Key language, cognitive and higher-order skills for L2 reading comprehension of expository texts in English as foreign language students: a systematic review

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Abstract

This systematic review addressed the following question: Which are the relations between L1 and/or L2 foundational and upper-level language skills, cognitive skills, high-order cognitive and self-regulation factors and L2-English reading comprehension skills in 11-to-19 year EFL secondary school students with different L1 language profiles? Following preferred reporting items for systematic reviews and meta-analyses guidelines, twenty-seven studies were included for a systematic synthesis of results in the light of the different grades of "family language distance" between L1 and L2-English (i.e., "close related" vs. "partially related" vs. "not related"). We found that several L1 and L2 language skills (e.g., vocabulary, morphological awareness), cognitive skills (e.g., working memory) and high-order factors as metacognitive knowledge were positively associated with L2-English reading comprehension, regardless of different language groups. Conversely, we found that several well-known predictors of text comprehension are neglected in the scientific literature on reading in L2. We discuss practical implications and key recommendations to support school and future research.

Keywords L2 reading comprehension · Language · Cognition · EFL secondary school students · Family language · Systematic review

Introduction

In today's societies, being proficient in more than one language is of paramount importance to interact with others and to participate in an increasingly globalized world. Countries and school systems are aware of this need and more effort is put on teaching foreign languages from early childhood through young adulthood. For

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instance, the Programme for International Students Achievement (PISA) 2025 assessment will include a Foreign Language Assessment.[1] While any language is a valid candidate to be learned as a foreign language, English provides several unique advantages. For instance, being able to read in English provides access to an incredible amount of knowledge: most of the websites whose content is known, including the popular online encyclopedia Wikipedia, is in English (Tarchi and Mason, 2022). Thus, schools made L2 reading competence a fundamental educational goal. English-as-a-foreign-language (EFL) secondary school students are faced daily with reading expository texts in English for school assignments and examinations (Barton, 1997). Moreover, many of these reading tasks in the academic context involve the use of digital devices. There is evidence about the interactive effect of reading medium and text genre on reading comprehension (Florit et al., 2022). Recent meta-analyses have found that reading comprehension can be affected by the medium of presentation of texts. Specifically, comprehension is negatively affected when reading expository texts digitally (Clinton, 2019; Delgado et al., 2018). It is therefore essential considering text comprehension in relation to reading medium when analyzing the performance of students at different educational stages.

Past research and theoretical models investigated a variety of cognitive, language, and higher order skills supporting reading comprehension (Just & Carpenter, 1992; Perfetti, 1999). Given this growing interest, it is important to gain a clear understanding of the literature to date in order to drive future research and practice. To address this aim, in this systematic review we identify and critically review which (L1 and/or L2) language (foundational and upper-level) skills, cognitive skills, high-order cognitive and self-regulation factors better relate to L2 reading comprehension of expository text in secondary school students with English as a foreign language (EFL). In an innovative way, we analysed whether the key language, cognitive, and high-order factors vary across different language profiles (i.e., distance between English and origin language).

Models of reading comprehension

Reading component models such as the Simple View of Reading (SVR; Gough & Tunmer, 1986; Hoover & Gough, 1990) have served as a basis for conceptualizing the individual differences that play an important role in reading comprehension. In the SVR model, reading comprehension is conceived as the result of the combination of decoding processes and language comprehension processes. The combination of these factors holds true for readers of English as well as for readers of other alphabetic orthographies such as Greek (Protopapas et al., 2012), Hebrew (Joshi et al., 2015), Italian (Tobia & Bonifacci, 2015) and even for non-alphabetic writing systems like Chinese (Florit & Cain, 2011). SVR has also been used as an explanatory framework for individual differences in reading comprehension in L2 (Verhoeven & van Leeuwe, 2012) and bilinguals (Bonifacci & Tobia, 2017). Although these two factors explain a large part of the variance in reading comprehension, their

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[1] https://www.oecd.org/pisa/foreign-language/.

contribution changes throughout development. In the first years of schooling, it is the decoding ability that explains most of the variance in reading comprehension, while in the last grades language comprehension has a greater weight (Catts, 2018). Scholars have further developed the model by considering that the Simple View of Reading is not so simplistic (Kim, 2017). Three orders of variables were identified: foundational (e.g., vocabulary, grammatical knowledge, orthographic awareness, morphological awareness) and upper-level language skills (e.g., word reading and listening comprehension), and cognitive skills (e.g., working memory, attentional control). Foundational language skills are key skills for constructing initial textbase representation, such as students' knowledge of word meanings and combinations in sentences (Kim, 2016, 2017). Other important factors for reading comprehension are upper-level language skills, such as word reading and listening comprehension. Foundational and upper-level skills are distinct but very interrelated: in a study on the component skills of the SVR model (Kim, 2017), word reading was predicted by foundational language skills (vocabulary, and grammatical knowledge) and listening comprehension, a discourse-level skill (e.g., LAARC & Chiu, 2018), which, in turn, is supported by foundational cognitive and language skills (Kim, 2017). The SVR model and other multi-component models of reading comprehension (e.g., the direct and indirect effects model of reading [DIER]; Kim, 2017) emphasize the involvement of foundational cognitive skills (such as executive functions) and meta-cognitive skills. Concerning cognitive skills, there is a growing body of research that focuses on the role of working memory, attentional control, pertaining to the construct of "executive functions" with respect to reading comprehension skills (Kim, 2016). Executive Functions (EF) is an "umbrella" term that refers to a set of higher-order processes that allow an individual's mental processes and behaviors to be controlled and regulated (Diamond, 2013). According to Cartwright et al. (2020), EFs seemed involved at several levels of reading comprehension, but the evidence regarding the structure of EF when it comes to their contributions on reading comprehension is controversial (Cartwright et al., 2020). Some studies suggest that working memory, inhibition and shifting have independent contributions (Potocki et al., 2015), some others suggest that inhibition and shifting operate together (Friedman & Miyake, 2017). In their study, Cartwright et al. (2020) tested the goodness of fit of a path model, and found that a working memory, inhibition and shifting loaded on a domain-general EF factor which, in turn, was indirectly associated with reading comprehension (of notice is that the direct association was just above the threshold of $p = 0.05$). The meta-analysis conducted by Follmer (2018) supports a positive association between executive function (e.g., working memory, shifting, inhibition, planning) and reading comprehension beyond different age range, type of executive function measure used, and type of reading comprehension measure used.

The role of metacognition has also been widely explored in reading comprehension literature. Metacognition is conceptualized as knowledge or cognitive activity that regulates other cognitive processes (Flavell, 1985). Awareness and monitoring of comprehension processes are critical aspects of skilled reading comprehension (Mokhtari & Reichard, 2002). Good readers are generally characterized by a higher knowledge of reading strategies (and a more flexible use of them), higher comprehension monitoring and higher awareness of themselves as readers (Brown, 1978).

Reading comprehension performances are influenced by text characteristics (Snow, 2002). Text genre represents a relevant factor: narrative texts are the main text genre to which we are exposed since early childhood, whereas expository texts are generally introduced into children's routines in upper-primary school. Once in secondary school, learning performances heavily rely on students' comprehension of expository texts, which are assigned to students in several disciplines. Expository texts are more difficult to comprehend than narrative one for several reasons: texts are constructed with different structures (e.g., definition-example, compare-contrast, and the like), the jargon is more sophisticated and the syntactic structure of the sentence is more complex (Tarchi, 2010).

