

ERD 2021
9th International Conference Education, Reflection, Development**THE FACTORIAL STRUCTURE OF THE PHONOLOGICAL
AWARENESS CONSTRUCT. A QUALITATIVE REVIEW**Carmen David (a)*, Roşan Adrian (b), Ana Eligia Moldovanu (c)
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Abstract

Phonological awareness is a cognitive ability important for the acquisition of reading and writing in alphabetic scripts. Its conceptualization as a unitary or a multidimensional construct is still under debate, and so are its components. However, most of the research on its conceptualization and structure is done on English language. The current paper provides a qualitative synthesis of factor- analytic studies that address the structure of the phonological awareness construct in order to incorporate more recent studies that are conducted on languages that differ on orthographic transparency or syllabic structure. The study addresses the dimensionality of the construct, as measured not only for different languages, but also with different tasks, and in different age groups. Findings can inform the way we conceptualize phonological awareness, as well as the development of valid phonological awareness assessment instruments. Results can also be applied in designing interventions that address phonological awareness as a prerequisite for reading and writing.

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Keywords: Dimensionality, factorial analysis, phonological awareness

1. Introduction

Phonological awareness is a cognitive ability important for reading and writing (Caravolas et al., 2012; Landerl & Wimmer, 2008; Melby-Lervåg et al., 2012; Pfost, 2015; Plaza & Cohen, 2007).

Phonological awareness encompasses the awareness of the fact that words are composed of smaller sound units and can be segmented into linear sequences of phonological units, which can be syllables, onset/ rimes, or phonemes (Dillon et al., 2012). This ability prepares the beginning reader to understand the alphabetic principle and to establish and use the correspondence between phoneme and grapheme (Lieberman et al., 1989). There are now almost 50 years since the first time it was emphasized in relation to reading (by I. Liberman and team at Haskins laboratories, Liberman, 1973). However, our understanding of it is still progressing. Currently, there are multiple terms in use with reference to phonological awareness, of which we mention the following: segmental awareness (Morais, 1987), phonological sensitivity (Stanovich, 1992), phoneme awareness. As there are multiple terms, so there are various definitions of the concept of phonological awareness. Previous works synthesized the information on phonological awareness definitions (Anthony & Lonigan, 2004; Stahl & Murray, 1998). Definitions of phonological awareness vary on the degree of coverage of phonological units (whether they include only phoneme, phoneme and rime, phoneme, rime and syllable etc.) (some are broader, while others are more restrictive) and on the type of phonological processing (whether explicit only, or including implicit processing of phonological units) (Anthony & Lonigan, 2004). These definitions carry different conceptualizations that can be grouped into two main categories: phonological awareness seen as a unitary ability that develops in a particular sequence (Adams, 1990; Stanovich, 1992); phonological awareness as a heterogenic ability (Bentin, 1992) which contains several phonological skills, different by linguistic complexity (rime awareness, syllable awareness, phoneme awareness) and by the operation being performed (phonological unit shallow processing or active manipulation of a particular phonological unit) (e.g. early phonological awareness and phonemic awareness; Bentin, 1992). As such, some researchers included only phonemes, while others broaden the term by considering subsyllabic units (Anthony & Lonigan, 2004; Treiman, 1983), as well. Syllable as a phonological unit operated by phonological awareness is rather controversial. Some do not include it into the phonological skills content since operating with this unit comes naturally (Anthony & Lonigan, 2004). Others have included all the range of phonological units, with emphasis on the explicit processing of these units, not only on detection and isolation. In this current state, content validity of the phonological awareness construct is problematic (Vloedgraven & Verhoeven, 2009). Moreover, most of the research is done on English language (Clinton et al., 2011; Lefebvre et al., 2008). Languages have different phonological complexity (Clinton et al., 2011; Cossu et al., 1988; Ziegler & Goswami, 2005), which may influence the development of phonological awareness, as well as its relationship with reading. Also, given the reciprocal relationship between phonological awareness and reading (Vloedgraven & Verhoeven, 2009), one can expect the orthography of a language to be relevant for phonological awareness development and structure. Research results indicate a better performance and a faster progress on phonological awareness measures for users of transparent orthographies (Clinton et al., 2011; Cossu et al., 1988). From a developmental point of view, the structure of the construct may take different shapes at different ages.

