Educational Psychology Review
https://doi.org/10.1007/s10648-022-09694-1

META-ANALYSIS

Relation Between the Essential Components of Reading and Reading Comprehension in Monolingual Spanish-Speaking Children: a Meta-analysis

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Accepted: 6 July 2022

Abstract

This meta-analysis aims to quantitatively synthesize the relation between the essential components of reading and reading comprehension in children whose first language is Spanish and who are learning to read in Spanish in a monolingual setting. Searches were conducted in WOS, Scopus, and ERIC from 2000 to 2021. We used a random effects model and Fisher's z as an index of effect size. We found 33 studies involving 146 effect sizes between the essential components of reading and reading comprehension. The essential components included phonological awareness, morphological awareness, alphabetic principle, fluency, vocabulary, and oral comprehension. Results of the meta-analysis revealed that (1) most studies have focused on understanding the relation between phonological awareness or alphabetic principle and reading comprehension, (2) the largest effect sizes were between phonological awareness and reading comprehension, and between fluency and reading comprehension, and (3) there is a large heterogeneity across studies which is explained, in part, by factors such as age, country where the study was conducted, and the reading comprehension tests used. Implications for practice and future research are discussed.

Keywords Comprehension · Meta-analysis · Phonological awareness · Alphabetic principle · Vocabulary · Fluency · Spanish

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Published online: 20 July 2022

Introduction

Reading is an action that includes several simultaneous processes such as recognizing that words are made up of sounds, that those sounds are represented by letters in the alphabet, and that sounds must be linked together to form words using grapheme-phoneme corresponding rules. In addition to reading words accurately in isolation, readers must be able to read words in text accurately, with a certain speed, and with prosody. However, reading words in isolation or within a text is not sufficient for optimal comprehension of the text. To comprehend, the reader must develop his or her vocabulary and have good oral comprehension (Gough & Tunmer, 1986; Caravolas et al., 2019; Vergara et al., 2016, Zevallos-Polo et al., 2017). In other words, reading does not only involve decoding graphic symbols and reading words, but it also involves understanding sentence structures, and interpreting the text according to personal experiences, and the context of texts (Colautti, 2015; Kintsch, 1988).

Purpose of Study

The purpose of this meta-analysis is to quantitatively summarize the strength of the relation between the essential components of reading and reading comprehension in children whose first language is Spanish and who are learning to read in a Spanish monolingual environment. In addition to analyzing the effect sizes of the relation between reading comprehension and the main core components of reading suggested by the National Research Panel (NRP, 2000) in the USA, in this study, we also examined the strength of the relation between reading comprehension and morphological awareness as well as between reading comprehension and oral or linguistic comprehension. Morphological awareness refers to the recognition of units of meaning such as recognizing regular and irregular verbs, pronouns, comparative and superlative adjectives, and derived nouns (Puyuelo et al., 2007). Oral or linguistic comprehension (in this study we will call it oral comprehension) refers, among other skills, to understanding an oral message either by answering questions, pointing out the sequence of events in a story read aloud, or discriminating two sentences read aloud.

Results of this meta-analysis are useful not only for teachers and researchers in Spanish-speaking countries, but also for educators and researchers in the USA where many Spanish-speaking children are taught to read in Spanish in bilingual programs. Often these programs use information about learning to read that is translated literally from English, or they do not consider studies on reading development in Spanish-speaking countries. This may lead to inequities in the education of Spanish-speaking children, given that the models used to teach them to read in Spanish are based more on English-speaking models, and taking the structure of English only into account. Thus, the awareness of the transparency of the Spanish orthographic system, and the characteristics of the Spanish language can lead to a better understanding of the reading development in Spanish monolingual and bilingual children, and to enhanced Spanish (and also English) reading instruction (Baker et al., 2021, 2022a, b; Honig et al., 2018).

Processes to Develop Reading Comprehension in Alphabetic Languages

Numerous studies have confirmed the importance of all the processes described above to be able to read and understand text in the English language particularly after the publication of the report of the NRP (2000) in the USA regarding the importance of teaching the essential components of beginning reading. The NRP pointed out the need to improve teachers' knowledge of these essential components to ensure that all children could be reading by the end of third grade (U.S. Department of Education, No Child Left Behind Act, 2002; Crespo, 2014). Findings from the NRP provided evidence on how explicit and systematic instruction on the essential components of reading could lead to better reading comprehension. Specifically, the NRP addressed the importance of early readers acquiring: phonological awareness skills (i.e., understanding that words are made up of sounds and syllables), phonics skills, (i.e., understanding that letters are symbols for sounds and by combining these letter-sounds one can read words), fluency (i.e., reading words in sentences and texts with a certain speed, prosody, and accuracy), vocabulary (i.e., reading and understanding the meaning of words, particularly words with multiple meanings), and finally, text comprehension (i.e., understanding the literal and inferential messages in the text; Perfetti, 1999). In this study, we will refer to phonics as the alphabetic principle because this construct encompasses all the processes that are necessary to read words such as the recognition of letter sounds, decoding these letter sounds in a word, and encoding the letter sounds to read words accurately and automatically.

The NRP report has been used as a basis for further research on reading development in other countries (Crespo et al., 2018). However, it is still unclear whether the reading components identified by the NRP have the same weight when predicting reading comprehension in transparent orthographies such as Spanish, compared to opaque orthographies such as English (i.e., where letter sound correspondences are more complex and one letter can have multiple sounds depending on the location and the type of letter in a word; Honig et al., 2018). In other words, there are important differences in the structure of the Spanish language versus the English language that might affect the strength of the association between beginning reading components and reading comprehension. For example, Spanish has 30 letters (i.e., including the three diagraphs ll, rr, and ch which have distinct sounds), but between 22 and 24 phonemes. This means that most phonemes correspond to a single letter. On the other hand, English has 26 letters, but between 42 to 44 phonemes, and more than 27 grapheme-phoneme correspondence rules that dictate how a set of letters should be pronounced and read (Honig et al., 2018). Furthermore, syllable patterns in Spanish are very consistent compared to English, and therefore, teachers tend to sometimes teach children to read in Spanish using syllabic patterns only, instead of teaching syllables and letter-sound correspondence rules. Teaching by syllables is not as efficient as teaching students to read words using letter-sound correspondence rules (see Cuetos, 2010, for a more detailed explanation of the difference between teaching to read in Spanish using syllables versus phonemes).

The transparency of the Spanish orthography might lead to Spanish-speaking children recognizing all letter sounds in words more quickly than in English, and

consequently, they might be able to read whole words in isolation or in context earlier than students learning to read in English (Baker et al., 2022a, b). However, Spanish has also many multisyllabic words that require an additional effort by the student to read the multisyllabic word accurately, with prosody, and at a certain speed (e.g., the word *astronauta* [astronaut] has four different syllabic patterns, which makes the word difficult to read fluently unless students have a strong mastery of Spanish letter sounds within syllables). In English, the effort is placed more in learning grapheme-phoneme corresponding rules such as the "silent e" (i.e., when a word ends in e, the first vowel is pronounced as its name such as *kite*). In summary, learning to read in Spanish is not the same as learning to read in English, and understanding how children in Spanish-speaking countries develop their reading skills is important to ensure their mastery of early reading components to allow them then to devote their mental processes to understanding what they read. We hypothesize that there are possible differences in how and when the essential components of reading predict reading comprehension in Spanish compared to English (see also Florit & Cain, 2011; Gottardo et al., 2021; Seymour et al., 2003).

Relation Between Essential Reading Processes and Reading Comprehension

Different models have been proposed to understand the relation between the different processes that are set in motion at the time of reading. For example, Adams (1990) emphasized the orthographic, phonological, semantic, and contextual processes that are necessary to read and comprehend text, suggesting that reading and understanding what one reads is more than just decoding. Perfetti (1999) suggests that phonemic awareness and decoding help children form a mental representation of the words they read. This representation facilitates the reading of these words and helps children read them automatically. The model of the simple view of reading (SVR, Gough & Tunmer, 1986; Hoover & Gough, 1990; Tunmer & Hoover, 2019) suggests that reading is composed of two different processes: decoding and listening comprehension. This model is widely used to teach children to read across countries (Florit & Cain, 2011; Caravolas et al., 2019; Peng et al., 2021).