Transfer from L1 to L2 reading comprehension

To support L2 reading comprehension performance it is important to know the underlying factors, so that primary prevention interventions can be designed and implemented. Firstly, it is relevant to understand whether there is a relationship between the development of text reading skills in L1 and L2, given the growing number of bilingual people in educational contexts. Some scholars consider the two language systems interrelated in a bilingual learner (Chung et al., 2019; Durgunoglu & Hancin, 1992; Koda & Reddy, 2008). It is hypothesized that the skills acquired in L1 reading contribute to L2 reading acquisition. Various interpretations of this transfer have been proposed. The Transfer Hypothesis (Goodman, 1971) states that L2 comprehension is determined by the skills acquired and consolidated by the reader in L1, who would transfer them through the contribution of metacognitive strategies acquired during reading tasks. Differences in the role of L1 and L2 components would therefore be negligible, with the exception of orthographic and grammatical knowledge of the second language.

In response to this hypothesis, Alderson (1984) postulated the Threshold Hypothesis, criticizing the simplistic view of transfer between L1 and L2. He assumed that understanding a text in a second language is a slower and more difficult task than doing the same task in one's own language, even if one understands the words and structure of the text. Thus, the role of the components of the text comprehension process is re-designed: L2-specific linguistic competences would be considered as a threshold to be crossed (thus to be acquired and consolidated) before L1 and L2 comprehension experiences can be considered as similar. Metacognitive and strategic skills would, therefore, be secondary to the acquisition of linguistic ones (Alderson, 1984; Clarke, 1979; Cummins, 1979; Sparks, 1995). A theoretical extension of this hypothesis, the Processing Efficiency Hypothesis (Koda, 1996; Segalowitz, 2001), emphasizes the automaticity and accuracy of lower-order processes, such as the recognition of words and syntactic analysis. During the text comprehension task, there is competition for resources between lower and higher order processes in the reader's working memory: if the former ones are slow and require more attentional load, the performance of the latter ones is impaired (van Gelderen et al., 2007). Finally, some authors proposed that the relationship between L1 and L2 is not so much determined by a transfer, or dependent on a threshold to be crossed, but rather

by access to a hierarchical mental structure in the reader's memory (Structure Building Framework, Gernsbacher, 2013). According to this hypothesis, comprehension performances are determined by integrating connections already existing or under construction.

Previous literature reviews on L2 reading comprehension

A few literature reviews have attempted to systematize the relationship between reading comprehension in L1 and L2. Two contributions focused exclusively on the role of vocabulary knowledge development in L2 comprehenders (August et al., 2006; Zhang & Zhang, 2020). Both concurred on the relevance of vocabulary for L2 comprehension, although the magnitude of its effect largely depended on the way it was assessed.

A meta-analysis conducted by Melby-Lervåg and Lervåg (2014) revealed that, compared to first-language learners, second-language learners display a medium-sized deficit in reading comprehension. Language comprehension and decoding acted as moderating variables, contributing to good reading comprehension performance. Another meta-analysis in the field of the relations between L1 and L2 reading comprehension has been conducted by Jeon and Yamashita (2014). In this meta-analysis the authors analyzed the contribution of 10 key reading component variables on second language comprehension. These factors were: L2 decoding, L2 vocabulary knowledge, L2 grammar knowledge, L1 reading comprehension, and six low-evidence correlates (L2 phonological awareness, L2 orthographic knowledge, L2 morphological knowledge, L2 listening comprehension, working memory and metacognition). The magnitude of correlations was the strongest for grammar and vocabulary knowledge. Also, L2 listening comprehension had a very strong average correlation with L2 reading comprehension.

Despite the important contribution of these review papers, all of them share the limitation of analyzing reading comprehension without distinguishing between primary and secondary school samples, narrative or expository genre, L2 language and distance from L1. Expository text reading in L2-English is fundamental in secondary schools when disciplinary readings in the English language are introduced. Furthermore, there is a growing presence of bilingual biliterate schools with instructional programs in English language.

The present review

The purpose of this systematic review was to identify the relations between L1 and/or L2 language, cognitive, and high-order skills and L2-English reading comprehension of expository texts. For clarity, we organize results into three main categories as follows: language domain (foundational and upper-level skills), cognitive domain (e.g., working memory), and higher-order cognitive and self-regulation factors. We focused on 11-to-19 year EFL secondary school students, given the increasing relevance of EFL comprehension of expository texts in secondary school. Moreover, due to the large variety of students' language profiles of L1, we analyzed results in

literature in relation to the different degrees of family language distance between L1 and L2-English. To date, studies and reviews have included mixed language populations with different language distance degrees, in terms of orthography, morphology, syntax complexity. However, functional L1-L2 associations in similar languages (e.g., L1-Dutch and L2-English) may not necessarily work with languages with scarce similarity (e.g., L1-Chinese and L2-English). The degree of distance between an L1 and an L2 plays a fundamental role in word processing and retention in an L2 (Gholamain & Geva 1999; Green & Meara, 1987; Hamada & Koda, 2008).

Specifically, this systematic review seeks to address the following research questions:

RQ 1:   Which are the relations between *language (foundational and upper-level) skills* in L1 and/or L2 and L2-English reading comprehension skills in 11-to-19 year EFL secondary school students with different degrees of family language distance between L1 and L2-English?

RQ 2:   Which are the relations between *cognitive skills* in L1 and/or L2 and L2-English reading comprehension skills in 11-to-19 year EFL secondary school students with different degrees of family language distance between L1 and L2-English?

RQ 3:   Which are the relations between *higher-order cognitive and self-regulation factors* in L1 and/or L2 and L2-English reading comprehension skills in 11-to-19 year EFL secondary school students with different degrees of family language distance between L1 and L2-English?

Our expectation, in line with theory and prior studies, is that L2 reading comprehension in EFL secondary school students is supported by a pattern of key language, cognitive, and higher-order factors, both within the L2 domain (threshold hypothesis) and between L1/L2 domains (transfer hypothesis).

Method

For the development of this systematic review, we referred and adhered to the steps outlined by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher et al., 2009).

Selection criteria

The following criteria were formulated to select well-designed studies addressing the research questions:

1. Participants must be aged 11-to-19 years (which corresponds to the age range for students attending secondary school);
2. Participants must be students with English as a foreign language (EFL students);

3. The quantitative researches/intervention-research must investigate the impact of language and/or cognitive-domain and/or higher-order skills on reading comprehension skills of L2-English;
4. Results related to L2 reading comprehension were reported and L2 reading comprehension was measured as a dependent variable in the study;
5. The outcome measure must include L2 reading comprehension skills measured with an expository task;
6. Publications were written in English and presented in peer-reviewed journals.

Study selection

After an accurate review of the literature, key terms were identified. Trial searches were conducted to reach the better Boolean search terms to identify relevant records. An advanced search adopted a set of unrestrictive terms to use for keyword searches (keywords separately treated as "SUBJECT", i.e. as topics covered in the publication) as follows: *Reading comprehension, Expository text, Informative text, English second language, Bilingualism, Foreign language, English language learners.*

The systematic literature search was conducted in January 2022. Studies were identified using psychological, educational, and general databases (i.e., PSYINFO, Web of Science, Scopus), as well as in selected journals as follows: *Child development, British Journal of Educational Psychology, European Journal of Psychology of Education, Language & Cognitive Processes, Cognition, Developmental Psychology, Applied Psycholinguistic, Reading Research Quarterly, First Language, Discourse Processes, The Language Learning Journal, Brain & Language, Bilingualism: Language and Cognition, International Journal of Bilingualism, International Journal of Bilingual Education and Bilingualism, Psychological Science.*

Searches returned 2052 papers in total. Duplicates were identified and removed, then resulting in 1614 papers to be checked. Later, in January 2023 we repeated the search on the general databases (i.e., PSYINFO, Web of Science, Scopus) 18 papers in total. Duplicates were identified and removed, then resulting in 14 papers to be checked.