2. Problem Statement

The structure of phonological awareness would be an important issue to address in terms of conceptualization, for a better understanding of the way it relates to reading, as well as in order to develop valid measures of phonological awareness for different languages. A previous work that gathered data from other four different studies was conducted by Anthony and Lonigan (2004). They used confirmatory factor methodology in order to overcome some of the methodologic limitations of exploratory factor analysis. All studies included were conducted on English speaking participants. All studies were published around the same period of time (1997- 1998). Also, they covered a wide age range, from 25 months old to 95 months old.

Current developments on this topic seem to have contributed to more studies performed on other languages, different from English: evidence of the importance of certain linguistic variables for the development of phonological awareness (syllabic complexity, morphologic complexity, orthographic transparency), development of phonological awareness instruments for different languages, evidence of phonological awareness as a universal predictor; data on the bidirectional relationship between reading and phonological awareness. In the light of these developments, we aim at synthesizing the wealth of new results.

The issue of the structure of phonological awareness has been addressed through various research methodologies (see Anthony & Lonigan, 2004 for a review): correlational including factorial research, prediction studies, item response theory methodology (Vloedgraven & Verhoeven, 2009). Exploratory factor analysis (EFA) comprises methods that allow among others for testing conceptualization of constructs. EFA is a technique that reduces complex sets of data from measured variables to latent variables (Popa, 2010). Confirmatory factor analysis, on the other hand starts with an apriori model that would be tested. As there is a rich literature addressing this topic, we will narrow down our review to factorial analysis studies.

3. Research Questions

We addressed, therefore, several research questions:

Is the phonological awareness a unidimensional construct?

What are the factors of the phonological awareness construct?

Is the structure of the construct different as a function of language?

Is the structure of the construct different as a function of age?

4. Purpose of the Study

The current paper provides a qualitative synthesis of factor- analytic studies that address the structure of the phonological awareness construct in order to incorporate more recent studies that are conducted on languages that differ on orthographic transparency or syllabic structure, as well as on different age groups.

5. Research Methods

For the purpose of this review, we have searched several databases (Proquest, EBSCO), as well as Google Scholar. The following key terms were used: phonological awareness. Our search was limited to articles published in English, that were peer- reviewed in order to ensure the quality of research methodology. In the first selection phase, all articles with titles and abstracts irrelevant to the topic were excluded. In the second phase, the articles with titles and abstracts relevant to the topic were examined in detail. References were also cross- referenced. We applied the inclusion and exclusion criteria, which narrowed down the number of articles to twenty- three.

Inclusion criteria were:

To address the structure of phonological awareness construct, either through a sufficient number of specific tasks, or through standardized instruments described in detail

To detail on the types of tasks, sample characteristics

To conduct a factor analysis and to offer enough information related to it

Exclusion criteria:

We excluded studies conducted on bilingual samples or on samples with disabilities.

All studies that met our inclusion criteria are catalogued in table1, based on author(s) name, year of publication, number of factors, factor structure, sample size, sample age and grade level, and language (all data is summarized in table 1).

Table 1. Author(s), year, number of factors, factor structure, sample size, sample characteristics, and language

Study	Year	Number of factors	Factor structure	Sample size (N)	Sample characteristics (Age and grade level)	Language
1.Stanovich, Cunningham, & Cramer	1984	1	-	49	M _{age} = 6 yrs. and 2 mths. (SD=4.4 mths) Kindergarten	English
2.Lundberg, Frost, & Petersen	1988	2	Word and syllable awareness and phoneme awareness	235 (EG) 155 (CG)	M _{age} = 6 yrs. old Kindergarten	Danish
3.Yopp	1988	2	Phonemic awareness and deletion	96	M _{age} = 5 yrs. and 10 mths. Kindergarten	English
4. Wagner, Torgesen, Laughon, Simmons, & Rashotte	1993	2	Analytical and synthetic factor for both kindergarten and second grade samples	95 (k) 89 (2 nd)	M _{age} = 5 yrs. and 11 mths. (K) M _{age} = 8 yrs. and 1 mth. Kindergarten and 2 nd grade	English
5. Stahl & Murray	1994	1	-	113 52 (k) 61 (1 st)	Kindergarten and 1 st grade	English
6. Carrillo	1994	2	Sensitivity to phonological	120 68 (k)	M _{age} = 5 yrs. and 10 mths. (K)	Spanish