According to the SVR model, reading is not the sum of decoding and oral comprehension, but the multiplication of them (i.e., reading equals decoding multiplied by oral comprehension). Both processes are necessary to read a text with comprehension and a deficiency in one of them (e.g., decoding or oral comprehension) leads to possible difficulties in learning to read in general. Although this relatively simple model presupposes the development and use of various underlying skills suggested by the NRP, it is not clear how much weight is given to each of these components and subcomponents considering the orthographic transparency of the language. Furthermore, other studies have shown that students who speak English as their native language read pseudowords significantly slower and with more errors than German, a language with a more transparent orthography than English (Wimmer & Goswami, 1994). Similar outcomes were found when pseudoword reading in English was compared to pseudoword reading in Spanish,

French or Greek. These three languages have a more transparent orthography than English (Seymour et al., 2003).

Florit and Cain (2011) conducted a meta-analysis to examine the weight of decoding and oral comprehension on reading comprehension in English compared to languages with more transparent orthographies (i.e., where a sound maps almost directly to a letter) such as Greek, Dutch, and Spanish. Results of this meta-analysis indicated that decoding was the best predictor of reading comprehension in English and in transparent languages. However, oral comprehension appeared to play a more significant role in reading comprehension in transparent languages than in opaque languages, especially the comprehension of academic lexical and semantic structures found in the written word read aloud.

Florit and Cain's (2011) meta-analysis did not address subcomponents of the essential components in reading (e.g., syllabic and phonemic awareness as subcomponents of phonological awareness). Moreover, the authors only identified eight studies that examined the effects between decoding and oral comprehension and reading comprehension in languages with transparent orthographies. These studies used different instruments to measure reading skills, which may have influenced the size of the effect of these processes on reading comprehension (see Ripoll-Salceda et al., 2020). In addition, researchers found only one study in Spanish that met their inclusion criteria. This study was carried out in the USA with Spanish-speaking children learning to read in an English-speaking environment, so it is possible that the effects of decoding and oral comprehension processes on reading comprehension were affected by student knowledge of two languages.

In a more recent study, Caravolas et al. (2019) examined decoding and oral comprehension as precursors of reading comprehension in English and in Spanish, Czech, and Slovak. These last three languages have a more transparent orthography compared to English. Findings indicated that decoding had a direct relation with comprehension in all languages, even longitudinally (e.g., 2 years after decoding was measured). However, for languages with transparent orthographies, oral comprehension played a significant and direct role on decoding and reading comprehension, while in languages with an opaque orthography such as English, oral comprehension was only indirectly related to reading comprehension.

Although the Caravolas et al. (2019) study was not a meta-analysis, it was one of the first longitudinal studies across languages where students with different languages were assessed on a reading assessment that was adapted to each of the languages based on language characteristics. This process allowed for a direct comparison of results. However, the authors did not include other factors that affect the process of learning to read such as the context where students were learning. In addition, the researchers only examined the essential components of beginning reading (e.g., understanding the alphabetic principle), but not its subcomponents as in the current study (e.g., pronouncing letter-sounds, reading words in isolation, reading pseudowords).

Another recent meta-analysis by Peng et al. (2021) found a moderate effect size of the relation between decoding and reading comprehension and between oral comprehension and reading comprehension in Chinese, a morpho syllabic

language in which orthographic symbols represent morphemes and syllables. In this meta-analysis, decoding and listening comprehension explained 52.7% of the variance in reading comprehension. The study also provided further evidence that the SVR model can be used to examine the reading development of students who are learning to read in languages where the alphabet is not the orthographic system.

Moderators of the Relation Between Early Reading Components and Reading Comprehension

In this study, we also examined the effect of age, geographical context, and type of assessment on the relation between early reading components and reading comprehension. None of the studies above considered these moderators except for the Caravolas et al. (2019) study where the authors created the same comprehension assessment in the different languages of participants to make the assessment comparable across languages. Next, we explain our rationale for including these three moderators: age, geographical context, and type of assessment.

First, age can potentially affect when the optimal time is to teach specific reading components, and the sequence of activities to teach these components. For example, according to Perfetti (1999), phonological awareness and decoding have a reciprocal relation, and they are considered the gateway to reading words automatically. Therefore, it makes sense that these components would be taught early and at the same time to maximize the benefit of mastering these skills on reading comprehension in Spanish (see for example Jiménez et al., 2014). On the other hand, developing oral comprehension can start early through read alouds even before children start first grade. However, it is not clear when the strength of the association between oral comprehension and reading comprehension is the strongest in Spanish. In this study we hypothesize that given the transparency of the Spanish orthography, phonological awareness and decoding will have a stronger relation with reading comprehension earlier than other components such as oral comprehension and vocabulary, two components that take time to develop (Authors; National Early Literacy Panel, NELP, 2008).

Second, the geographical context where the study was conducted has also the potential of moderating the relation between early reading components and reading comprehension given that countries have different education systems and different educational philosophies of how social factors affect the reading development (see for example, Vissani et al., 2017). These different philosophies might affect how reading teachers are trained, what components they emphasize during instruction, and what curricular materials they use to teach reading. In addition, differences in socioeconomic status (SES) and ethnicity and cultural background might also affect children's reading development (Espinoza & Rosas, 2019). For example, Spain has a very heterogenous society, where approximately 11% of students in the elementary schools are immigrants either from other European countries or from countries in Africa (Ministerio de Educación de España, 2020–2022. [Department of Education from Spain]). Chile, on the other hand has only 3% of students who are immigrants,

many from other Spanish-speaking countries in Latin America (MINEDUC, 2018). Thus, we hypothesized that geographical context could be a moderator of the relation between early reading components and reading comprehension, because of the potential variability of reading instruction and student characteristics across countries.

Third, results from our literature search revealed that studies used diverse types of reading assessments (e.g., PROLEC, LECTUM) that have been validated with different populations across countries. Therefore, we decided to include type of assessment as a moderator to examine if this variable would also affect the relation between reading components and reading comprehension. Previous studies that have included assessment as a moderator have found a significant moderating effect of assessment on the relation between reading components (see Ripoll-Salceda et al., 2020; Cutting & Scarborough, 2006).

Research Questions

The specific research questions we attempted to answer in this meta-analysis were as follows:

1. What is the effect size of the relation between reading comprehension and each of the essential reading components identified by the NRP in Spanish monolingual children between the ages of 5 and 12?
2. What is the effect size of the relation between oral comprehension and reading comprehension, and between morphological awareness and reading comprehension in Spanish monolingual children between the ages of 5 and 12?
3. Do the moderators of age, geographical context, and type of testing influence the relation between the essential components of reading and reading comprehension?

For questions 1 and 2, we hypothesized that the strength of the relation between reading components, subcomponents, and reading comprehension would be strong given previous reviews indicating the strong relation between components in different alphabetic languages such as English and Finnish, (Caravolas et al., 2019; Seymour et al., 2003), and even in morpho syllabic languages such as Chinese (Peng et al., 2021). We clarify that the intention of this study was not to compare the strength of the relation between early reading components and reading comprehension across languages, but to focus on this relation in Spanish only.

For question 3, we hypothesized that age, geographical context, and type of assessment could moderate the effect of the relation between early reading skills and reading comprehension in Spanish given the characteristics of the Spanish orthographic system, the differences in the geographical context where studies were conducted, and the diverse types of reading comprehension measures used across studies.

However, it is beyond the scope of this meta-analysis, to examine which specific aspects of the moderators influenced the relation between essential reading components, subcomponents, and reading comprehension. Thus, question #3 is exploratory in nature and it is intended to determine if our hypothesized moderators affect the relation between early reading components and reading comprehension. To our knowledge, this is the first study that provides a thorough analysis of studies that have examined the strength of the relation between early reading components and subcomponents and reading comprehension in Spanish, the second most widely spoken language in the world (Berlitz, 2022).