Screening the articles and deciding on the studies' eligibility

The screening phase was undertaken by researchers working independently with selection criteria applied first to titles and abstracts and subsequently to full texts. From the study selection process, 405 articles were assessed for eligibility. The other 1223 papers were excluded for one or more of the following reasons: they were not relevant to the topic of the review, did not present empirical data on the target measures, discussed specific contexts, targeted students of primary school or university or adults (see Fig. 1).

We reviewed information regarding the degree of distance between L1 and L2, the nature of research designs, the task used to assess L2 expository text comprehension, and results. 27 articles were included in the final analysis. The following Table 1
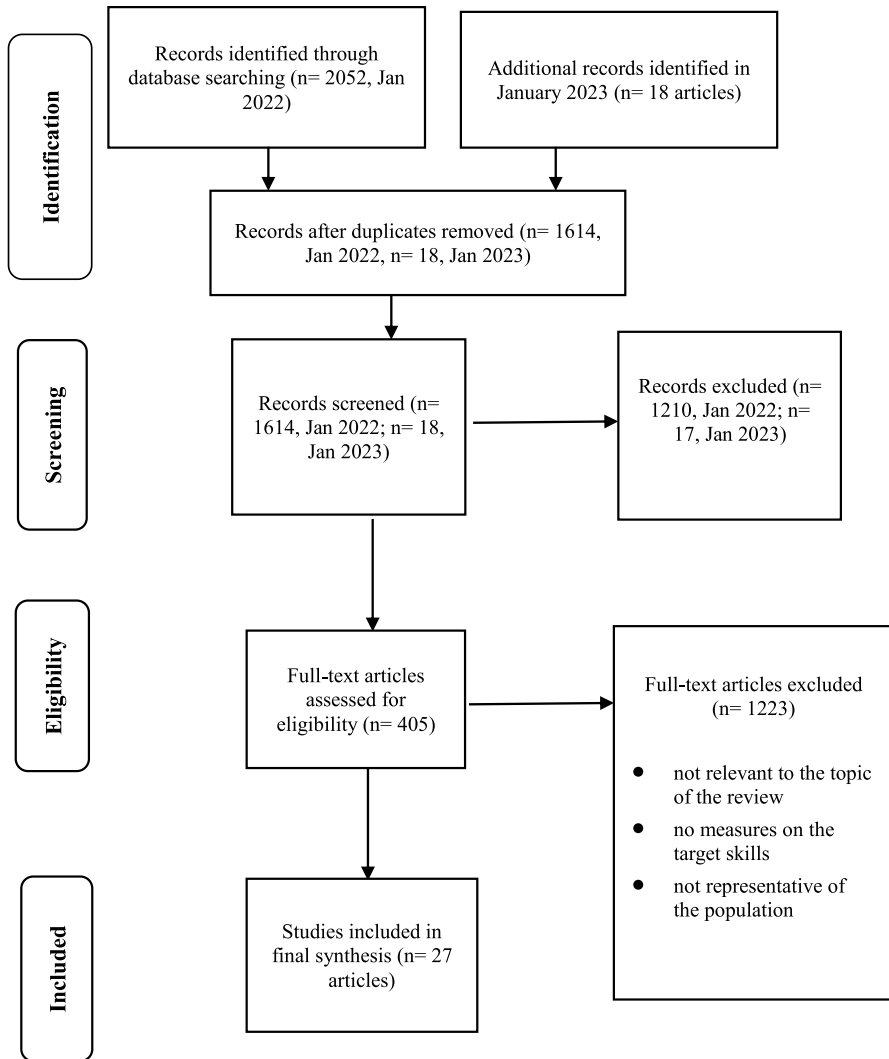
Fig. 1 PRISMA scheme detailing selection process adapted from Moher et al. (2009)

reports the selected studies for data extraction. All these studies are marked with asterisks in the reference list.

In the following section, we synthesize study characteristics, including study participants and EFL profiles.

Table 1 Selected articles

Paper	L1 and family language distance (FLD)		Independent variable/s in L1 and/or L2			Population			
	L1	FLD	Cognitive	Foundational Language	Higher-order Language	School grade	Gender distribution	Years of English education	Other aspects (SES, SEN)
1	Turkish	1	✗	✓	✗	Grade 10 Upper secondary school		6	Not available (n/a)
Arpaci (2016)									
2	Catalan and Spanish	2	✗	✓	✗	Grade 7 and 8 lower secondary school	50% males; 50% females		Medium–high level of SES
Artieda et al. (2017)									
3	Norwegian	3	✗	✓	✗	Upper secondary schools	Two samples: 52% males, 48% females; 51% males, 49% females		N/a
Brevik et al. (2016)**									
4	Norwegian (91%)	3	✗	✓	✗	Upper secondary schools	66% males and 34% females	10	N/a
Brevik and Hellekjær (2018)**									
5	Dutch	3	✗	✗	✓	Lower secondary school students		At least 3 years	N/a
Bügel and Buunk (1996)									
6	Chinese	1	✓	✗	✗	Grade 8 lower secondary school	Two samples: 70 females; 80 males; 45 males; 35 females		N/a for SES All participants were right-handed with normal or correct-to-normal visual acuity
Chang et al. (2019)									
7	Chinese	1	✗	✓	✗	Upper secondary school students			N/a
Chung (2000)									

Table 1 (continued)

Paper	L1 and family language distance (FLD)		Independent variable/s in L1 and/or L2			Population			
	L1	FLD	Cognitive	Foundational Language	Higher-order Language	School grade	Gender distribution	Years of English education	Other aspects (SES, SEN)
8	Cueva et al., (2022) Spanish	2	✗	✓	✗	Grade 1 and Grade 3 lower secondary school	Grade 1st: 24 females; 20 males Grade 3rd: 20 females; 9 males	Grade 1: 9 Grade 3: 11	Middle-class SES N/a for SEN
9	Erbeli and Joshi (2022) Slovenian	2	✗	✓	✗	Grade 7 lower secondary school	53.5% males; 46,5 females	3	N/a
10	Fukkink et al. (2005) Dutch	3	✗	✓	✗	Grade 8 lower secondary school students		3.5	N/a
11	Ghaith and El-Sanyoura (2019) Arabic	1	✗	✗	✓	Upper secondary school students	84.87% females; 15.12% males		Low SES mostly N/a for SEN
12	Jeon (2011) Korean	1	✗	✓	✓	Grade 10 upper secondary school	102 males; 86 females	7	N/a
13	Kahn-Horwitz and Saba (2018) Arabic	1	✗	✓	✗	Grade 11 upper secondary school	All females		Low SES Low-achieving adolescent girls
14	Lee and Schallert (2014) Korean	1	✗	✓	✗	Lower secondary school students	162 males; 127 females	At least 4	N/a

Table 1 (continued)

Paper	L1 and family language distance (FLD)		Independent variable/s in L1 and/or L2			Population			
	L1	FLD	Cognitive	Foundational Language	Higher-order Language	School grade	Gender distribution	Years of English education	Other aspects (SES, SEN)
15 Li and Kirby (2014)	Chinese	1	✓	✗	✓	Grade 8 lower secondary school	69 males; 177 females	At least 6	N/a
16 Maluch and Sachse (2020)	German	3	✗	✓	✗	Grade 8 lower secondary school			N/a
17 Mulder et al. (2021)	Dutch	3	✗	✓	✗	Lower secondary school students	238 males; 203 females		N/a
18 Namaziandost et al. (2019)	Persian	1	✗	✓	✗	Upper secondary school students	25 males; 27 females		N/a
19 Pae (2019)	Korean	1	✗	✓	✗	Upper secondary school	47% females; 53% males	At least six years	N/a
20 Schluer (2018)	German	3	✗	✓	✗	Grade 9 upper secondary school			N/a
21 Schoonen et al. (1998)	Dutch	3	✗	✓	✓	Grades 6, 8 and 10 lower secondary school		Grade 6: 1 Grade 8: 3 Grade 10: 5	N/a
22 Sok et al. (2021)	Korean	1	✓	✓	✗	Lower secondary school	47% females; 53% males	3	89% high-SES; 11% low-SES N/a for SEN