			similarities and segmental awareness/ holistic and analytic awareness	52 (1 st)	M _{age} = 6 yrs. and 10 mths. (1 st grade) Kindergarten and 1st grade	
7. Høien, Lundberg, Stanovich, & Bjaalid	1995	3	Phoneme factor, syllable factor and a rhyme factor	128 (Study1) 1509 (Study 2)	Age range (K)= 6 yrs. and 5 mths. to 7 yrs. and 5 mths.) Age range (1 st) = 7 yrs. and 4 mths. to 8 yrs. and 4 mths. Kindergarten and 1 st grade	Norwegian
8. Muter, Hulme, Snowling, & Taylor	1997	2	Rhyme and segmentation	38	Age range= 3 yrs. to 4 yrs. and 9 mths. Preschool	English
9. Lonigan, Burgess, Anthony, & Barker	1998	2 (3- and 4-year-olds) 1 (5-year-olds)	*Oddity Tasks and Non-oddity Tasks	238	Age range= 2 yrs. and 1 mth. and 6 yrs. and 10 mths. M _{age} = 50.4 mths.) Preschool	English
10. Schatschneider, Francis, Foorman, Fletcher, & Mehta	1999	1	-	945 (315/grade)	Mean age: M _{age} = 5 yrs. and 8 mths. (K) M _{age} = 6 yrs. and 9 mths. (1 st) M _{age} = 8 yrs. (2 nd) Kindergarten to Second Grade	English
11. de Jong & der Leij	1999	1	-	166	M _{age} = 5 yrs. and 7 mths. (SD= 2,7 mths.) Second year of kindergarten	Dutch
12. Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor	2002	1 for both age groups	-	258	M _{age} = 39.43mths. (N=109) M _{age} = 56.55mths. (N=149) Preschool	English
13. Van Bon & van Leeuwe	2003	1	-	171	M _{age} = 74 mths. (k) M _{age} = 84 mths. (1 st)	Dutch
14. Runge & Watkins	2006	2	Phonological awareness and one for rhyme	161	M _{age} = 75.5 mths. Kindergarten	English
15. Vloedgraven and Verhoeven	2007	1	-	172 (k) 173 (1 st)	M _{age} = 6 yrs. and 1 mth. (k)	Dutch

						M _{age} =7 yrs. and 1 mth. (1 st)	
16. Papadopoulos, Spanoudis, & Kendeou	2009	1	-	280		M _{age} = 5 yrs. and 8 mths. (first testing) (k) M _{age} =6 yrs. and 6 mths. (Second testing) (1 st grade)	Greek
17. Mott & Rutherford	2012	1	-	333		Pre-K, K, and Grades 1 and 2	English
18. Godoy & Cogo-Moreira	2015	3	segmentation, CVC deletion, CCV deletion	176		M _{age} = 9.3 yrs. 1 st through 5 th grade	Brazilian Portuguese
19. Wolff & Gustafsson*	2015	-	a general phonological awareness factor and 4 residual factors representing the processing and linguistic complexity factors	364		M _{age} = 4 yrs. and 1 mth. Preschool	Swedish
20. Santos & Lima	2017	3	Factors relating to sound position (initial, median, final)	510		M _{age} = 8.4 yrs 2 nd and 6 th grade students	Brazilian Portuguese
21. Germano, de C. Cesar, & Capellini	2017	2	The PA measures loaded on two factors: measures of rhyme, alliteration, and letter naming; separately measures of phoneme analysis and synthesis	149		Age range= 6yrs.- 6 yrs. and 11 mths. 1 st grade	Brazilian Portuguese
22. Meira, Cadime, & Viana	2018	3	syllable, rhyme and phonemic awareness	256		M _{age} =66.37 mths. Last year of preschool*	Portuguese
23. Milankov, Golubović, Krstić, & Golubović	2021	4	stylistic awareness (syllable), advanced awareness, initial phoneme awareness, phoneme segmentation	689		M _{age} =101.59 mths. Grade 1 through Grade 3	Serbian

6. Findings

6.1. Characteristics of the studies

After applying the selection criteria, twenty- three studies were kept. The selected studies were published between 1984 and 2021.

