, rhyme detection, syllable segmentation, first phoneme detection, and phoneme blending. Their average scores were lower in last phoneme detection ($M = 59.09$), phoneme segmentation ($M = 40.90$), and phoneme substitution ($M = 36.74$).

Comparison of the Composite Scores of Phonological Awareness and Progress Over Time

The mixed between-within subjects analysis of variance with Time (1–2) as a within subject factor and Group (children with ID–typically developing children) as a between subject factor indicated that there was no interaction between Time and Group, $F(1, 89) = 3.50, p = .07$, partial $\eta^2 = .04$. This means that there is no statistically significant difference between the progress made by typically developing children and children with ID in their phonological awareness composite score during 2

Table 1
Mean, Standard Deviation, and Range of Scores at Each Task of Phonological Awareness at Time 1 and Time 2

		Time 1 ($n = 94$)			Time 2 ($n = 88$)		
		M	SD	Range	M	SD	Range
Composite score	TD children	41.25	12.94	9.17–62.50	83.88	15.60	42.78–100
	Children with ID	33.95	15.54	3.70–63.43	71.06	23.48	6.02–100
Syllable blending	TD children	83.69	20.99	0–100	95.83	16.52	0–100
	Children with ID	75.89	31.81	0–100	95.08	17.82	0–100
Syllable segmentation	TD children	54.52	28.00	0–100	85.51	22.22	0–100
	Children with ID	46.28	40.80	0–100	84.94	30.33	0–100
Rhyme detection	TD children	71.98	29.30	0–100	95.45	16.22	0–100
	Children with ID	48.94	32.86	0–100	86.74	26.80	0–100
First phoneme blending	TD children	62.13	29.85	0–100	91.36	16.37	40–100
	Children with ID	61.28	35.97	0–100	90.00	27.11	0–100
Phoneme blending	TD children	50.27	27.40	0–100	83.52	20.84	25–100
	Children with ID	37.23	27.89	0–87.50	71.59	33.49	0–100
First phoneme detection	TD children	48.67	38.41	0–100	90.62	20.20	25–100
	Children with ID	35.90	38.80	0–100	74.43	34.83	0–100
Last phoneme detection	TD children	X	X	X	84.94	25.23	12.50–100
	Children with ID	X	X	X	59.09	43.25	0–100
Phoneme segmentation	TD children	X	X	X	76.51	33.97	0–100
	Children with ID	X	X	X	40.90	45.53	0–100
Phoneme substitution	TD children	X	X	X	51.14	40.89	0–100
	Children with ID	X	X	X	36.74	42.77	0–100

Note. The scores represent the percentage of successfully solved items. ID = intellectual disability; TD = typically developing.

school years. Even if p did not reach statistical significance ($p = .07$), a trend can be observed suggesting that typically developing students may have made very slightly more progress. The main effect of Group is significant with a medium effect size: $F(1, 89) = 10.37, p = .002, \text{partial } \eta^2 = .10$. This indicates that there is a difference in the phonological awareness composite scores between the two groups. Univariate ANOVAs show that, at Time 1, typically developing children ($M = 41.25, SD = 12.94$) had significantly better phonological awareness skills than children with ID ($M = 33.95, SD = 15.54$) with a medium effect size: $F(1, 92) = 6.13, p = .015, \eta^2 = .06$. At Time 2, typically developing children ($M = 83.88, SD = 15.60$) had significantly better phonological awareness skills than children with ID ($M = 71.06, SD = 23.48$) with a medium effect size: $F(1, 86) = 9.10, p = .003, \eta^2 = .09$.

Comparison of the Scores in Specific Tasks of Phonological Awareness at Time 1

Six dependent variables were entered in the MANOVA: rhyme detection, syllable segmentation, syllable blending, first phoneme blending, phoneme blending, and first phoneme detection at Time 1. There was a statistically significant difference between typically developing children and children with ID for the combined dependent variables: $F(6, 81) = 2.59, p = .03$. The effect size was large (partial $\eta^2 = .16$). The results for the dependent variables considered separately are

presented in Table 2. The children with ID ($M = 48.94, SD = 32.86$) scored significantly lower than the matched typically developing children ($M = 71.98, SD = 29.30$) in rhyme detection. This difference would have reached statistical significance even if a conservative Bonferroni adjusted α level of .008 had been used. The children with ID ($M = 37.23, SD = 27.89$) also scored significantly lower than the matched typically developing children ($M = 50.27, SD = 27.40$) in phoneme blending, $F(1, 86) = 4.89, p = .03$, but the effect size was small (partial $\eta^2 = .05$).