Table 1 (continued)

Paper	L1 and family language distance (FLD)		Independent variable/s in L1 and/or L2			Population			
	L1	FLD	Cognitive	Foundational Language	Higher-order Language	School grade	Gender distribution	Years of English education	Other aspects (SES, SEN)
23 Van Gelderen et al. (2004)	Dutch	3	✓	✓	✓	From Grade 8 to Grade 10 of lower secondary school		Grade 8: 1.5 (at a secondary level)	N/a
24 Van Gelderen et al. (2007)	Dutch	3	✗	✓	✓	From Grade 8 to Grade 10 of lower secondary school		Grade 8: 1.5 (at a secondary level)	N/a
25 Yau (2009)	Chinese	1	✗	✗	✓	Grade 11 upper secondary school	48 males; 89 females	4	N/a
26 Yau (2011)	Chinese	1	✗	✗	✓	Upper secondary school students			N/a
27 Yeom and Jun (2020)**	Korean	1	✗	✗	✓	Grade 7, Grade 8 and Grade 9 middle and upper secondary school			N/a

FLD score assigned: *Score 3*=L1 closely related with L2-English; *Score 2*=L1 partially related with L2-English; *Score 1*=not related with L2-English. SES=socioeconomic status; SEN=special educational needs

Independent variables: ✓=variable/s measured in the study; ✗=variable/s not measured in the study

**Studies in which reading comprehension has been assessed using digital devices

Results

Study participants

The included studies involved secondary school students. To consistently present findings, we used two designations: lower secondary school (11–14-year-old; grades 7–9) and upper secondary school (15–18-year-old; grades 10–12). In summary, as detailed in Table 1, 55.6% of the 27 studies (n = 13) were on lower secondary school students, 48% (n = 10) were on upper secondary school students, and 15% (n = 4) focused on both lower and upper secondary school students of which two were longitudinal studies (i.e., Van Gelderen et al., 2004, 2007). As shown in Table 1, most of the included studies (n = 22) do not report specific information for (socio-economic status) SES and none mention participants with special educational needs. Among the few studies that reported information about SES, three studies included participants with medium-to-high levels of SES and two studies included mostly participants with low levels of SES.

EFL students' language profiles

To identify the degree of language distance between L1 and L2-English, in line with the Simple view of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) and the indications by Mikawa and De Jong (2021) and Daller et al. (2011), we first established the main language family of L1 as "Latin script/Latin alphabetic group" (e.g., Dutch, Spanish, Norwegian, Turkish) and "non-Latin script or non-alphabetic group" (e.g., Chinese, Arabic, Korean). Then, within the "Latin script/Latin alphabetic group" we further categorized the studies by similarity in language comprehension processing: "non-Indo-European language" (i.e., Turkish), "West German language group" (for example including Dutch, Norwegian, German) and "Non-West German language group" (for example including French, Spanish). We proceeded to assign a score for each pair of languages to identify three language groups based on the degree of language distance between an L1 and L2-English as following described:

- The *score of 1* was assigned when L1 and L2-English were "not related", such as in the case of a L1 belonging to the "non-Latin script or non-alphabetic group", for example L1-Korean and L2-English, n = 14 selected articles; as well as in the case of Turkish, a non-Indo-European language (Kirkici & Clahsen, 2013) which is written with a Latin script but is completely unrelated to English, n = 1 selected article.
- The *score of 2* was assigned when L1 and L2-English were "partially related", such as in the case of a L1 belonging to the "Non-West German language group" within the "Latin script/Latin alphabetic group", for example L1-Spanish and L2-English; n = 3 selected articles.
- The *score of 3* was assigned when L1 and L2-English were "closely related", such as in the case of a L1 belonging to the "West German language group"

within the "Latin script/Latin alphabetic group", for example L1-Dutch and L2-English; n = 10 selected articles.

RQ 1 language domain (foundational and upper-level skills)

Our first research question concerned the relation between foundational and upper-level language skills and L2 reading comprehension skills in EFL secondary school students with different degrees of family language distance. Table 2 shows the 21 articles identified with details about L1 and L2-English family language distance, L1 and/or L2 foundational and upper-level language skills assessed, design features and effect size, and other covariates assessed and included in the equation tested, if present. Of these 21 articles, 9 articles investigated students characterized by a non English-related L1, such as Chinese (family languages: score 1), 3 articles investigated partially-related L1, such as Spanish (family languages: score 2), and 9 articles investigated closely-related L1, such as Dutch (family languages: score 3). Regarding variables assessed within these 21 articles, a wide range of foundational and upper-level language skills in L1 and L2-English were assessed, including foundational language skills as vocabulary, syntactic/grammar knowledge, upper-level language skills as listening comprehension and word reading, and related word reading components as phonological and morphological awareness, intended as the ability to apply the "knowledge of compounding rules and derivational morphology to provide correct interpretations of complex words" (Wang et al., 2006, p. 543) and the "ability to identify the constituent morphemes of a complex word" (Wang et al., 2006, p. 543).

Of notice, there is a high heterogeneity of tasks and measures assessed both across different constructs and within the same construct. For example, regarding the construct of vocabulary (foundational language skill), the study by Li and Kirby (2014) investigated L2 vocabulary breadth, while other studies (e.g., Schoonen et al., 1998; Van Gelderen et al., 2004, 2007) assessed L2 vocabulary knowledge. Moreover, those studies assessed vocabulary separately from other foundational and/or upper-level language skills, while in the study by Pae (2019), a global index of L2 proficiency was derived from the combination of L2 vocabulary and L2 grammar knowledge test scores.

Regarding results emerged within these 21 articles, on the one hand, some of these studies supported the transfer hypothesis of L1 language (foundational and upper-level) skills to L2-English reading comprehension skills. Among L1–L2 (English) languages that are closely related, the longitudinal study by Van Gelderen et al. (2007) showed that L1 and L2 reading comprehension skills are highly related in students with Dutch as L1 in Grade 8 through 10. Also, the longitudinal results by Van Gelderen et al. (2004) conducted with Grade 1–8 Dutch students were in line with the transfer hypothesis. The transfer hypothesis is also supported by results found when L1 and L2 were not related or partially related in terms of family language. For example, the study by Pae (2019) showed that L1-Korean general reading skills are critical for L2-English reading comprehension skills and the study by Cueva et al. (2022) found that L2-English reading comprehension of expository text

Table 2 RQ1 Language (foundational and upper-level) skills: design features and effect size in included studies

	Included studies	FLD score assigned	L1 and/or L2 Language skills	Design features and effect size	Other covariates assessed and included in the data analysis
1	Arpaci (2016)	1	Processing of L1 and L2 glosses	Between-group comparison Gloss: Cohen's d = 0.75	
2	Artieda et al. (2017)	2	L2 exposure	Between-group comparison Additional L2 exposure, r = 0.23	
3	Brevik et al. (2016)**	3	L1 reading proficiency L1 reading comprehension L1 language	Correlational research design L1 reading proficiency, $R^2 = 0.41$ L1 reading comprehension and L1 language, $R^2 = 0.43$	Gender Study programme
4	Brevik and Hellekjær (2018)**	3	L1 reading proficiency	Correlational research design L1 reading proficiency (nationwide sample), r = 0.68 L1 reading proficiency (Outliers), no relationship	
7	Chung (2000)	1	Logical connectives	Between-group comparison Logical connectives, $F_{(3323)} = 6.53$,	Paragraph heading
8	Cueva et al., (2022)	2	L1 and L2 synonym judgment task (vocabulary) L1 and L2 syntactic judgment task L1 and L2 morphological task	Correlational research design (3rd grade) L2 vocabulary ($p < 0.05$), L2 morphology ($R^2 = 0.228$); L2 syntax ($R^2 = 0.228$); L1 reading comprehension ($R^2 = 0.391$)	Grade
9	Erbeli and Joshi (2022)	2	L2 reading fluency L2 orthographic skills L2 vocabulary L2 listening comprehension L1 reading skills	Correlational research design L2 decoding, L2 linguistic comprehension, and L2 reading comprehension, 96% of variance accounted, but not in interaction Any significant effect of L1 reading	
10	Fukkink et al. (2005)	3	L2 lexical decision L2 reading fluency (i.e., speed) L1 reading comprehension	Correlational research design Any significant transfer effect of increased word recognition in L2	