Ten of the studies address the structure of Phonological awareness (PA) in the case of English language. Thirteen studies were conducted on other languages, such as: Dutch (3 studies), Norwegian (1 study), Greek (1 study), Brazilian Portuguese (3 studies), one European Portuguese (one study), Serbian (1 study), Danish (1), Spanish (1), and Swedish (1). Fourteen of the studies used exploratory factor analysis, and ten used confirmatory factor analyses. Two studies used both methods. However, one of them reports in detail the confirmatory factor analysis. Several studies conducted separate analyses for different age groups. Two of the studies did not report mean age or age range, only school level.

6.2. Characteristics of the samples

Sample sizes vary from 38 to 1509. Age of participants varies from 2 years and a month to 11 years. Most of the studies are conducted on kindergarten and first grade samples. Eleven of the studies are conducted separately on kindergarten samples. Three other studies included kindergarten students in their samples (Mott & Rutherford, 2012; Stahl & Murray, 1994; Schatschneider et al., 1999).

6.3. Characteristics of the Phonological awareness tasks included in the studies:

Studies used a wide range of tasks to measure phonological awareness.

Tasks differ on phonological units addressed, on presentation/response formats, and on cognitive demands.

Of the twenty- three studies, twenty-two included rhyme tasks (all but Santos & Lima, 2017), all included phoneme tasks, and only nine studies included syllable tasks (the second study from Høien et al., 1995 also had a syllable task). Of the nine studies that used syllables, only two were conducted on English language (Anthony et al., 2002; Mott & Rutherford, 2012), the rest were conducted on other languages (Danish, Norwegian, Greek, Portuguese, Serbian, Swedish). In Lundberg et al. (1988), they used two syllable tasks: syllable synthesis and syllable segmentation with a small number of items (3 each). Høien et al. (1994) had two similar syllable counting tasks in their studies. For the kindergarten sample, they employed a 16- item task, while for the 1st graders, they used a similar counting task with only 11 items. In Anthony et al. (2002), a blending syllable variable was derived from non-pictured blending and multiple-choice blending. Similarly, an elision syllable variable used items from the non-pictured and multiple-choice items. Internal consistency values for these two variables were moderate. This was explained also thorough the small number of items for each of the two syllable variables. In Papadopoulos et al. (2009), they employed a syllable segmentation and a syllable completion task, with 15 items each. Moreover, final cluster oddity and onset- oddity were also performed on syllable units, as reported by Papadopoulos et al. (2009). Mott and Rutherford (2012) examined the technical qualities of an assessment instrument The Leveled Assessment of Phonological Sensitivity (LAPS), which included

syllable blending, segmenting and deletion items. Meira et al. (2018) had 10 syllable tasks from the total of 18 tasks (syllable segmentation, syllable synthesis, initial syllable identification, initial syllable oddity, initial syllable naming, syllabic recognition, syllabic localization). Only one task had 4 items, the rest had 7, 9 or 10 items. In Germano et al. (2017), a syllabic segmentation task was included. Milankov et al. (2021) had two syllable tasks: syllable merging and syllable segmentation.

Rhyme tasks were also various: rhyme choice, rhyme supply, sensitivity to rhyme, rhyme recognition, rhyme detection, rhyme production, rhyme oddity detection, rhyme categorization, rhyme oddity, rhyme matching, rhyme judgement, rhyme recognition and rhyme production in different presentation formats (oral or picture presentation). Most of the rhyme tasks contain ten or more items. Only in Høien et al. (1994), for the 1st grade sample, a 5- items task was given. Ceiling effects are reported for the rhyme measures in several studies that have kindergarten and first grade samples. However, for the rhyme generation task in Papadopoulos et al. (2009) and rhyme production in Muter et al. (1997) floor effects are reported.

Some tasks were oddity, while others were non- oddity. Some required matching, phoneme counting, production of words from a given phoneme, response to rhyme or alliteration (sensitivity). As far as operations involved, studies included blending (synthesis), segmenting (analysis) (isolation, identification, position segment identification, unit counting), categorization, and manipulation (with elision, deletion, substitution, reversal). Two tasks were less used (appeared only once): auditory discrimination (Yopp, 1988) and pseudoword repetition (van Bon & van Leeuwe, 2003). In many studies, the position of the phonological unit on which the child is supposed to operate has been considered (e.g., initial consonant same, final consonant same, deletion of initial consonant, identifying a phoneme at the beginning, middle, and end of words; sound isolation; position segment identification; first sound categorization and last sound categorization, final cluster oddity). Sixteen of the studies reported data on the internal consistency of the tasks, most of which computed either Cronbach alpha or Guttman, Spearman- Brown coefficients for each task. Values of internal consistency coefficients are mostly in the high range. Some studies reported an overall internal consistency coefficient. In Lonigan et al. (1998) were reported low internal consistency coefficients for oddity tasks in the case of 2- and 3-year-olds, and alliteration oddity for 4-year-old. Table 2 integrates information on tasks used in the selected studies. Regression analysis are the following (table 2):