Method

Search and Inclusion of Articles

To identify relevant studies, we followed the guidelines suggested by Ripoll-Salceda et al. (2014) and Sánchez-Meca (2010). These guidelines involved (1) the search for references in the literature on the topic: reading predictors, (2) the search in the following databases: World of Science (WOS), Scopus, and Education Resources Information Center (ERIC). We limited our search to studies published between 2000, the year the NRP published their report and September 2021. The search terms used were "reading comprehension," "phonological awareness and Spanish," "reading comprehension and pseudoword reading and Spanish," "reading comprehension and reading fluency and Spanish," "reading comprehension and decoding and Spanish," "reading comprehension and Spanish," "reading comprehension and vocabulary and Spanish," "reading comprehension and Syllabic awareness and Spanish."

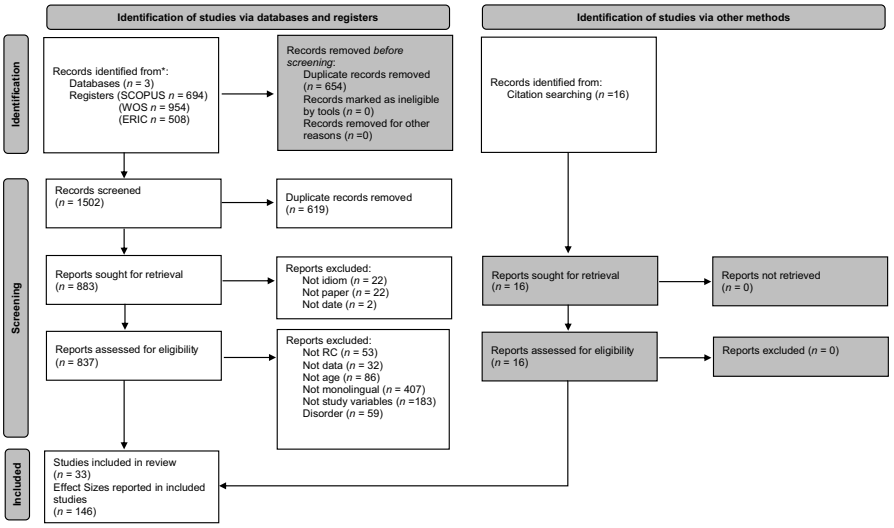

Fig. 1 PRISMA 2020 flow diagram for our meta-analysis

We also conducted a manual search of bibliographic references in the studies found through the databases. In case an article was not found, we emailed the author to obtain a copy of the study. Figure 1 illustrates the flow diagram we followed based on the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2021).

Eligibility Criteria

A study was considered eligible for further review if they included the following: (1) The sample had to consist of monolingual students in Spanish attending elementary school (i.e., they were between 5 and 12 years old). (2) The study had to measure the variable reading comprehension and other components related to reading acquisition that can be taught in a school setting. (3) Participants in the studies did not have any identified reading difficulties. (4) The study was published between 2000 and 2021; (5) The study was published in a peer-reviewed journal in English and/or in Spanish.

Coding of the Information

Once we completed the search process, we coded the studies that met the established criteria. Three authors participated in this process (AA, BB, and CC), and in case of doubt, we included a fourth author. Next, 2 authors (AA and BB) proceeded to analyze the quality of the studies. If there was a discrepancy in the inclusion criteria, this was clarified between all the investigators and by a more detailed review of the study. Only data indicating a correlation between the reading components and reading comprehension were collected. We excluded all data that had a correlation between working memory, or other cognitive aspect and reading comprehension, because the focus of this meta-analysis was to investigate reading components that could be taught in a classroom setting. Table 1 includes the variables that we used to code the selected studies (e.g., geographical context, participants, age, reading components and subcomponents, correlations between the subcomponent and reading comprehension, instruments to measure reading comprehension, and study design).

If a study included the main reading components and various subcomponents within each component, we reported the relation between the subcomponent and reading comprehension or between various tasks within a component and reading comprehension as illustrated in Table 2. Likewise, if the results reported data from more than one time point, we chose the data from the first contact with the participants and the last contact with the participants where reading comprehension was assessed. If more than one study included the same participants, we only included one of the studies. The selection of the relevant results of each study was made by consensus among three of the authors (AA, BB, and CC). Although selecting studies published in peer-reviewed journals may have limited our search, we decided to choose only published studies because they are easier to find for teachers and educational administrators interested in learning more about research on the relation between components of reading and reading comprehension (Authors).

Table 1 Description of Studies Included in the Meta-analysis

Study	Country	*N*	Average age	Component	Sub-component	*r*	Assessment Tool	Design
Calet et al. (2015)	Spain	51	6–8	Fluency	Prosody	.61	PROLEC	Cross sectional
			9–12	Alphabetic principle	Word reading in isolation	.40		
			6–8	Alphabetic principle	Pseudoword reading	.58		
			9–12	Alphabetic principle	Pseudoword reading	.32		
			6–8	Alphabetic principle	Word reading in isolation	.46		
Calet et al. (2016)	Spain	92	9–12	Vocabulary	Expressive	.28	WC	Cross sectional
				Phonological awareness	Phonemic awareness	.30	WC	
				Alphabetic principle	Word reading in isolation	.70	PROLEC	
Calet et al. (2020)	Spain	139	9–12	Alphabetic principle	Word reading in isolation	.22	ACL	Cross sectional
				Alphabetic principle	Pseudoword reading	.22		
Clinton et al. (2013)	Colombia	57	5–6	Phonological awareness	Phonemic awareness (sound similarity)	.60	WC	Cross sectional
				Phonological awareness		.46		
				Phonological awareness	Phonemic awareness (sound category)	.76		
					Phonemic awareness (omission)			
Caravolas et al. (2019)	Spain	188	6–8	Alphabetic principle	Letter knowledge	.32	Gates-MacGinitie	Longitudinal
			5–6	Phonological awareness	Phonemic awareness (blending)	.20		
			5–6	Phonological awareness	Phonemic awareness (isolation)	.33		
			5–6	Morphological awareness	Various tasks (noun, verb phrases)	.40		
			5–6	Oral comprehension	Relation of sentence to picture	.35		
			5–6	Alphabetic principle	Word reading in isolation	.27		
			6–8	Alphabetic principle	Word reading in isolation	.53		
			5–6	Alphabetic principle	Pseudoword reading	.45		
D'Alessio et al. (2019)	Argentina	125	9–12	Phonological awareness	Phonemic awareness	.27	LEE	Cross sectional
De la Calle et al. (2016)	Spain	126	6–7	Phonological awareness	Various tasks	.45	LEE	Cross sectional
				Phonological awareness	Rhyme	.01		
				Phonological awareness	Syllabic awareness (syllable count)	.34		
				Phonological awareness		.29		
					Syllabic awareness (omission)			

Table 1 (continued)

Study	Country	*N*	Average age	Component	Sub-component	*r*	Assessment Tool	Design
De Mier et al. (2012)	Argentina	48	6–8	Alphabetic principle	Word reading in isolation	.50	LEE	Cross sectional
				Fluency	Speed	.52		
				Alphabetic principle	Letter knowledge	.19		
				Alphabetic principle	Letter knowledge	.03		
				Alphabetic principle	Word reading in isolation	.33		
				Fluency	Speed	.18		
				Fluency	Speed	.34		
Escobar and Rosas (2018)	Chile	110	6–8	Alphabetic principle	Word reading in isolation	.77	WC	Cross sectional
				Fluency	Speed	.71		
Ferroni (2020)	Argentina	42	9–12	Alphabetic principle	Word reading in isolation	.49	ADHOC (Adapted PRO-LEC Readings)	Cross sectional
		42		Fluency	Accuracy	.43		
		42		Vocabulary	Receptive	.45		
		42		Vocabulary	Expressive	.41		
		42		Oral comprehension	Relation of sentence to picture	.36		
		19		Alphabetic principle	Word reading in isolation	.35		
		19		Fluency	Accuracy	.14		
		19		Vocabulary	Receptive	.00		
		19		Vocabulary	Expressive	.78		
		19		Oral comprehension	Relation of sentence to picture	.43		
Figueroa-Sepúlveda & Gallego-Ortega (2021)	Chile	98	6–8	Vocabulary	Receptive	.29	CLP	Cross sectional
		108	9–12	Vocabulary	Receptive	.17		
		108	9–12	Vocabulary	Receptive	.46		
Fumagalli et al. (2017)	Argentina	172	9–12	Fluency	Speed	−.37	ADHOC (Various Readings)	Cross sectional
				Alphabetic principle	Word and pseudoword reading	.33		
				Phonological awareness	Various tasks	.16		
Gómez-Velázquez et al. (2010)	México	121	6–7	Alphabetic principle	Letter Knowledge	−.28	ENI	Longitudinal (1 year)