Table 2 (continued)

	Included studies	FLD score assigned	L1 and/or L2 Language skills	Design features and effect size	Other covariates assessed and included in the data analysis
12	Jeon (2011)	1	L2 phonological reading L2 word knowledge L2 (interpretation and identification) morphological awareness L2 listening comprehension	Correlational research design phonological decoding ($R^2 = 0.116$), morphological structure ($R^2 = 0.146$; $R^2 = 0.057$ $p < 0.0$; $R^2 = 0.055$ from other models), verbal suffix knowledge (step 2), $R^2 = 0.086$; $R^2 = 0.032$ $p < 0.01$; $R^2 = 0.018$ from other models), listening comprehension (step 1), $R^2 = 0.279$, $R^2 = 0.279$ from other model), word knowledge (step 1), $R^2 = 0.239$; $R^2 = 0.239$ from other model Pseudoword Reading ($R^2 = 0.116$; $R^2 = 0.116$ from other model), word knowledge ($R^2 = 0.156$, $R^2 = 0.156$ from other model), listening comprehension ($R^2 = 0.076$ from other model), meta-cognitive awareness ($R^2 = 0$), verbal suffix knowledge ($R^2 = 0.007$ $R^2 = 0.004$), morphological structure ($R^2 = 0.013$ $R^2 = 0.016$ from other model)	Reading strategy use and metacognitive awareness when they read

Table 2 (continued)

	Included studies	FLD score assigned	L1 and/or L2 Language skills	Design features and effect size	Other covariates assessed and included in the data analysis
13	Kahn-Horwitz and Saba (2018)	1	L1-Arabic linguistic abilities Morphological derivational awareness Phonological awareness Orthographic knowledge EFL reading abilities Word recognition	Correlational research design L1 morphological awareness, $\beta=0.25$ No significant effect for L1 phonological awareness and L1 orthographic awareness Mediating role of morphological judgment and production between L1 phonological awareness (indirect $=0.13$) and L1 orthographic knowledge (indirect $=0.61$)	TV viewing in L2 Home density
14	Lee and Schallert (2014)	1	L1 and L2 language proficiency tests L1 reading comprehension test	Correlational research design L2 reading proficiency, $B=0.83$	L2 reading attitude
15	Li and Kirby (2014)	1	Vocabulary Measures L2 Vocabulary breadth L2 Word definitions L2 Multiple-meaning vocabulary L2 Morphological awareness Higher Level Literacy Skills L2 Listening comprehension	Between-group comparison L2 vocabulary skills, Wilks's $\lambda=0.67$, $F(8, 170)=4.76$; vocabulary breadth, $F(2, 88)=11.04$, partial $\eta2=0.20$; multiple meanings, $F(2, 88)=8.55$, partial $\eta2=0.16$; and morphological awareness, $F(2, 88)=4.44$, partial $\eta2=0.09$ Higher level skills, Wilks's $\lambda=0.55$, $F(8, 170)=7.30$, listening comprehension, $F(2, 88)=9.81$, partial $\eta2=0.18$	Inference and strategy
16	Maluch and Sachse (2020)	3	L2 reading speed L2 reading efficiency L2 reading proficiency L1 German reading fluency	Correlational research design Positive association found between L2 reading speed and comprehension There is a strong relationship between L1 and L2 reading speed, $R^2_{adj}=0.54$	

Table 2 (continued)

	Included studies	FLD score assigned	L1 and/or L2 Language skills	Design features and effect size	Other covariates assessed and included in the data analysis
17	Mulder et al. (2021)	3	Word-to-text: syntactic, semantic integration	Correlational research design Word-to-text integration indices, $R^2 = 0.04$	
18	Namaziandost et al. (2019)	1	L2 extensive reading	Between-group comparison L2 extensive reading of materials above students' reading competence level, $t(52) = 3.6$, Cohen's d (i.e. per standard deviation units) = 1.1	
19	Pae (2019)	1	Global index of L2 proficiency	Correlational research design L1 reading proficiency ($\beta = 0.26$) and L2 proficiency on L2 reading comprehension ($\beta = 0.53$) Variance explained by L2 proficiency and L1 reading ability together = 45.8% (L2 proficiency 13%) No significant moderating role of L2 proficiency in the relation between L1 and L2 skills	L1 and L2 Expository Writing ability
20	Schluer (2018)	3	L2 lexical awareness L2 conceptual awareness	Qualitative and mixed-data analysis with MAXQDA 11 Many items occurring in the authentic texts read by L2 learners of English pose lexical challenges	
21	Schoonen et al. (1998)	3	L1 and L2 vocabulary knowledge	Correlational research design Vocabulary knowledge, $\chi2(4) = 48.65$ (Grade 8) and $\chi2(4) = 36.49$ (Grade 10). Its importance diminishes at grade 10 compared to grade 8	Metacognitive knowledge on reading

Table 2 (continued)

Included studies	FLD score assigned	L1 and/or L2 Language skills	Design features and effect size	Other covariates assessed and included in the data analysis
22 Sok et al. (2021)	1	Language aptitude; L1 competence reading comprehension, grammar, and vocabulary	Correlational research design; Language aptitude (modest effect), $\beta=0.27$, $p<0.001$; Any significant role of L1 competence	L1 Phonological working memory; Motivation for L2; SES; Gender; Class level; Student level
23 Van Gelderen et al. (2004)	3	L1 and L2 vocabulary knowledge	Correlational research design; L1 reading comprehension, $\beta=0.85$; L1 vocabulary knowledge, $\beta=0.26$	L1 and L2 speed of word recognition; L1 and L2 speed of sentence verification; Metacognitive knowledge relevant to reading (statements in L1)
24 Van Gelderen et al. (2007)	3	L1 and L2 vocabulary; L1 and L2 grammar knowledge; L1 and L2 speed of word recognition; L1 and L2 sentence verification	Longitudinal research design; L1 vocabulary, $\chi2(3)=94$; L2 and L2 vocabulary, $\chi2=711.2$; L1 and L2 grammar, $\chi2=647.6$; L1 and L2 word recognition, $\chi2=509.6$; L1 and L2 sentence verification, $\chi2=544.2$	L1 reading comprehension; L1 and L2 metacognitive knowledge

**Studies in which reading comprehension has been assessed using digital devices

was predicted by L1-Spanish syntactic awareness and reading comprehension skills in middle school years. The results by Cueva et al. (2022) also showed several correlations between L2-English and L1 syntax, Spearman value = 0.453, $p < 0.001$ (whole group, Grade 1 and 3), L1 morphology, Spearman value = 0.462, $p < 0.001$ (whole group, Grade 1), L1 comprehension, Spearman value = 0.538, $p < 0.001$ (whole group, Grade 1). Instead, the results by Brevik and Hellekjær (2018) pose a challenge to assumptions about cross-linguistic reading given that their sample of poor readers in L1 Norwegian (16-year-old) showed adequate reading skills in L2-English. Also, any significant effect of L1 reading was found in the study by Erbeli and Joshi (2022) conducted with participants with L1 partially related with L2-English.