Table 2. Phonological awareness tasks

Study	Year	Tasks/Number of items
1.Stanovich, Cunningham, & Cramer	1984	Strip initial consonant (10)
		Supply initial consonant (10)
		Initial consonant same (10)
		Initial consonant different (10)
		Initial consonant not same (10)
		Final consonant same (10)
		Final consonant different (10)
		Rhyme choice (10)
		Rhyme supply (10)
		Substitute initial consonant (10)
2.Lundberg, Frost, & Petersen	1988	Rhyme test (21 items)
		Segmentation of sentences into words (2 sentences of 5

		and 7 monosyllable words)
		Syllable synthesis (3)
		Syllable segmentation (3)
		Deletion of initial phoneme (8)
		Phoneme segmentation (8)
		Synthesis of phoneme (8)
		Auditory discrimination (40)
		Phoneme blending test (30)
		Phoneme counting test (42)
		Phoneme deletion test (30)
3.Yopp	1988	Phoneme deletion test Rosner (13)
		Rhyming test (Yopp) (20)
		Phoneme segmentation (16)
		Phoneme segmentation (Yopp- Singer) (22)
		Sound isolation (15)
		Word- to- word matching (24)
4.Wagner, Torgesen, Laughon, Simmons, & Rashotte	1993	- phoneme segmentation (15 items)
		- phoneme elision (15 items)
		- sound isolation (initial, median and final) (15 items)
		- sound categorization (18 items)
		- blending onset and rime (15 items)
		- blending phonemes into words (15 items)
		- blending phonemes into non-words (15 items)
		Blending (3 levels of linguistic complexity)
		Isolation (first and final sound) (4 levels)
5.Stahl&Murray	1994	Segmentation (3 levels)
		Deletion (4 levels)
		14 tests of 5 items each
		Sensitivity to rhyme (5 test items) (15 pairs to compare)
		Sensitivity to alliteration (same)
		Position segment identification (5 series of 4 words)
		Final segment deleting (15 words)
6.Carrillo	1994	Initial segment deleting (same as previous)
		Initial segment isolation (10 words)
		Final segment isolation (same as just the previous)
		Total segmentation (10 words)
		Reversal segments (10 words)
		- rhyme recognition (11 items)
		- syllable counting (16 items)
7. Høien, Lundberg, Stanovich, & Bjaalid	1995	- initial-phoneme matching (10 items)
		- deletion of initial phonemes (10 items)
		- phoneme blending (10 items)
		- phoneme counting (6 items)
		- rhyme detection (10 items)
		- rhyme production (2 target words, 30 seconds to produce rhyming words)
8. Muter, Hulme, Snowling, & Taylor	1997	- phoneme identification (8)
		- phoneme deletion (10)
		- at time 2 and 3 a sound blending tasks was added (32)
9. Lonigan, Burgess, Anthony, & Barker	1998	- rhyme oddity detection (11)
		- alliteration oddity detection (11)