Comparison of the Scores in Specific Tasks of Phonological Awareness at Time 2

Six dependent variables were entered in the MANOVA: syllable segmentation, phoneme blending, first phoneme detection, last phoneme detection, phoneme segmentation, and phoneme substitution at Time 2. There was a statistically significant difference between typically developing children and children with ID for these combined dependent variables: $F(6, 81) = 3.68, p = .003$. The effect size was large (partial $\eta^2 = .21$). The results for the dependent variables considered separately are presented in Table 2. In phoneme segmentation, children with ID ($M = 40.90, SD = 45.53$) scored significantly lower than typically developing children ($M = 76.51, SD = 33.97$), $F(1, 79) = 17.29, p < .001$, with a large effect size (partial $\eta^2 = .17$). The children with ID ($M = 59.09, SD = 43.25$) also scored significantly

Table 2
Univariate Effects for the Phonological Awareness Tasks Administered at Time 1 and Time 2 (Significance at $p < .008$)

Variable	Time 1 ($n = 94$)				Time 2 ($n = 88$)			
	Univariate F	df	p	Partial η^2	Univariate F	df	p	Partial η^2
Syllable blending	1.83	1	.16	.02	X	X	X	X
Syllable segmentation	.64	1	.26	.007	.01	1	.92	.00
Rhyme detection	12.23	1	.001	.12	X	X	X	X
First phoneme blending	.10	1	.75	.001	X	X	X	X
Phoneme blending	4.89	1	.03	.05	4.02	1	.05	.04
First phoneme detection	2.38	1	.13	.03	7.12	1	.01	.08
Last phoneme detection	X	X	X	X	11.73	1	.001	.12
Phoneme segmentation	X	X	X	X	17.29	1	.000	.17
Phoneme substitution	X	X	X	X	2.60	1	.11	.03

Note. X means that a nonparametric test was used.

lower in last phoneme detection than typically developing children ($M = 84.94$, $SD = 25.23$), $F(1, 69) = 11.73$, $p = .001$, with a medium effect size (partial $\eta^2 = .12$). These two differences would have reached statistical significance even if a conservative Bonferroni-adjusted p -value of .008 had been used. Additionally, children with ID had significantly lower scores in first phoneme detection ($M = 74.43$, $SD = 34.83$) than typically developing children ($M = 90.62$, $SD = 20.20$), $F(1, 69) = 7.12$, $p = .01$, with a medium effect size (partial $\eta^2 = .08$).

Mann-Whitney U Tests were conducted to identify whether there was a difference between the scores of children with ID and typically developing children in the three variables that could not be entered in the MANOVA due to severe violations of assumptions: syllable blending, first phoneme blending, and rhyme detection at Time 2. No difference was found between the children with ID ($Mdn = 100$, $n = 44$) and typically developing children ($Mdn = 100$, $n = 44$) in syllable blending ($U = 965.50$, $z = -.042$, $p = .967$), rhyme detection ($U = 842.50$, $z = -1.52$, $p = .128$), and first phoneme blending ($U = 896$, $z = -8.53$, $p = .394$) at Time 2.

Discussion

Studies on the strengths and weaknesses in phonological awareness skills among children with ID with an unspecified etiology are very scarce. This study attempted to fill this gap by comparing the phonological awareness skills of 7- to 8-year-old children with ID with an unspecified etiology to those of 4- to 5-year-old typically developing children matched for gender, early reading skills, and expressive vocabulary. The phonological awareness skills that they displayed 2 school years later were also compared. Our findings suggest that, globally, phonological awareness is a significant weakness in children with ID. However, children with ID did not make significantly less progress than the typically developing students during 2 school years. Moreover, statistically significant differences in performance were noted for some tasks, but not others. Indeed, children with ID showed a marked weakness in rhyme detection and a slight weakness in phoneme blending when they were 7 to 8 years old. Two school years later, these differences were not detectable anymore, but marked weaknesses ap-

peared in phoneme segmentation and first/last phoneme detection. Each of these findings are discussed separately.