On the other hand, other results assessed within-language relationships between L2 language (foundational and upper-level) skills and L2 reading comprehension skills. These studies found a statistically significant association between language skills and L2 reading comprehension in students with L1 not or partially related with L2-English. Within the group of L1 partially related with L2-English, the results by Cueva et al. (2022) showed several correlations between L2-English and L2 vocabulary, Spearman value = 0.398, $p < 0.001$ (whole group, Grade 1), L2 syntax, Spearman value = 0.682, $p < 0.001$ (whole group, Grade 1 and 3), L2 morphology, Spearman value = 0.421, $p < 0.001$ (whole group, Grade 1). Within the group of L1 not related with L2-English, the study by Jeon (2011) was conducted with South Korean high school students to verify the independent contribution of L2-English morphological awareness to L2-reading comprehension when the variance due to other key reading- and language-related variables was controlled. Correlations showed several association between L2-English reading comprehension and L2 listening comprehension, $r = 0.210$, $p < 0.01$, morphological structure, $r = 0.481$, $p < 0.01$, verbal suffix knowledge, $r = 0.381$, $p < 0.01$, word knowledge, $r = 0.497$, $p < 0.01$, pseudoword reading, $r = 0.341$, $p < 0.01$. Moreover, several models in regression analysis were tested with the following results: Model 1 Effect of phonological decoding (step 1), $R^2 = 0.116$ $p < 0.01$), and morphological structure (step 2), $R^2 = 0.146$ $p < 0.01$; Model 2 Effect of phonological decoding (step 1), $R^2 = 0.116$ $p < 0.01$, and verbal suffix knowledge (step 2), $R^2 = 0.086$ $p < 0.01$; Model 3 Effect of listening comprehension (step 1), $R^2 = 0.279$ $p < 0.01$, and morphological structure (step 2), $R^2 = 0.057$ $p < 0.01$; Model 4 Effect of listening comprehension (step 1), $R^2 = 0.279$ $p < 0.01$, and verbal suffix knowledge (step 2), $R^2 = 0.032$ $p < 0.01$; Model 5 Effect of word knowledge (step 1), $R^2 = 0.239$ $p < 0.01$, and morphological structure (step 2), $R^2 = 0.055$ $p < 0.01$; Model 6 Effect of word knowledge (step 1), $R^2 = 0.239$ $p < 0.01$, and verbal suffix knowledge (step 2), $R^2 = 0.018$ $p < 0.01$. These results showed that morphological competence assessed in L2, especially the ability to infer the meaning of a morphologically complex word from its constituent morphemes, predicted L2 reading comprehension over and above phonology, listening comprehension, and vocabulary knowledge in L2.

A further study (Sok et al., 2021) was focused on L2 language aptitude. "Aptitude" was conceptualized as language acquisition competence and included four skills (Carroll, 1962): phonemic coding (the skill to "code" the sounds of a language in a way that they can be retained in memory), grammatical sensitivity (the ability to

be sensitive to the ways that linguistic forms function within natural utterances), rote memory (the ability to form and retain a large number of associations within a short period of time) and inductive language learning (the ability to notice and identify forms, rules, and patterns within the linguistic input). According to the results, the aptitude was a positive and a significant predictor of L2 reading comprehension.

Not surprisingly, the foundational language skill of vocabulary received significant attention by studies on L2 reading comprehension. The study by Van Gelderen et al. (2004) conducted with Grade 1–8 Dutch students showed that although the contribution of L1-Dutch reading comprehension on L2-English was significant and large, L2-English vocabulary had an additional significant contribution. Moreover, the authors found that neither L2-English processing speed components (word recognition and sentence comprehension) nor grammar knowledge had a significant influence on L2-English reading comprehension. The role of vocabulary was also found in a subsequent study by Van Gelderen et al. (2007), in which L2-English vocabulary contributed to the explanation of L2-English reading comprehension in Grade 8 Dutch students. Within the family of scarcely-related languages, in the study by Pae (2019), conducted in a L1-Korean sample, L2-English proficiency in vocabulary and L2-English grammar knowledge were associated with L2-reading comprehension.

Also, the study by Li and Kirby (2014) showed that vocabulary was the main source of reading difficulties. The advantage of the good comprehenders group was primarily due to discourse comprehension and strategic processes and was only possible with high language proficiency. Finally, the review showed a significant predictive role for two other foundational language skills: phonological decoding (Jeon, 2011) and morphological skills (Jeon, 2011; Kahn-Horwitz & Saba, 2018; Kieffer et al., 2013).

RQ 2: cognitive-domain skills

Our second research question concerned the relation between L1 and/or L2 cognitive skills and L2 reading comprehension skills in EFL secondary school students with different degrees of family language distance. As shown in Table 3, of the 27 articles included in the review, only 3 of them explored the association between cognitive abilities in L1/L2 and L2-reading comprehension, and all these limited their attention to executive functions (Chang et al., 2019; Sok et al., 2021; Van Gelderen et al., 2004).

Chang et al. (2019) investigated the contribution of working memory. These authors developed two different studies. In the first study they tested the predictive power of working memory on the performance of English reading comprehension. The results of this prior study revealed that working memory is a significant predictor of reading comprehension in L2 (explaining the 82.7% of the variance). The standard regression coefficient of working memory on reading comprehension and the coefficient of determination ($\beta = 0.910$; $R^2_{adj} = 0.827$) were larger than those of working memory on grammar ($\beta = 0.735$; $R^2_{adj} = 0.709$), on writing ($\beta = 714$; $R^2_{adj} = 0.537$), and on English-learning score ($\beta = 0.843$; $R^2_{adj} = 0.506$). Study 2

Table 3 RQ2 cognitive–domain skills: design features and effect size in included studies

	Included studies	FLD score assigned	L1 and/or L2 Cognitive skills	Design features and effect size	Other variable assessed
6	Chang et al. (2019)	1	*Study 1* Working memory in L2 Study 2 Verbal working memory in L2 Inhibition Updating function Transfer function	Correlational research design *Study 1* Working memory, β = 0.91, variance explained 82.7% *Study 2* VWM, the high group outperformed the low group, np2 = 0.292 No significant difference in inhibition or transfer between these two groups	Academic performance L2 grammar L2 writing
22	Sok et al. (2021)	1	L1 Phonological working memory	Correlational research design L1 Phonological working memory, β = 0.27	Language aptitude L1 competence Motivation for L2 SES Gender Class level Student level
23	Van Gelderen et al. (2004)	3	L1 and L2 speed of word recognition L1 and L2 speed of sentence verification	Longitudinal research design No significant effect of the speed components	L1 and L2 vocabulary knowledge Metacognitive knowledge relevant to reading (statements in L1)

further explored the effects of different components of working memory on English reading comprehension in different reading comprehension groups (high vs. low); specifically, the components tested were the verbal working memory and the central executive system, via three core functions: inhibition (inhibition of prepotent responses), transfer (mental set shifting), and updating (information updating and monitoring) (Miyake et al., 2000). Results showed that working memory tasks could explain 90% of the accuracy rate in strong readers in EFL and 85% in poor readers in EFL. Moreover, significant differences between working memory and its components in different reading comprehension groups (high *vs.* low) were found: differences in 1-back accuracy were significant and the accuracy rate of the high group was higher than that of the low group; conversely, there was no significant difference in the inhibition function and in the transfer task between these two groups.