			- blending (22)
			- elision (17)
			- blending onset and rime (15)
			- blending phonemes into words (15)
			- blending phonemes into nonwords (15)
			- phoneme elision (15)
			- phoneme segmentation (15)
			- sound categorization (15)
			- first sound comparison (15)
			- Rhyme categorization (10)
			- First sound categorization (10)
			- Last sound categorization (10)
			- rhyme oddity (11)
			- rhyme matching (11)
			- word blending (11)
			- nonpictured blending (11)
			- multiple-choice blending (10)
			- word elision (11)
			- nonpictured elision (10)
			- multiple-choice elision (10)
			- phoneme recognition (30)
			- phoneme blending (30)
			- phoneme counting a (10)
			- phoneme counting b (20)
			- phoneme deletion (20)
			- phoneme segmentation (30)
			- pseudoword repetition (30)
			- rhyme judgment (20)
			Rhyme Recognition—Oral Presentation (10 items)
			Rhyme Recognition—Picture Presentation (10)
			Rhyme Production—Oral Presentation (10)
			Rhyme Production—Picture Presentation (10)
			Categorization Recognition—Picture Presentation
			Same (10)
			Categorization Recognition—Picture Presentation
			Different (10)
			Categorization Production—Oral Presentation (12)
			Categorization Production—Picture Presentation
			(15)
			Blending Recognition (15)
			Blending Production—Oral Presentation (phonemes)
			(15)
			Blending Production—Oral Presentation (linguistic
			units) (15)
			Segmenting Recognition—Neutral Presentation (42)
			Segmenting Production—Oral Presentation (22)
			Segmenting Production—Oral Presentation (15)
			Manipulation Recognition (15)
			Manipulation Production—Oral Presentation (15)
			Manipulation Production—Oral Presentation (15)
			Letter Name Recognition
			Letter Name Production—Identification
10.	Schatschneider, Francis, Foorman, Fletcher, & Mehta	1999	
11.	De Jong & der Leij	1999	
12.	Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor	2002	
13.	Van Bon & van Leeuwe	2003	
14.	Runge and Watkins	2006	

			Letter Name Production—Written
			Rapid Serial Naming Production—Animals
			Rapid Serial Naming Production—Objects
			Rapid Serial Naming Production—Colors.
15. Vloedgraven and Verhoeven	2007		- rhyme (30)
			- phoneme identification (30)
			- phoneme blending (40)
			- phoneme segmentation (40)
			- rhyme oddity (15)
			- rhyme generation (10)
			- syllable segmentation (15)
			- syllable completion (15)
16. Papadopoulos, Spanoudis, & Kendeou	2009		- final syllable/ cluster oddity (10)
			- initial syllable oddity (15)
			- initial sound oddity (15)
			- sound isolation (15)
			- phoneme elision (15)
			- blending (15)
			Rhyme, alliteration, words, syllables, onsets and rimes
			Phonemic isolation
			Phonemic identification
17. Mott & Rutherford	2012		Phonemic categorization
			Blending
			Segmenting
			Manipulation
			15 items for each
			LAPS instrument
			Segmentation (8 items with three syllable structures)
			Subtraction with consonant- vowel- consonant structures (16)
18. Godoy & Cogo-Moreira	2015		Subtraction with consonant- consonant- vowel structure (10)
			Identification at the morpheme, syllable, and phoneme level (9 items each task ; one task at the morpheme level, one at the syllable level, and three tasks at the phoneme level)
19. Wolff & Gustafsson	2015		Blending/ segmentation at the morpheme level, 2 tasks at the syllable level, and 2 tasks at the phoneme level
			Manipulation at the morpheme level (2 tasks), two tasks at the syllable level, and two tasks at the phoneme level
20. Santos & Lima	2017		- identifying a phoneme at the beginning, middle, and end of words (5 items each)
			Rhyme production (20-word stimuli)
			Rhyme identification (20)
			Syllabic segmentation (21)
21. Germano, de C. Cesar, & Capellini	2017		Production of words from a given phoneme
			Phonemic synthesis (21)

		Phonemic analysis (21)
		Identification of the initial sound structure (21)
		- syllabic segmentation (9)
		- syllabic synthesis (4)
		- initial syllable identification (9)
		- initial syllable oddity (9)
		- initial syllable naming (9)
		- final syllable identification (9)
		- final syllable oddity (10)
		- final syllable naming (10)
		- syllabic recognition (7)
		- syllabic localization (7)
		- rhyme recognition (7)
		- rhyme oddity (7)
		- initial phoneme recognition (7)
		- initial phoneme identification (7)
		- initial phoneme oddity (9)
		- initial phoneme naming (10)
		- phonemic recognition (6)
		- phonemic localization (5)
		- syllable merging (6)
		- syllable segmentation (6)
		- initial phoneme identification (6)
		- rhyme recognition (6)
		- phoneme segmentation (6)
		- final phoneme identification (6)
		- phoneme deletion and phoneme substitution (6)
22. Meira, Cadime, & Viana	2018	
23. Milankov, Golubović, Krstić, & Golubović	2021	

Our study addressed four research questions pertaining to the construct of phonological awareness. Firstly, on the basis of factorial studies' findings, we wanted to see whether a unidimensional or a multidimensional structure of phonological awareness has more support.