Table 1 (continued)

Gutiérrez et al. (2020)	Spain	183	5–6	Phonological awareness Vocabulary Alphabetic principle Alphabetic principle	Phonemic awareness Expressive Letter knowledge (name) Letter knowledge (sound)	.73 .07 .03 .71	EGRA	Longitudinal (1 year)
Infante et al. (2012)	Chile	73 72	6–8 9–12	Oral comprehension Oral comprehension	Comprehension of read alouds Comprehension of read alouds	.53 .13	ADHOC	Cross sectional
Jiménez and Ortiz (2000)	Spain	136	5–6	Alphabetic principle Phonological awareness Phonological awareness Alphabetic principle Phonological awareness	Word reading in isolation Phonemic awareness Phonemic awareness Pseudoword reading Syllabic awareness	−.57 .60 .52 −.53 .31	TALE	Longitudinal (2 years)
Jiménez et al. (2014)	Spain	400	6–8	Phonological awareness Alphabetic principle Alphabetic principle Fluency Oral comprehension Alphabetic principle	Phonemic awareness Word reading in isolation Pseudoword reading Speed Comprehension of read alouds Letter knowledge	.58 .70 .66 .69 .2 .58	EGRA	Longitudinal (1 year)
Kim and Pallante (2012)	Chile	468	6–7	Vocabulary Alphabetic principle Alphabetic principle	Expressive Word reading in isolation Pseudoword reading	.24 .71 .59	WC	Longitudinal (1 year)

Table 1 (continued)

Lazaro et al. (2021)	Chile	24 24 24 24 30 30 30 30	9–12	Morphological awareness Vocabulary Phonological awareness Alphabetic principle Morphological awareness Vocabulary Phonological awareness Alphabetic awareness	Various tasks (8 morphological tasks) Receptive Various tasks (sound/syllable tasks) Word reading in isolation Various tasks (8 morphological tasks) Receptive Various tasks (sound/syllable tasks) Word reading in isolation	.77 .72 .67 .67 .45 .58 −.14 .07	PROLEC	Cross sectional
Lopez-Escribano (2007)	Spain	29	8–13	Alphabetic awareness Alphabetic awareness Fluency	Word reading in isolation Pseudoword reading Speed	.16 −.05 .15	PROLEC	Cross sectional
López-Escribano (2012)	Spain	100	6–7	Phonological awareness Phonological awareness Alphabetic principle Vocabulary	Phonemic awareness (deletion) Phonemic awareness (blending) Word reading in isolation Expressive	.28 .30 .45 .41	WC	Cross sectional

Table 1 (continued)

López-Escribano et al. (2013)	Spain	33	8–9	Alphabetic principle Alphabetic principle Alphabetic principle Alphabetic principle Vocabulary	Word reading in isolation (accuracy) Word reading in isolation (speed) Pseudoword reading (accuracy) Pseudoword reading (speed) Expressive	.15 −.34 .03 −.37 .37	PROLEC	Cross sectional
López-Escribano et al. (2018)	Spain	77	6–8	Phonological awareness Fluency Vocabulary	Various tasks Speed Expressive	.41 .26 .55	LEE	Cross sectional
López-Escribano and Katzir (2008)	Spain	38	8–13	Alphabetic principle Alphabetic principle Fluency	Word reading in isolation Pseudoword reading Speed	.40 .09 .22	PROLEC	Cross sectional
Pérez-Pereira et al. (2020)	Spain	142 142 142 142 142 142 126 126	6–8	Oral comprehension Oral comprehension Alphabetic principle Alphabetic principle Vocabulary Alphabetic principle Phonological awareness Phonological awareness	Relation of sentence to picture Relation of sentence to picture Letter knowledge Pseudoword reading Receptive Word reading in isolation Phonemic awareness Syllabic awareness	−.13 .14 .14 .07 .02 .14 .13 .13	PROLEC	Longitudinal

Table 1 (continued)

Riffo et al. (2018)	Chile	28	6–8	Phonological awareness Phonological awareness Phonological awareness Phonological awareness Phonological awareness Phonological awareness Phonological awareness Vocabulary Fluency Fluency Fluency Fluency	Various tasks (average) Syllabic awareness (syllabic segmentation) Syllabic awareness (syllabic analysis) Syllabic awareness (syllabic inclusion) Syllabic awareness (first sound isol.) Phonemic awareness (sound segment.) Phonemic awareness (sound blending) Receptive Speed Prosody Accuracy Various tasks (average)	.71 .30 .24 .57 .25 .66 .64 .62 .80 .67 .33 .72	LECTUM	Cross sectional
Rodríguez-Ortiz et al. (2021)	Spain	273	9–12	Alphabetic principle Alphabetic principle Vocabulary Morphological awareness Oral comprehension	Word reading in isolation Pseudoword reading Receptive Morphological knowledge Relation of sentence to picture	.30 .22 .40 .25 .44	LEE	Cross sectional

Table 1 (continued)

Rosselli et al. (2006)	Various countries	625 100 625 625 625 625 625 625	9–12	Phonological awareness Phonological awareness Phonological awareness Phonological awareness Phonological awareness Phonological awareness Phonological awareness Phonological awareness	Spelling Phonemic awareness (Ph. synthesis aloud) Phonemic awareness (sound counting) Word count Spelling (silent comprehension) Phonemic awareness (Ph. synthesis silent) Phonemic awareness (syll. com. sound count.) Word count	.22 .21 .09 .18 .37 .36 .20 .29	ENI	Cross sectional
Simpson et al. (2020)	Spain	234	9–12	Alphabetic principle Morphological awareness Alphabetic principle Vocabulary Oral comprehension	Word reading in isolation Morphological knowledge Pseudoword reading Receptive Relation of sentence to picture	.19 .17 .11 .38 .36	LEE	Cross sectional
Vargas et al. (2020)	Perú	126	7–8	Phonological awareness Phonological awareness Phonological awareness Phonological awareness	Various Tasks Phonemic Awareness Syllabic Awareness Phonemic Awareness (Intrasyll. Awareness)	.68 .65 .61 .64	PROLEC	Cross sectional

Table 1 (continued)

Rodriguez-Vega et al. (2017)	Chile	36	9–12	Morphological awareness Morphological awareness Morphological awareness Morphological awareness Morphological awareness	Make up words Finish sentences Make up words Find the root of a word Various tasks	.33 .53 .52 .50 .66	CLP	Cross sectional
Vergara et al. (2016)	Chile	202	6–8	Vocabulary Oral comprehension Phonological awareness	Expressive Comprehension of read alouds Various tasks (rhyme and omission)	.12 .31 .36	LEE	Cross sectional
Zevallos-Polo et al. (2017)	Ecuador	87	9–12	Oral comprehension Oral comprehension Alphabetic principle Alphabetic principle	Relation of sentence to picture Comprehension of read alouds Word and pseudoword reading (accuracy) Word and pseudoword reading (speed)	.46 .51 .32 −.31	CLP	Cross sectional

In the column called Instrument, the tests used to assess reading skills are indicated. The column labeled Average age indicates the age of participants

LEE Reading and Writing in Spanish, *EGRA* Early Grade Reading Assessment, *WC* Woodcock-Muñoz Language Survey – Revised, *TALE* Reading and Writing Analysis Test, *PROLEC* Assessment of Reading Processes, *CLP* Comprehension Progressive Linguistic Complexity Reader, *ENI* Child Neurological Assessment, *GATES-MacGINITIE* Adaptation of the Gates MacGinitie Reading Comprehension Test to Spanish

Moderator Analysis

We also examined specifically the effects of three moderators on outcomes: (a) the age of the participants, (b) the geographical context in which the study was conducted, and (c) the instrument used to measure reading comprehension. Regarding differences in participant ages, we decided to group students by the following age criteria: 5–6 years old, 6–8 years old, and 9–12 years old.