Sok et al. (2021) investigated phonological working memory, under the assumption that this capability contributes to the acquisition of new words, and in so doing, mediates language learning (Baddeley et al., 1998). The authors assessed phonological working memory using a digit span task (CELF-4, Semel et al., 2003). The task was applied in the participants' L1, and it gauged the ability to recall strings of numerical digits presented orally. The authors found that phonological working memory was a significant predictor of L2 reading comprehension, in combination with the variable "aptitude" (a knack for language learning that is independent of intelligence; Carroll, 1962). The two factors explained 38% of the variance in L2 reading comprehension. However, the effect sizes for phonological working memory were even lower than those for aptitude.

Finally, in the study conducted by Van Gelderen et al. (2007), no significant effect of the speed components (i.e., word recognition and sentence verification) on L2-English reading comprehension in Grade 8 Dutch students emerged.

As a marginal note, in the study by Li and Kirby (2014) nonverbal cognitive ability was assessed as a control measure, rather than as a predictor of reading comprehension. This factor was assessed through Raven's Progressive Matrices (Raven et al., 1983).

Taken together, the results show that there is a very small percentage of studies analyzing the predictive role of cognitive processes in reading comprehension in English as a foreign language. Furthermore, when studies included a cognitive factor, it usually was working memory. Other executive functions such as inhibition or attentional control have been neglected by empirical studies in the field. In addition, these three studies consider bilingualism between languages very distant from each other (English as L2 and Korean/Chinese as L1).

RQ 3 higher-order cognitive and self-regulation domain

Our third research question concerned the relation between L1 and/or L2 higher-order cognitive and self-regulation factors and L2 reading comprehension skills in EFL secondary school students with different degrees of family language distance. As shown in Table 4, of the 27 articles included in the review, 11 of them explored the predictive role of higher-order factors (Brevik & Hellekjær, 2018;

Table 4 RQ3 Higher-order cognitive and self-regulation factors: design features and effect size in included studies

Included studies	FLD score assigned	L1 and/or L2 Higher-order factors	Design features and effect size	Other variable assessed
4 Brevik and Hellekjær (2018)**	3	Strategies, interest in and motivation for reading in L2-English	Between group comparison Reading comprehension strategies in poor readers in L1, but good readers in L2: 4–38% Interest in and motivation in poor readers in L1, but good readers in L2: 81–85%	
5 Bügel and Buunk (1996)	3	Prior knowledge related to the content of the texts Topic interests	Between group comparison Prior knowledge and interests, reading habits Male have a greater experience with more complex informative texts on specialised topics: 13.77, $p < 0.01$	Students' reading and television viewing habits with respect to the topics of the English texts in the reading comprehension tests
11 Ghaith and El-Sanyoura (2019)	1	L2 metacognitive awareness of reading strategies	Correlational research design Problem-solving strategy (explain 9.2% of the variance), r = 0.304 with reading comprehension and r = 0.232 with higher-order reading comprehension No significance of global, and support categories	
12 Jeon (2011)	1	Reading strategy use and metacognitive awareness when they read in L2	Correlational research design Metacognitive Awareness Reading, r = .210, and $R^2 = 0.040$	L2 phonological reading L2 word knowledge L2 L2 morphological awareness L2 listening comprehension

Table 4 (continued)

	Included studies	FLD score assigned	L1 and/or L2 Higher-order factors	Design features and effect size	Other variable assessed
15	Li and Kirby (2014)	1	Inference and strategy	Correlational research design Higher level skills, Wilks's λ = 0.55, $F(8, 170) = 7.30$; inference and strategy, $F(2, 88) = 16.42$, partial η2 = 0.27	Vocabulary measures and L2 Listening comprehension
21	Schoonen et al. (1998)	3	Metacognitive knowledge on reading	Correlational research design Metacognitive knowledge, $χ2(4) = 10.48$	L1 and L2 vocabulary knowledge
23	Van Gelderen et al. (2004)	3	Reading metacognitive knowledge	Longitudinal research design Metacognitive knowledge, β = 0.70	L1 and L2 vocabulary knowledge L1 and L2 speed of word recognition L1 and L2 speed of sentence verification
24	Van Gelderen et al. (2007)	3	L1 and L2 metacognitive knowledge	Longitudinal research design Metacognitive knowledge, 0.64 (Grade 8), 0.18 and 0.35 (in the two following grades)	L1 reading comprehension L1 and L2 vocabulary L1 and L2 grammar knowledge L1 and L2 speed of word recognition L1 and L2 sentence verification
25	Yau (2009)	1	Metacognitive knowledge about L1 and L2 reading and strategies	Correlational research design Self-reported use of strategy r = 0.23 Cognitive strategies r = 0.21 Support strategies r = 0.25	students' test performance
26	Yau (2011)	1	Mental translation as a processing strategy	Correlational research design Intra- and inter-language translation, $t(82) = 18.63$	

Table 4 (continued)

	Included studies	FLD score assigned	L1 and/or L2 Higher-order factors	Design features and effect size	Other variable assessed
27	Yeom and Jun (2020)**	1	Reading and test-taking strategies	Correlational research design Reading and test-taking strategies differed statistically significantly across proficiency ($p < 0.05$)	Background information

**Studies in which reading comprehension has been assessed using digital devices

Bügel & Buunk, 1996; Ghaith & El-Sanyoura, 2019; Jeon, 2011; Li & Kirby, 2014; Schoonen et al., 1998; Van Gelderen et al., 2004, 2007; Yau, 2009, 2011; Yeom & Jun, 2020).

Brevik and Hellekjær (2018) investigated the association between several reading comprehension strategies, i.e. the reader's awareness of comprehension problems and the use of appropriate tools to solve them, and L2 reading comprehension. Specifically, the authors used a self-report questionnaire to assess the strategies employed by the participants in two situations: during a L2 test and also in general (in line with the PISA test item: 'How often do you use these strategies to remember and understand factual texts in English?'). With regard to the reading comprehension strategy used in the L2 test, the participants were asked about the following strategies: close reading (using the context to understand unknown words), scanning (looking for details), reflection, re-reading, or other strategies. The percentages of use of each strategy were as follows: close reading (36–38%), scanning (30%), reflection (23–29%), re-reading (16–17%), or other (4–5%) reading comprehension strategies. With regard to the general reading comprehension strategies used when reading, i.e. in response to the question 'How often do you use these strategies to remember and understand factual texts in English?', students had to rate their use of 15 specific reading comprehension strategies (e.g., close reading, skimming, summarization) on a four-point Likert scale, from 1 (almost never) to 4 (almost always). According to the students' responses, the strategies employed to remember and understand factual texts in English were the following ones (ordered from most to least use): close reading, focusing on important parts, scanning, setting purposes, skimming, activating prior knowledge, using a glossary, contextual reading, re-reading, summarization, using keywords, underline, cooperative learning, reading aloud and others. In sum, the results of the survey revealed that L2 proficient readers engage in strategic reading by drawing on cognitive and metacognitive resources to adjust their reading behaviors to accommodate text and task demands.

Bügel and Buunk (1996) showed that gender differences in reading comprehension performances are linked with prior knowledge and interests, and mostly with differences in reading habits. For example, male students show higher experience with more complex informative texts on specialised topics than female students.

Ghaith and El-Sanyoura (2019) conducted a study in order to test the mediating role of metacognitive strategies on L2 reading comprehension. Metacognitive strategies were evaluated through the Survey of Reading Strategies (SORS) (Mokhtari & Sheorey, 2002). Moreover, the authors evaluated global reading strategies (intentional reading strategies used to set the stage for the reading act, such as assessing what to read or ignore), problem-solving strategies (problem-solving or repair strategies used when problems arise in comprehending textual information, such as re-reading for more understanding), and support reading strategies (these strategies offer the support mechanism used to sustain responses to reading, such as underlining or circling information) using a 5-point Likert-type scale (1 = "I never or almost never do this"; 5 = "I always or almost always do this"). The results revealed that the problem-solving strategies were reported to be highly used, while the global and the support strategies were reported to be moderately used. Moreover, the problem-solving category of strategies was found to be a significant predictor of both literal and

higher-order comprehension (r = 0.304, $p < 0.01$). However, the global and support reading strategies' categories were unrelated to reading comprehension.