Eleven of the studies (including an analysis on a distinct age sample in the same study) reported a one- factor structure. In 13 studies, the resulting structure is multidimensional, with 2- 4 factors (mostly 2). Wolff and Gustafsson (2015) obtained support for a model with two dimensions, a processing and a linguistic complexity one. They further analysed whether these dimensions can be unified under the construct of phonological awareness. Results indicate a general phonological awareness factor, and several residual factors pertaining to processing (blending/ segmenting and manipulation) and to the linguistic complexity (morpheme and phoneme).

Given the data from the 23 studies included in our review, there appears to be equally strong support for either a unidimensional or a multidimensional phonological awareness construct. However, in our review, we used frequency counts of findings, which does not indicate the proportion of cases or the validity of findings (Levitt, 2018). These mixed findings come from exploratory, as well as confirmatory factor analyses. Five confirmatory factor analysis studies (out of nine identified) found support for two- or three factor structures (we excluded Wolff & Gustafsson, 2015 from this count as they used higher-order CFA models). There are no significant differences in the findings from the EFA and CFA studies, pertaining to the unifactorial or the multifactorial structure of the construct.

Factor structure of the phonological awareness construct

Secondly, we addressed the factor structure of the construct. Factors yielded are diverse. However, most contain a phonemic awareness factor.

Two studies yielded a similar factorial structure: Meira et al. (2018) and Høien et al. (1995). It is worth mentioning that in Høien et al. (1995), this factor structure was extracted based on data from a kindergarten sample, through principal component analysis with varimax rotation, and also with Oblimin. These findings were replicated in the case of a large sample of 1509 1st graders. Meira et al. (2018) used a confirmatory factor analysis and tested three models: a one- factor model, a two- factor model (supraphonemic unit awareness and phonemic awareness), and a three- factor model (syllabic, intrasyllabic, phonemic). Of the three models, the tridimensional had the best fit.

Most of the multidimensional structures include a phoneme awareness dimension. Some factorial structures include an analytical and a synthetic factor (Carrillo, 1994- analytic awareness; Godoy & Cogo-Moreira, 2015- segmentation; Milankov et al., 2021- phoneme segmentation; Wagner et al., 1993). On the other hand, in Germano et al. (2017), measures of phoneme analysis and synthesis loaded on the same latent factor. Several of the studies that obtained a multifactorial structure for the PA construct contain factors that are in relation to the phonological unit sizes/ linguistic complexity: syllable, phoneme, and rhyme (Lundberg et al., 1988- word and syllable and phoneme awareness; Høien et al., 1995- phoneme factor, syllable factor, and rhyme factor; Muter et al. (1997)- rhyme and segmentation; Runge & Watkins, 2006- phonological awareness and rhyme; Germano et al. (2017)- measures of rhyme and alliteration loaded on a different factor than phoneme analysis and synthesis; Meira et al., 2018- syllable, rhyme, and phonemic awareness; Milankov et al., 2021- stylistic awareness(syllable), initial phoneme awareness, phoneme segmentation). These studies bring evidence against a unidimensional construct of phonological awareness. Rhyme tasks, syllable tasks, and phoneme tasks may tap onto different phonological skills.

Godoy and Cogo-Moreira (2015) and Yopp (1988) identified by means of exploratory factor analysis, and confirmatory factor analysis, respectively, a deletion factor. This factor may overlap with advanced awareness, having loadings from items that impose higher cognitive demands on the participants.

Lonigan et al. (1998) performed a principal component analysis on data obtained from preschoolers. The two factors extracted were in relation to the type of task: oddity and non- oddity tasks. However, it is worth mentioning that there were floor effects for the young pre-schoolers performance on the phonological awareness tasks. Also, internal consistency of most of the tasks for the young sample was poor.

Santos and Lima (2017) analysed the factorial structure in the case of phonemic awareness tasks in which they manipulated the position of the phonemic unit. They extracted three factors that were relating to the sound position (initial, medial, and final).

Factor structure of phonological awareness and language

Thirdly, we investigated whether the structure of the PA construct is different as a function of language/ linguistic factors (syllabic structure, orthographic transparency).

Of the eleven studies that yielded a one- factor solution, seven were conducted on English samples, while three were on Dutch, and one on Greek samples. In five factorial analyses conducted on English language, a multi- factor structure was obtained.