In the case that a study offered a joint score for children of different ages within a group, the score was included in the age category in which the mean age was included. If a study offered different scores according to age groups, all scores were included (e.g., see Figueroa-Sepúlveda & Gallego-Ortega, 2021; Lázaro et al., 2021).

Meta-Analysis

We used the Comprehensive Meta-Analysis software (CMA Version 3.3.070) to examine the correlation of components, subcomponents, and reading comprehension. The effect size metric used was Pearson's correlation coefficient (r). We extracted for each correlation, the value of r or an estimate that could be converted to a correlation. To accurately account for each study's weight based on its sample size, Pearson's r was converted to Fisher's z, and all analyses were performed using Fisher's z values (Borenstein et al., 2021). Then, the effect size and 95% confidence interval (CI) were transformed back to Pearson's r using the equation $[r = (e2z - 1)/(e2z + 1)]$ for easy interpretation. Due to the variability of the studies, we analyzed random-effects models to examine the pooled effect size (Hall & Rosenthal, 2018). We used Cohen's (1988, 1992) guidelines to assess effect sizes with 0.10, 0.30, and 0.50 representing low, medium, and large effects, respectively. We estimated the effect size heterogeneity using Cochrane's Q test and the I^2 statistic. We assessed publication bias using a funnel plot, Begg's and Mazumdar (1994) rank correlation test, and Egger's et al. (2003) regression asymmetry test.

Results

Selection of Studies

As can be seen in Fig. 1, we found 33 studies that followed our established parameters. Most of the articles were discarded for the following reasons: the reading comprehension measure was not reported, the sample did not meet our established criteria, or the data were incomplete making it impossible to calculate the relation between predictors and reading comprehension. The total number of participants in all studies was 21,097 between the ages of 5 and 12 years old. Four of the studies were longitudinal within 1 year and two were longitudinal over 1 year (i.e., the same children were assessed over several school years).

As indicated in Table 1, 33 articles met the inclusion criteria and were included for analysis, 16 of these were carried out in Spain, corresponding to 48% of the studies analyzed. The rest of the studies reviewed were conducted in Latin American countries including Chile (8), Argentina (4), Peru (1), Colombia (1), Ecuador (1), Mexico (1), or in a combination of several countries (1).

Regarding the reading assessments, eight studies used the Batería de Evaluación de los Procesos Lectores—Revisada (PROLEC-R; Cuetos et al., 2007), seven studies used the Spanish Reading and Writing Test (LEE; Defior-Citoler et al., 2006; Citoler et al., 2006), five studies used the Woodcock-Muñoz Battery III (Muñoz-Sandoval et al., 2009), and three studies used the CLP (Reading Comprehension of Progressive Linguistic Complexity, Alliende et al., 2007). Appendix 1 provides a summary of the characteristics of the reading comprehension measures.

Estimated Effect Sizes

Based on the 33 studies that met our inclusion criteria, a total of 146 effect sizes were reported. Most of the reports were found in studies with children ages 6–8 ($n=9054$), and 9–12 ($n=8280$). The overall mean of all effects according to Cohen (1988) is moderate and significant ($r=0.41$). Table 2 presents the effect sizes according to the components and subcomponents predicting reading comprehension. Table 3 shows the effect sizes of the relation between each of the essential components of reading and reading comprehension by age. We summarize our findings by component, subcomponent, and by age.

Phonological Awareness

The relation between phonological awareness and reading comprehension was one of the most researched relations in the studies included in this meta-analysis. The total number of students who participated in these studies was 16,909. As indicated in Table 2, 44 effect sizes of the relation between phonological awareness and reading comprehension were calculated out of a total of 146 effect sizes. The effect sizes were medium ($r=0.42$; 95% CI: 0.35, 0.49; $k=44$), and heterogeneous (Q [43] = 393.42, $p<0.001$, $I^2=89.07$).

To better understand the source of this heterogeneity, six subcomponents of phonological awareness emerged in the analysis (i.e., syllabic awareness, phonemic awareness, counting words in a sentence, rhyming, spelling, and the combination of various phonological awareness tasks such as isolating and blending sounds and syllables) were analyzed. As can be seen in Table 2, phonemic awareness ($k=23$; $n=9752$) and various tasks ($k=8$; $n=785$) have a moderate and significant effect size ($r=0.47$). Syllabic awareness has also a medium and significant, but smaller effect size ($r=0.37$; $k=8$).

Table 3 shows the effect sizes by age. For example, the relation between phonological awareness and reading comprehension is strong for students in the 5–6 age range, but it becomes weaker as students get older. Specifically, the effect size between phonological awareness and reading comprehension is large for children

Table 2 Average effect sizes between reading components, subcomponents, and reading comprehension

Variable	Effect sizes (ES) and confidence intervals (IC -95%)						
	K	*ES*	*p*	Lower limit	Upper limit	*Q*	I^2
Phonological awareness	44	.42	.00	0.35	0.49	393.42***	89.07
Syllabic awareness	8	.37	.00	0.22	0.52	24.83***	71.81
Phonemic awareness	23	.47	.00	0.36	0.58	265.11***	91.70
Word count	2	.24	.00	0.13	0.36	4.31*	76.80
Rhyme	1	.01	.89	-0.16	0.19	00.00	00.00
Spelling	2	.30	.00	0.15	0.46	7.88*	87.31
Various tasks	8	.47	.00	0.27	0.67	49.09***	85.74
Morphological awareness	6	.40	.00	0.24	0.57	20.40**	75.50
Alphabetic principle	46	.39	.00	0.30	0.49	557.17***	91.92
Word reading in isolation	24	.45	.00	0.31	0.58	267.98***	91.42
Pseudoword reading	14	.34	.00	0.19	0.50	157.94***	91.77
Letter knowledge	8	.33	.00	0.10	0.56	114.24***	93.87
Fluency	16	0.47	.00	0.22	0.71	230.15***	93.48
Speed	10	.41	.02	0.07	0.75	218.62***	95.88
Accuracy	3	.36	.00	0.14	0.58	1.18***	00.00
Prosody	2	.74	.00	0.51	0.97	0.16	00.00
Various tasks	1	.90	.00	0.51	1.29	0.00	00.00
Vocabulary	21	.36	.00	0.27	0.45	77.83***	73.30
Expressive	9	.34	.00	0.21	0.48	34.53***	76.83
Receptive	12	.38	.00	0.26	0.49	38.51***	71.44
Oral comprehension	13	.32	.00	0.21	0.43	61.02***	80.34
Comprehension of read alouds	5	.35	.00	0.18	0.51	17.67**	77.36
Relation of sentences to pictures	8	.31	.00	0.15	0.46	43.10***	83.76
Total	146	.41	.00	0.32	0.51	1483.18***	90.22

Only categories with more than one effect are indicated. K = number of effects found; Q = the Q statistic is a chi-square statistic; I^2 is a proportion of unexplained variance ($Q - df/Q$). Significance: $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$

ages 5–6 ($r = 0.58$; 95% CI: 0.38, 0.77; $k = 9$), medium high for children ages 6–8 ($r = 0.45$; 95% CI: 0.34, 0.56; $k = 23$), and small for children ages of 9–12 ($r = 0.25$; 95% CI: 0.18, 0.33; $k = 12$).