At Time 1, the children with ID had already spent 2 to 3 years at school, but the typically developing children had only begun kindergarten and had, therefore, likely not benefitted from phonological awareness instruction. Despite this fact and the strong matching procedure used in the present study, 7- to 8-year-old children with ID were found to have significantly lower phonological awareness skills than 4- to 5-year-old typically developing children with a medium effect size. Two school years later, the phonological awareness skills of children with ID remained significantly lower than those of typically developing children. This finding suggests that phonological awareness is a specific weakness in primary school pupils with ID with an unspecified etiology. They concur with the findings of previous studies conducted with children with Down syndrome (Lemons & Fuchs, 2010; Næss, 2016), Fragile X syndrome (Adlof et al., 2015), and with children with ID with mixed etiology (Channell et al., 2013; van Tilborg et al., 2014).

According to the lexical restructuring hypothesis, vocabulary can foster phonological awareness (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003). In the present study, 7- to 8-year-old children with ID were matched with typically developing children with similar expressive vocabulary at Time 1. At Time 2, there was no difference between the expressive vocabulary ($F[1, 86] = .06$, $p = .813$) of children with ID ($M = 62.18$; $SD = 8.69$) and typically developing children ($M = 62.60$; $SD = 7.93$). Therefore, lower levels of expressive vocabulary cannot explain this specific weakness in phonological awareness among children with ID found at Time 1 and Time 2.

Learning letter names or letter sound correspondences is recognized as fostering the development of phonemic awareness skills (Catts et al., 2015; Lerner & Lonigan, 2016). In the present study, there was no difference between the letter-sound knowledge of the children with ID ($M = 10.26$; $SD = 9.37$) and the typically developing children ($M = 9.43$; $SD = 8.51$) at Time 1: $F(1, 93) = .20$, $p = .654$. At Time 2, children with ID ($M = 26.05$; $SD = 7.69$) had a slightly better letter-sound knowledge than typically developing children ($M = 21.77$; $SD = 10.07$) with a small effect size: $F(1, 87) = 5.00$, $p = .028$, $\eta^2 = .05$. Therefore,

lower levels of letter knowledge cannot explain this specific weakness in phonological awareness among children with ID.

One possible interpretation is that this specific weakness in phonological awareness in children with ID could be related to a specific weakness in phonological short-term memory or phonological working memory displayed by children with ID (Channell et al., 2013; Rosenquist, Conners, & Roskos-Ewoldsen, 2003; van der Molen, Van Luit, Jongmans, & Van der Molen, 2009). Indeed, in typically developing children, phonological working memory predicts phonological awareness (Vellutino et al., 2007). An alternative interpretation could be that this weakness in phonological awareness in children with ID, mostly at Time 2, is due to an insufficiently explicit and intensive training in phonological awareness. Until recently, training in phonological awareness tended to be neglected by researchers and professionals in reading interventions for children with ID (Browder, Wakeman, Spooner, Ahlgrim-Dezell, & Algozzine, 2006; Joseph & Seery, 2004; Katims, 2000). In contrast, training phonological awareness is part of the curriculum for typically developing children during kindergarten and the first primary school year.

Despite the fact that phonological awareness was a significant weakness in 7- to 8-year-old children with ID, and remained a weakness after 2 school years, their progress did not significantly differ from the progress made by the 4- to 5-year-old typically developing children over 2 school years. This shows that children with ID can progress significantly in their phonological awareness skills despite the fact that this is an area of weakness.

The findings also indicate that 7- to 8-year-old children with ID do not have a homogenous weakness in all phonological awareness tasks but, instead, experience more difficulties in some specific phonological awareness tasks than others. Indeed, their scores in syllabic awareness tasks, first phoneme blending, and first phoneme detection did not significantly differ from those of 4- to 5-year-old typically developing children who were matched for early reading skills and expressive vocabulary. In contrast, children with ID had lower phoneme blending skills with a small effect size and lower rhyme detection skills with a medium effect size. This suggests that rhyme awareness is a marked weakness in 7- to 8-year-old children with ID with an unspecified

etiology. This deficit in rhyme awareness was also found in previous studies conducted with children with Down syndrome and Williams syndrome (Menghini et al., 2004; Næss, 2016; Steele et al., 2013). Our findings suggest that a deficit in rhyme detection is perhaps not syndrome-related, but is common in children with ID during the early stages of reading acquisition. This deficit may be related to weaknesses in phonological short-term memory or phonological working memory that were identified in children and youths with ID with an unspecified or mixed etiology. The rhyme identification task used in this study probably relied more heavily on phonological working memory than tasks such as syllable segmentation, first phoneme blending, or first phoneme identification that involved only one or two units to retain in memory. Indeed, even if picture cues were used in the rhyme identification task, the child had to retain in memory three phonological items, compare them, and identify the two that rhymed. The phoneme blending task, where a slight difference was also found, also relied more heavily on phonological memory, requiring the child to retain in memory three to five units and blend them together to form a word. An alternative explanation is that our 7- to 8-year-old participants with ID had not been exposed enough to language activities that appear to promote sensitivity to rhyme among typically developing children. It is also possible that they were exposed to such activities but did not profit from them because they need more explicit and intensive instruction to acquire rhyme detection skills.