English language is the best represented in these studies. We were also able to identify three studies on Dutch, and four on Portuguese. All studies conducted on Dutch speaking samples yielded one factor solutions. All studies conducted on Portuguese obtained a multifactorial structure, however different.

Of the nine studies that used syllables, only two were conducted on English language (Anthony et al., 2002; Mott & Rutherford, 2012), the rest of seven were conducted on other languages (Danish, Norwegian, Greek, Portuguese, Serbian, Swedish). Of the studies conducted on other languages, five (considering both studies included in Høien et al., 1995) obtained a syllabic factor (all previously mentioned, except for Greek). Wolff and Gustafsson (2015) did not test a syllable factor in the bifactor model with a general phonological awareness factor, a blending/ segmentation, manipulation, morpheme, and phoneme factor. However, the syllable is not consistently represented in phonological awareness task content.

Twenty-one studies included rhyme tasks. However, only 6 studies obtained a rhyme factor (Carrillo, 1994; Germano et al., 2017; Høien et al., 1995; Muter et al., 1997; Meira et al., 2018; Runge & Watkins, 2006). Of these analyses, only two were conducted on English language.

Based on Seymour et al. (2003), identified studies were grouped into a simple and a complex syllable structure category. Spanish, Greek, and Portuguese were included into the simple syllabic structure category. Only the study performed on Greek language yielded a one factor solution. English, Danish, Norwegian, Dutch, and Swedish were included into the complex syllable structure category. Sixteen studies were conducted on languages with a complex syllabic structure. Eight studies obtained a one- factor solution, while eight obtained multifactorial solutions, and various factorial structures.

Based on Seymour et al. (2003) (with the exception of Serbian), we grouped the studies into a class of orthographic transparent (Greek, Spanish, Serbian*, Norwegian) and opaque orthographies (English and Danish). Dutch, Swedish, and Portuguese are considered semi-transparent. The structure of the PA construct does not seem to differ in relation to the orthographic transparency of the language, as in each class there are multifactorial and unifactorial structures.

Factor structure of Phonological awareness and age

Lastly, based on identified studies, we analyzed whether there is an indication of a different structure of the PA construct as a function of age.

Most of the studies address phonological awareness at a similar point, that is at around 5.5- 7-year-old (kindergarten or first grade entrance).

More consistency is found with regard to grade level. Eleven of the studies are conducted separately on kindergarten samples. Three other studies included kindergarten students in their samples (Mott & Rutherford, 2012; Stahl & Murray, 1994; Schatschneider et al., 1999). In the case of seven studies (from eleven) that had kindergarten samples, phonological awareness was multifactorial. Studies that included kindergarten samples in their overall sample yielded one- factor solutions.

7. Conclusion

The purpose of the study was to collect and analyse scientific data on phonological awareness structure and to investigate whether this structure is in relation to some factors, such as age or language.

Taken together, studies offer equal support for phonological awareness as a multidimensional or a unidimensional construct. Its content is not uniformly agreed upon: holistic vs. analytic, rhyme, syllable, phoneme, only rhyme and phoneme factors etc... Further investigation of the structure of such a critical construct would be needed by means of more refined analytical methodologies, such as the one employed by Wolff and Gustafsson (2015).

However, evidence is gathered on the existence of a syllable factor distinct from rhyme or phoneme. Whether it's a different component (sustained by studies that yielded a syllable factor) or a different level in the development of phonological awareness, given the salience of its extraction in the case of the reviewed studies, we consider it important in relation to phonological awareness. Also, given the number of studies that yielded multiple factors, this result informs the process of content design for phonological awareness tests. As a general observation, syllable was not consistently present in the phonological awareness content.

If there are multiple skills of phonological awareness, one needs to research their importance for the reading and writing acquisition in a particular language. This can further inform the process of designing instruction that addresses components of phonological awareness that are relevant to learning to read in a particular language.

However, results should be interpreted with caution, considering some important limitations of our study.

One limitation is the literature bias. We should extend the search to other library data bases as well as to scientific literature published in other languages, in order to reduce the risk of omitting important studies. Also, search was conducted by only one person and decisions on study selection were not confronted.

Another limitation is given by focusing the review on exploratory and confirmatory factor analytic methodologies.

Further investigation is needed in order to uncover the underlying structure of this critical construct for reading and writing, more specifically in relation to underlying linguistic characteristics (phonological complexity, orthographic transparency etc.) and in the case of literate and pre- literate.

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