Morphological Awareness

Five studies reported 6 effect sizes for the relation between morphological awareness and reading comprehension. Most of the studies were conducted with children ages 9–12. The effect size was medium ($r = 0.40$; 95% CI: 0.24, 0.57; $k = 6$) and heterogeneous (Q [5] = 20.40, $p < 0.01$, $I^2 = 75.50$).

Alphabetic Principle

Regarding the alphabetic principle, 46 effect sizes were found, which in combination were all medium and significant ($r=0.39$; 95% CI: 0.30, 0.49; $k=46$), and heterogeneous (Q [45] = 557.17, $p<0.001$, $I^2=91.92$). To better understand the source of this heterogeneity, we analyzed the effect sizes of the relation between reading comprehension and each of the following subcomponents: single word reading, pseudoword reading, and letter knowledge. Many studies examined the relation between reading words in isolation and reading comprehension ($k=24$; $n=2346$) with a medium–high effect size ($r=0.45$), followed by pseudoword reading with a medium–low effect size ($r=0.34$; $k=14$), and finally letter knowledge with an effect size similar to that of pseudoword reading ($r=0.33$; $k=8$). Letter knowledge includes tasks where students can say either the name or the sound of the letter, or a combination of the two.

We also found a decrease in the relation between the alphabetic principle and reading comprehension as age increased. Thus, we found a medium–high effect size between alphabetic principle and reading comprehension ($r=0.48$; 95% CI: 0.25, 0.72; $k=6$) in children ages 5–6, a medium effect size in children ages 6–8 ($r=0.43$; 95% CI: 0.30, 0.56; $k=23$), and a medium–low effect size in the 9 to 12 year old age group ($r=0.31$; 95% CI: 0.17, 0.45; $k=17$).

Fluency

Sixteen reports on the relation between fluency and reading comprehension were found in a total of 10 studies involving 1143 students. Most studies measured fluency through reading speed ($k=10$). The effect size of fluency on reading comprehension was medium–high ($r=0.47$; 95% CI: 0.22, 0.71; $k=16$), and heterogenous (Q [15] = 230.15, $p<0.001$ and $I^2=93.48$). The effect size of the relation between reading speed, a subcomponent of fluency, and reading comprehension was medium and significant ($r=0.41$; 95% CI: 0.07, 0.75; $k=10$). The effect size of the relation between accuracy and reading comprehension was medium–low ($r=0.36$; 95% CI: 0.14, 0.58; $k=3$), but the effect size of the relation between prosody and reading comprehension was large ($r=0.74$; 95% CI: 0.51, 0.97; $k=2$) for 6–8-year-old children.

In analyzing the data by age group, findings indicate that most of the studies that examined the relation between reading fluency and reading comprehension focused on the reading fluency of children ages 6 to 8. The effect size was large and significant in this age group ($r=0.63$; 95% CI: 0.45, 0.80; $k=11$), while in the 9 to 12 years old group the effect size was small and not significant ($r=0.10$; 95% CI: -0.28, 0.49; $k=5$).

Vocabulary

The relation between vocabulary and reading comprehension was analyzed in 15 studies yielding 22 effect sizes involving 2322 children. The effect size was

medium and significant ($r = 0.36$; 95% CI: 0.27, 0.45; $k = 21$), and heterogenous (Q [20] = 77.83, $p < 0.01$; $I^2 = 73.30$). Regarding the relation between vocabulary subcomponents and reading comprehension, the effect size was medium and significant for both expressive vocabulary ($r = 0.34$; $k = 9$) and receptive vocabulary ($r = 0.38$; $k = 12$). The effect size of the relation between vocabulary and reading comprehension was medium and significant among students ages 6–8 ($r = 0.31$; k = 9) and 9–12 ($r = 0.44$; $k = 11$). We found only one study that examined the relation between vocabulary and reading comprehension for children ages 5–6 (Gutiérrez et al., 2020).

Oral Comprehension

The last component analyzed was oral comprehension, with 13 reports of effect sizes in 9 studies in which 1628 students participated. The mean effect size of the relation between oral comprehension and reading comprehension was medium and significant ($r = 0.32$; 95% CI: 0.21, 0.43; $k = 13$), and heterogenous (Q [12] = 61.02, $p < 0.01$, $I^2 = 80.34$). The effect size of the relation between oral comprehension and

Table 3 Average effects grouped by age

Age	Effect sizes (ES) and confidence intervals (IC -95%)						
	K	*ES*	*p*	Lower limit	Upper limit	*Q*	I^2
5–6	18	.49	.00	0.36	0.62	193.75***	91.23
Phonological awareness	9	.58	.00	0.38	0.77	78.32***	89.79
Morphological awareness	1	.42	.00	0.28	0.57	00.00	00.00
Alphabetic principle	6	.48	.00	0.25	0.72	79.36***	93.70
Vocabulary	1	.07	.35	−0.07	0.21	00.00	00.00
Oral comprehension	1	.36	.00	0.22	0.51	00.00	00.00
6–8	71	.44	.00	0.38	0.50	816.37***	91.43
Phonological awareness	23	.45	.00	0.34	0.56	167.84***	86.89
Fluency	11	.63	.00	0.45	0.80	51.43***	8.56
Alphabetic principle	23	.43	.00	0.30	0.56	296.52***	92.58
Vocabulary	9	.31	.00	0.19	0.43	30.40***	73.68
Oral comprehension	5	.26	.00	0.13	0.36	13.20***	69.70
9–12	60	.33	.00	0.26	0.40	278.44***	78.81
Phonological awareness	12	.25	.00	0.18	0.33	54.36***	79.76
Morphological awareness	5	.41	.00	0.20	0.62	17.25***	76.81
Fluency	5	.10	.38	−0.28	0.49	32.34***	87.63
Alphabetic principle	17	.31	.00	0.17	0.45	56.86*	71.86
Vocabulary	11	.44	.00	0.32	0.56	24.58	59.32
Oral comprehension	7	.42	.00	0.32	0.51	9.39*	36.12

Only categories with more than one effect are indicated. K = number of effects found; Q = the Q statistic is a chi-square statistic; I^2 is a proportion of unexplained variance ($Q - df/Q$). Significance: *$p < .05$; **$p < .01$; ***$p < .001$

reading comprehension was low in students ages 6–8 ($r=0.26$; 95% CI: 0.13, 0.36; $k=5$), but medium in students ages 9 to 12 ($r=0.42$; 95% CI: 0.32, 0.51; $k=7$).

Publication Bias

To check for publication bias, we applied the Egger test (Sterne & Egger, 2005) to the effect size calculated on the overall computation of each component. Only the oral comprehension component showed a bias confirmed by Egger's test, which yielded a statistically non-significant p-value ($p=0.19$). All other correlations did not appear to be biased. In addition, no significant publication bias was identified by our funnel plot (Fig. 2) and Egger's regression test, The Duval and Tweedie 'trim and fill' method suggested that seven studies were potentially missing and, if imputed, the overall summary effect would drop to 0.37 (95% CI 0,33 to 0.42).

Meta-regression

We also conducted a fixed and random effects meta-regression analysis to identify the effect of moderators on the relation between the essential components of reading and reading comprehension. First, we examined the moderating effect of age by analyzing the relation between essential components and reading comprehension for children ages 5–6 years old, 6–8 years old, and 9–12 years old. Considering the 5–6 age range as the reference ($Z=23.76$; $p<0.001$), correlations were higher for studies with students in the 6–8 age range ($Z=0.45$; $p=0.652$), and lower for studies with students in the 9–12 age range ($Z=$-8.44; $p<0.001$). The joint effect of age was significant in the model ($Q=195.79$[2], $p<0.001$), and the variability between studies was reduced by 13%, ($R^2=0.12$) when taking age into account.

Second, we examined the moderating effect of geographical context on the relation between essential reading components and reading comprehension. Taking Spain as the reference, geographical context had a positive moderating effect when the studies were conducted in Chile ($Z=5.62$; $p<0.001$), Colombia ($Z=4.71$; $p<0.001$), or Peru ($Z=8.19$; $p<0.001$), but a negative effect when the studies were conducted in Argentina ($Z=-3.16$; $p<0.001$) or Mexico ($Z=-0.56$; $p=0.577$). The joint effect of geographical context was significant in the model ($Q=293.30$[8], $p<0.001$), and the variability between studies was reduced by 15% ($R^2=0.15$) when taking geographical context into account.