In some studies, children with Down syndrome or Williams syndrome were found on average to succeed better in first phoneme detection tasks than in rhyme awareness tasks (Cardoso-Martins et al., 2002; Fletcher & Buckley, 2002; Snowling et al., 2002; Steele et al., 2013; Van Bysterveldt & Gillon, 2014). This is not the case in our sample of children with ID with an unspecified etiology. Indeed, the average score in the rhyme awareness task was higher ($M = 48.94$) than in the first phoneme detection task ($M = 35.90$). Moreover, a thorough examination of each child's scores at Time 1 indicates that only five of the children with ID in our sample who did not master rhyme detection mastered first phoneme detection task. Even if a specific weakness in rhyme detection can be observed in children with ID with an unspecified etiology in

comparison to typically developing children, our findings suggest that, generally, first phoneme detection does not precede rhyme awareness. This could suggest that the deficit in rhyme awareness may be less severe in 7- to 8-year-old children with ID with an unspecified etiology than in children with Down syndrome. This should be investigated by studies comparing both groups before drawing firmer conclusions.

The analysis conducted at Time 2 showed that the profiles of children with ID in phonological awareness changed over time. No significant differences were found at Time 2 between the two groups in the syllable awareness or rhyme awareness tasks. The majority of the 9- to 10-year-old children with ID obtained the maximum score in syllable blending (91%). Many of them (70%) also correctly solved all items in syllable segmentation. The specific weaknesses in rhyme awareness that were observed when they were 7 to 8 years old disappeared 2 school years later. At 9 to 10 years old, 75% of the children with ID obtained the maximum score in the rhyme awareness task, indicating that most of them mastered this skill. This is not consistent with the findings from some studies conducted with children with Down syndrome, suggesting that this deficit is persistent (Baylis & Snowling, 2012; Hulme et al., 2012). In primary school pupils with ID with an unspecified etiology, this deficit appears to be transitory.

At 9 to 10 years of age, the slight weakness in phoneme blending displayed 2 school years earlier by children with ID was no longer significant. Almost half of the children with ID (48%) obtained the maximum score in the phoneme blending task. Other specific weaknesses in phonemic awareness tasks appeared to emerge when the children with ID were compared to 6- to 7-year-old typically developing children who had finished kindergarten. Our findings highlighted that 9- to 10-year-old children with ID had significantly lower scores in phoneme segmentation (large effect size), last phoneme detection (medium effect size), and first phoneme detection (medium effect size). An examination of individual scores shows that only 39% succeeded in at least two-thirds of the items of the phoneme segmentation task, in comparison to 82% of the 6- to 7-year-old typically developing children. This is worrisome because the phoneme segmentation task was relatively easy and involved mainly monosyllabic words. Moreover, phoneme segmentation and phoneme blending are the phonolog-

ical awareness tasks that more strongly predict reading skills in typically developing children (NICHD, 2000).

These specific weaknesses in phoneme segmentation and first/last phoneme detection at Time 2 cannot be explained by lower letter-sound knowledge given that children with ID ($M = 26.05$; $SD = 7.69$) had slightly better letter-sound knowledge than typically developing children ($M = 21.77$; $SD = 10.07$) with a small effect size ($F(1, 87) = 5.00$, $p = .028$, $\eta^2 = .05$). It may be that the abstract nature of phonemes challenges 9- to 10-year-old children with ID even more than 6- to 7-year-old typically developing children. An alternative interpretation would be that children with ID received an insufficiently intensive and systematic training in phonemic awareness during the first years of primary school.