Third, we examined the moderating effect of measurement instruments to assess reading comprehension. Findings indicated that correlations between essential components and reading comprehension were sometimes higher, and other times lower than our reference measure, the PROLEC. For example, correlations were higher in studies that used the Early Grade Reading Assessment (EGRA; RTI International, 2009, $Z=10.56$; $p<0.001$), the LECTUM (Riffo et al., 2011; $Z=5.04$; $p<0.001$), the Test de Análisis de la Lectoescritura (TALE; Toro & Cervera, 1980; $Z=5.19$; $p<0.001$) and the Woodcock Muñoz (WC; Muñoz-Sandoval et al., 2009; $Z=8.43$; $p<0.001$).

On the other hand, studies that used the ADHOC ($Z = -3.85$; $p < 0.001$) and the Neuropsychological Evaluation of Infants test (ENI; Matute et al., 2007; $Z = -3.67$; $p < 0.001$) instruments, correlations were lower than the reference measure, the PROLEC. The joint effect of assessment instruments was significant in the model ($Q = 484.00[10]$, $p < 0.001$). The variability between studies was reduced by 29% ($R^2 = .29$) when taking type of reading comprehension assessment into account.

Discussion

The purpose of this meta-analysis was to understand the strength of the relation between the essential components and subcomponents of reading and reading comprehension in children whose first language is Spanish and who are learning to read in a Spanish monolingual environment. We examined specifically, the effect sizes of six reading components (i.e., phonological awareness, alphabetic principle, fluency, vocabulary, morphological awareness, and oral comprehension), their subcomponents, and reading comprehension. In addition, we explored the role of age, geographical context, and type of reading comprehension assessment as moderators of the relation between early reading components and reading comprehension. We discuss these findings in the context of our theoretical frameworks and the moderators we included.

Age as a Moderator of the Relation Between Reading Components and Reading Comprehension

Results of our analyses of studies indicated that (1) the effect size of the relation between phonological awareness and reading comprehension is medium and significant, in students in the 5 to 8 age range; (2) the effect size of the relation between the alphabetic principle and, within this, the reading of isolated words, is medium and significant in students in the 5–6 and 6–8 age ranges; (3) the effect size of the relation between fluency and reading comprehension is large and significant in students in the 6–8 age range, but very small and not significant in students in the 9–12 age range; and (4) the relation between reading comprehension and listening comprehension, morphological awareness and vocabulary have the largest effect sizes in students in the 9–12 age range compared to the other age groups.

These results indicate that certain subcomponents might develop, at certain age ranges, and that not all components and subcomponents have the same correlation with reading comprehension. Regarding phonological awareness, the phonemic awareness subcomponent has the highest effect size on reading comprehension compared to the other subcomponents in children between 5–6 and 6–8 years old indicating that phonemic awareness is a strong contributor to reading comprehension in Spanish. This finding is important because it provides additional evidence that phonemic awareness, and not just syllabic awareness, should be taught in

Spanish, contrary to what many teachers have learned and experienced. Cuetos (2010), for example, suggests that if we only teach syllabic awareness to students, they will need to learn more than 945 different syllabic patterns compared to learning approximately 30 letter sound corresponding rules. The evidence of the strong relation between phonemic awareness and reading comprehension is based on more than 23 reports.

We also found that a set of phonological awareness tasks (e.g., isolating and combining syllables, phonemes, and rhyming) are better predictors of reading comprehension than each task considered separately. This finding, however, should be taken with caution, as studies are scarce to generate a clear practical interpretation of which tasks in the above combination are to be prioritized or taught.

Regarding the alphabetic principle, this component has a moderate correlation with reading comprehension in students in the 5–6 and 6–8 age ranges, similar to phonological awareness. However, the alphabetic principle component is also moderately correlated with reading comprehension even for students in the 9–12 age range, suggesting that understanding the alphabetic principle is a moderate to strong contributor to reading comprehension. Moreover, in transparent orthographies such as Spanish, the relation between phonological awareness and the alphabetic principle tends to be strong and supportive of each other. For example, students who have a good grasp of letter-sound correspondence in Spanish, might also likely have strong phonological awareness skills and spelling skills because they do not have to memorize high frequency words and learn more than 27 grapheme-phoneme corresponding rules as children learning to read in English (Author, Honig et al., 2018). This hypothesis, however, would need to be explored further.

The relation between reading comprehension and word reading in isolation has the largest effect size, compared to the relation between reading comprehension and pseudoword reading or letter knowledge. A potential reason for the medium high

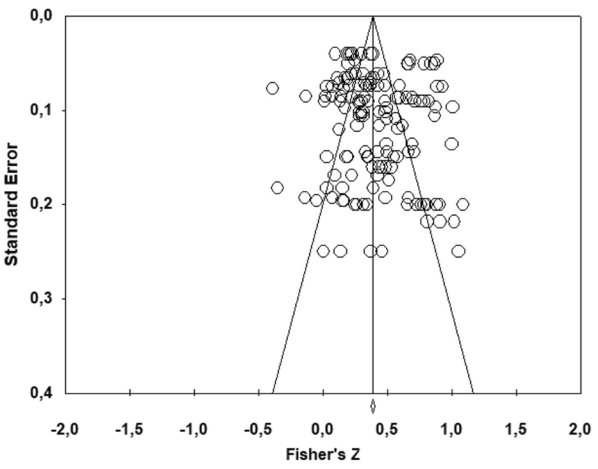

Fig. 2 Funnel plot

effect size between words read in isolation and reading comprehension is because vocabulary, word exposure, and decoding combined, facilitate word reading. This hypothesis is supported by the lexical quality hypothesis (Perfetti & Hart, 2002) suggesting that children with a high quality mental representation of a word (e.g., they know how to decode a word, and the meaning of the word in isolation, and in context), can read words faster and more accurately than children with a low mental representation of the word (e.g., they might be able to decode the word, but not know the meaning of the word). Our findings also provide convergent evidence that despite the transparency of the Spanish orthography, reading real words automatically is not just a matter of being able to decode, (i.e., what some researchers label "word callers"; Stanovich, 1986) but other components such as vocabulary also influence word automaticity and the relation between word reading and reading comprehension (Perfetti, 1999).

Regarding fluency, most studies that examined the relation between fluency and reading comprehension focused on measuring speed, and less on measuring accuracy and prosody. We found that the effect size of the relation between reading comprehension and prosody was large and significant, while the relation between reading comprehension and accuracy was medium, and much lower than the relation between reading comprehension and speed or prosody. However, these results should be interpreted with caution because they are based on a few studies. We found only two reports that measured prosody (6–8 age range) (Calet et al., 2015; Riffo et al., 2018), and only three reports that measured accuracy (Ferroni, 2020; Riffo et al., 2018).

Another important finding was that the strength of the relation between reading comprehension and fluency was low in students in the 9–12 age range. In a recent meta-analysis on the relation between reading speed and reading comprehension in children 6–13 years old, Ripoll-Salceda et al. (2020) found comparable results (i.e., the older the age group the weaker the relation between speed and reading comprehension).

Although that study examined the relation between reading comprehension and speed across languages, not just Spanish as in our current study, they did find heterogeneity of results based on geographical context, age, and type of measures used similar to our findings. In our study age, geographical context, and type of measure explained significant variance in reading comprehension outcomes when taking fluency into account.

We also want to point out that the SVR (Gough & Tunmer, 1986) did not mention fluency as a necessary component that needs to be taught to improve reading comprehension, although the NRP did recommend teaching this component because of its strong relation to reading comprehension in English (LaBerge & Samuels, 1974). We were surprised to find few studies on reading fluency in Spanish, given that this skill is easy to measure, and initial evidence indicates that there is a moderate to high correlation between fluency and reading comprehension in Spanish and in English (see also Baker et al., 2011, 2012, 2015).