The present study extended the current knowledge on the phonological awareness skills of children with ID with an unspecified etiology. However, some of the study's limitations must be taken into account. This study was a secondary analysis of the data collected in two independent studies. Data at Time 2 were not collected during the same month. The test was administered at the end of the school year to children with ID (June) and 2 months later, at the beginning of the next school year, to the typically developing children (September). Thus, it should be taken into account that, for the typically developing children, the period between Time 1 and Time 2 was longer (23 months) than for children with ID (21 months). This may have given a slight advantage to typically developing children, but probably not an important one because these 2 supplementary months included the summer holidays (6 weeks). Another study limitation is that no information was collected on the participants' home literacy experiences and on the literacy instruction and phonological awareness training provided to them at school. This type of information would have been very useful in interpreting our findings. The fact that all the typically developing children did not attend the same type of classroom (multiage classrooms, ordinary kindergarten classrooms), and that the children with ID attended either general education classrooms or special schools probably enhanced the differences in the type of instruction received by the participants.

Finally, the fact that the group of 1st and 2nd grade pupils with ID included some second language students is also a limitation. In typically

developing children, it has been shown that phonological awareness skills transfer from the first to the second language (Cisero & Royer, 1995; Dickinson, McCabe, Clark-Chiarelli, & Wolf, 2004; Durgunoglu, Nagy, & Hancin Bhatt, 1993; Saiegh-Haddad & Geva, 2008; Verhoeven, 2007). Moreover, the phonological awareness skills of 1st or 2nd grade students who received classroom instruction in a language other than the language they speak at home are very similar to those of native speakers (Chiappe & Siegel, 1999; Chiappe, Siegel, & Wade-Woolley, 2002; Geva, Yaghoub-Zadeh, & Schuster, 2000; Lesaux & Siegel, 2003). Nevertheless, it is currently unknown if these findings also apply to children with ID.

Even if caution is required in the absence of similar studies, this study has several implications for practice. Our findings suggest that children with ID should receive systematic and explicit phonological awareness training when they are in kindergarten. This may reduce the deficit in phonological awareness that was observed when they were 7 to 8 years old, which is very probably an obstacle in learning to read. In typically developing children, and at risk children, training phonological awareness skills during kindergarten years has been shown to prevent reading difficulties (Bus & van Ijzendoorn, 1999). Our findings also indicate that phonological awareness instruction needs to continue at least during the first 3 primary school years for most children with ID. Intensive, explicit, and systematic phonics instruction encompassing phonological awareness training should be provided to them. It was shown to be effective for children with mild to severe levels of ID (Allor et al., 2014; Bradford et al., 2006; Browder et al., 2008; Browder et al., 2012; Connors, et al., 2006; Flores et al., 2004; Fredrick et al., 2013).

One of the characteristics of systematic instruction is to plan activities that grow progressively in complexity as the child progresses. The findings from our study appear to hint that teachers can follow the order of complexity recommended for typically developing children. However, they must be conscious that rhyme awareness is probably especially difficult for most of these children when they are 7 to 8 years old. They should not wait for it to be mastered before training phonemic awareness skills. Indeed, in typically developing children, phonemic awareness has been found to be a stronger predictor of

reading skills than rhyme awareness (NICHD, 2000). Furthermore, they could teach children to name and manipulate letters. Indeed, learning the letters' names that are associated with their sounds facilitates the detection of phonemes (Ziegler & Goswami, 2005). Finally, our findings highlight the heterogeneity in phonological awareness skills in children with ID, which is visible in the large standard deviations for most scores of phonological awareness skills. For example, some 9- to 10-year-old children with ID still had not mastered syllable segmentation, but some of them had already mastered phoneme segmentation. It is, therefore, crucial to tailor phonological awareness training to the children's level and to monitor their progress closely.

As a conclusion, this study yielded information on the phonological awareness skills of primary school pupils with ID. It highlighted the interest in conducting studies with children with ID with an unspecified etiology. Indeed, our findings suggest that atypical patterns of phonological awareness skills observed in children with specific syndromes could also be observed in children with ID with an unspecified etiology. More studies should be conducted with samples of children with ID with an unspecified etiology before drawing firmer conclusions. To improve our comprehension of their profiles of phonological awareness skills and their evolution over time, future studies should have samples with narrow age ranges (2 years). They should assess the quantity and quality of the instruction provided to clarify whether the weaknesses, which are observed in phonological awareness, are inherent to intellectual disability or due to insufficiently intensive, explicit, and systematic instruction. Furthermore, future studies should investigate relations between phonological awareness skills in children with ID and phonological short-term and phonological working memory to clarify their relationship.

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