Finally, oral comprehension as well as vocabulary and morphological awareness significantly predict reading comprehension supporting the SVR model. The effect size on the relation between these components and reading comprehension is large for children between 9 and 12 years old. The lack of studies on the relation between vocabulary, morphological awareness, oral comprehension, and reading comprehension is striking and more studies are needed to better understand these relations.

Geographical Context as a Moderator of the Relation Between Reading Components and Reading Comprehension

In this meta-analysis we included studies that were conducted in any Spanish monolingual country with Spanish-speaking children following our search criteria. As the results of our moderator analysis reveal, geographical context is a significant moderator of the relation between early reading skills and reading comprehension. It is beyond our meta-analysis to analyze specifically what and how geographical context affects the relation between early reading components and reading comprehension.

We provide, however, some potential hypotheses for the moderating effect of geographical context, although more studies need to be conducted to empirically test our hypotheses. For example, it is possible that the heterogeneity among studies based on the geographical context was because differences in (a) the diversity of the student population across countries (e.g., Chile's population is much more homogenous than the Spanish population); (b) the diversity in the Spanish pronunciation and vocabulary (i.e., Spanish in Latin America has been influenced by Indigenous languages and the immigration of multiple ethnic groups such as Germans, English, Chinese, and Japanese speakers, while the language in Spain has been mainly influenced by European languages and Arabic); and (c) the diversity of methodologies used to teach reading (e.g., the use of the whole language approach, or the syllabic method where only syllables are taught and emphasized, versus the science of teaching reading approach that includes teaching phonemes systematically as well as other specific reading components; Cuetos, 2010; Vissani et al., 2017).

Type of Reading Comprehension Measure as a Moderator of the Relation Between Reading Components and Reading Comprehension

As indicated by our findings, the type of reading comprehension measure also significantly affects the relation between early components and reading comprehension. We hypothesize that the moderating effect of the type of measure is because of the different tasks each measure uses, and differences in the norming population of the measure. For example, the LEE requires students to read three passages and answer 6 open-ended and 2 multiple choice questions, while the Woodcock Muñoz (WC) requires students to read different sentences of two or three lines and identify

the main or missing word. The ENI, a comprehension measure used in a study in Mexico, requires students to read silently a passage of 101 words. In addition, the LEE was normed with Argentinian children, while the WC was normed with bilingual students living in the US, and the ENI was normed with Mexican children. Appendix 1 illustrates the differences between measures of comprehension used in the reviewed studies. The effect of the type of measure on the relation between components has also been found in other studies as mentioned earlier (see Cutting & Scarborough, 2006; Ripoll-Salceda et al., 2020).

Implications for Practice

The findings of the present study have important implications for practice. First, we examined studies conducted in Spanish monolingual countries only, to reduce any potential influences from English or any other language on the development of student Spanish reading skills. Second, although we did find that phonological awareness is necessary to read in Spanish just as it is in English, there is still a widespread *assumption* that syllabic awareness and not phonemic awareness are essential to learning to read in Spanish (Cuetos, 2010). Therefore, providing teachers with the evidence that both skills are related to reading comprehension might foster the teaching of the two subcomponents for students learning to read in Spanish, instead of the more traditional approach of teaching only syllabic awareness.

Our findings also provide evidence of when the relation between each of the early reading components, subcomponents, and reading comprehension is the strongest. For example, the strength of the relation between phonological awareness and reading comprehension is particularly strong between the ages of 5–6 while the strength of the relation between oral comprehension and reading comprehension is the strongest in students ages 9–12. However, research on the development of oral comprehension in English shows that this process develops with time (NELP, 2008). Therefore, teaching oral comprehension early, even before entering elementary school, might support the development of oral comprehension and reading comprehension.

Implications for Future Research

This meta-analysis also revealed the need to conduct more rigorous studies to better understand the effects of the relation between the essential components of reading and reading comprehension in Spanish. First, we found only one

study that examined the effect of the relation between vocabulary and reading comprehension for children ages 5–6, only two studies that examined the effect of the relation between prosody and reading comprehension, and only six studies that examined the effect of the relation between morphological awareness and reading comprehension despite the theoretical and empirical evidence that mastering these components leads to better reading comprehension in Spanish (Author, Tunmer & Hoover, 2019; Caravolas et al., 2019).

Second, to improve the quality of the studies and reduce the heterogeneity found between studies, it would be useful for studies to include a more detailed explanation of the measures used to assess the different reading components, as well as information on the reliability in the administration and scoring of the application of these measures. Few of the studies reviewed included more detailed information about the measures used. Third, based on our meta-regression, age, geographical context, and instruments used to measure comprehension are factors that moderate the relation between predictors and reading comprehension. These factors should be researched further to better understand how and why they affect the strength of the relation between early reading components and reading comprehension.

The small number of studies found did not allow us to do more in-depth analyses of all components and subcomponents related to reading comprehension, and the effects of the moderators on this relation. In addition, given that the effect size analyzed in this study was based on correlations, it is not possible to claim that the reading components and subcomponents examined are the cause of good or poor comprehension. Finally, in this meta-analysis, we decided to examine only studies that had been published in peer-reviewed journals to make it easier for the readers to access these studies. This limitation led to some publication bias, at least in studies that reported correlations between oral comprehension and reading comprehension.

To our knowledge, this is the first meta-analysis that has focused specifically on examining the strength of the relation between essential components of reading, its subcomponents, and reading comprehension in Spanish monolingual countries. Understanding how essential components and subcomponents of reading affect reading comprehension in Spanish, the second most widely spoken language in the world, can potentially lead to improved teacher preparation programs, the quality of reading instruction for millions of students, and ultimately their reading success.

Appendix 1

Table 4

Table 4 Characteristics of Reading Comprehension Measures Identified in the Studies

Comprehension measure	Norming population	Task used to measure comprehension	Number of studies that used the measure	Geographical context
PROLEC	Spain	Reading of four texts with different complexities	8	Spain (6) Chile (1) Peru (1)
CLP	Chile	CLP assesses reading comprehension through multiple-choice questions and a classification task, based on three narrative texts	3	Chile (2) Ecuador (1)
LEE	Argentina	Reading of three texts (two narrative, one expository). For each text, children must answer eight questions (six open-ended and two multiple-choice)	7	Spain (4) Argentina (2) Chile (1)
WC	USA	Reading different sentences of two or three lines and identifying the main or missing word	5	Spain (2) Colombia (1) Chile (2)
EGRA	USA	Different types of questions, including literal questions and inferences about a text read by the child	2	Spain (2)
TALE	Spain	Answer immediately after reading 10 questions about a text of 69 words	1	Spain (1)
LECTUM	Chile	Multiple choice questions, including literal questions and inferences about different texts read by the child	1	Chile (1)
ENI	México	Reading sentences Silent reading of a narrative text of 101 words	2	Several countries (1) México (1)
Not a standardized measure	Not applicable	Reading aloud of a text and questions	3	Argentina (2) Chile (1)

Table 4 (continued)

Comprehension measure	Norming population	Task used to measure comprehension	Number of studies that used the measure	Geographical context
Gates-MacGinitie	USA	Reading five short texts, each consisting of four short passages. Each passage was associated with three pictures printed on a sheet. Children had to select the one that matched with what they had read in the passage	1	Spain (1)
ACL	Spain	Reading of three expository, one data interpretation, two graphical interpretation, and one narrative text and answering 35–36 multiple choice questions	1	Spain (1)

LEE Reading and Writing in Spanish, *EGRA* Early Grade Reading Assessment, *WC* Woodcock-Muñoz Language Survey-Revised, *TALE* Reading and Writing Analysis Test, *PROLEC* Assessment of Reading Processes, *CLP* Comprehension Progressive Linguistic Complexity, *ENI* Child Neurological Assessment, *Gates-MacGinitie* Adaptation of the Gates MacGinitie Reading Comprehension Test to Spanish, *LECTUM* Reading Comprehension Test); ACL (Assessment of Reading Comprehension.

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