The results of the correlation analysis conducted by Jeon (2011) showed associations between L2-English and metacognitive awareness. The author tested ten sequential multiple regression analyses to verify the impact of morphological awareness in relation to other skills. Model 7 showed the effect of metacognitive awareness reading (step 1), $R^2 = 0.040$ $p < 0.01$, and morphological structure (step 2), $R^2 = 0.184$ $p < 0.01$; Model 8 showed the effect of metacognitive awareness reading (step 1), $R^2 = 0.040$ $p < 0.01$, and verbal suffix knowledge (step 2), $R^2 = 0.109$ $p < 0.01$. Moreover, two sequential regression analyses for six variables predicting reading comprehension, including metacognitive reading awareness, were tested. Model 5 showed the effect of pseudoword reading (step 1), $R^2 = 0.116$ $p < 0.01$, word knowledge (step 2), $R^2 = 0.156$ $p < 0.01$, listening comprehension (step 3), $R^2 = 0.076$ $p < 0.01$, metacognitive awareness (step 4), $R^2 = 0$, $p = $ n.s., verbal suffix knowledge (step 5), $R^2 = 0.007$ $p = $ n.s., morphological structure (step 6), $R^2 = 0.013$ $p < 0.05$; Model 6 showed the effect of pseudoword reading (step 1), $R^2 = 0.116$ $p < 0.01$, word knowledge (step 2), $R^2 = 0.156$ $p < 0.01$, listening comprehension (step 3), $R^2 = 0.076$ $p < 0.01$, metacognitive awareness (step 4), $R^2 = 0$, $p = $ n.s., morphological structure (step 5), $R^2 = 0.016$ $p < 0.05$, verbal suffix knowledge (step 6), $R^2 = 0.004$ $p = $ n.s.

Li and Kirby (2014) assessed inference and strategy as a measure of higher-level literacy skills. Their results suggested that higher level skills contribute significantly to students' reading comprehension if students have adequate English vocabulary and basic language skills.

Schoonen et al. (1998) assessed metacognitive knowledge using a questionnaire covering four domains (assessment of oneself as a reader-questions about perceived self-efficacy as a reader-; knowledge of reading goals and comprehension criteria-questions about the awareness of the important aspects of understanding a text and monitoring comprehension-; knowledge of text characteristics -questions about text structure and organization-; knowledge of reading strategies- questions about how a reading problem can be solved). The results showed that metacognitive knowledge explained additional variance in L2 reading comprehension, beyond L2 vocabulary knowledge. Moreover, knowledge of text characteristics, knowledge of reading strategies and, to a lesser extent, knowledge of reading goals and comprehension criteria, appeared to be the most important domains of metacognitive knowledge.

Van Gelderen et al. (2004) analyzed whether there are differences in the contribution of processing speed components (word recognition and sentence comprehension), linguistic knowledge components (vocabulary and grammar knowledge), and metacognitive knowledge to the explanation of L1 and L2 reading comprehension. The authors employed a metacognitive knowledge test in order to measure L1 and L2 reading and writing strategies and text characteristics in the form of a questionnaire. The authors found that for L1 reading comprehension, only metacognitive knowledge makes a significant contribution, whereas for L2 reading comprehension there are two components that contribute significantly: metacognitive knowledge and vocabulary knowledge. In a subsequent study Van Gelderen et al. (2007) showed that the continuative effects of metacognitive knowledge related to reading

(e.g., text characteristics and about reading and writing strategies) on L2 reading comprehension across grades 8–10.

Yau (2009) showed a positive and significant correlation between the self-reported use of metacognitive strategy aimed at a global analysis of text (item example "I have a purpose in mind when I read"), the set of cognitive strategies aimed at overcoming difficulties while reading (item example "I read slowly and carefully to make sure I understand what I am reading") and the set of support strategies aimed at improving remember or synthesizing concepts in texts (item example "I take notes while reading to help me understand what I read") on L2 reading comprehension. Interestingly, Yau (2011) found that students' application of translation to reading (mental translation) that serves as a processing strategy impacted positively on L2 reading comprehension, suggesting a mediation by first language knowledge and proficiency.

Finally, Yeom and Jun (2020) tested the extent to which test-presentation mode and reading proficiency affect the use of reading and test-taking strategies in English learners as assessed through a self-report questionnaire. Results indicated that there are differences in the strategies used by learners with different levels of English reading proficiency (high, middle and low, depending on the scores on the reading comprehension tests). The high-proficiency group employed more strategies to enhance the quality of their reading comprehension than the other groups. The participants with high reading proficiency read the passage more carefully and used more metalinguistic knowledge of the passage than those with lower proficiency. The middle-proficiency group reread the passage and the questions, translated words or sentences and used the process of elimination much more frequently than the high and low-proficiency groups. Finally, the participants with lower proficiency tended to resort to guessing strategies. They reported using the strategies based on background knowledge.

Analyzing these studies as a whole, it can be said that metacognitive knowledge is usually assessed by means of self-report questionnaires. It is worth noting that some studies focused on reading strategies only, other studies included also other dimensions of metacognitive knowledge, such as the assessment of oneself as a reader, the knowledge of reading goals and comprehension criteria and the knowledge of text characteristics. In summary, these studies point out the contribution of metacognitive knowledge in EFL reading comprehension. In relation to reading strategies, problem solving seems to be an important predictor of comprehension. Specifically, students with high reading proficiency tend to use appropriate problem-solving strategies such as rereading, reading carefully, guessing the meaning of unfamiliar words and phrases.

Discussion

The purpose of this systematic review was to identify which are the relations between L1 and/or L2 language, cognitive, and higher-order cognitive and self-regulation skills and L2-English reading comprehension skills in 11-to-19 year EFL secondary school students. The degree of distance between EFL students' L1 and

L2-English was controlled to verify whether the predictors were stable across different language groups. It is important to consider the degree of distance between an L1 and an L2 (Gholamain & Geva, 1999; Green & Meara, 1987; Hamada & Koda, 2008) to verify whether relations between components identified in a language profile with high similarity (e.g., L1-Dutch and L2-English) also function in a language profile with scarce similarity (e.g., L1-Chinese and L2-English). We adopted the Simple View of Reading model (Gough & Tunmer, 1986; Hoover & Gough, 1990) and the multi-component models of reading comprehension (Kim, 2017) as the analytical frameworks of this review by targeting results on foundational (e.g., vocabulary) and upper-level (e.g., linguistic comprehension) language skills, cognitive (e.g., working memory) skills, and higher-order cognitive and self-regulation factors.

For what concerns the results of foundational and upper-level language skills, on the one hand, a part of the results traced L1 and L2-English *between-domains relations* (see, Brevik & Hellekjaer, 2018; Cueva et al., 2022; Kahan-Horwitz & Saba, 2018; Pae, 2019; Van Gelderen et al., 2004, 2007). Results showed that EFL secondary school students' L1 foundational language skills, such as vocabulary, syntactic/grammar knowledge play a significant role on L2-English reading comprehension. These studies provide empirical support of the linguistic interdependence hypothesis which highlights the role of L1 foundational language skills for L2 reading comprehension. This review also extends our understanding by showing that L1 foundational language skills can be easily transferable across L1 and L2-English regardless of their family language distance. In fact, L1 foundational language skills play a significant role for L2-English reading comprehension not only when L1 and L2 are closely related in terms of family language (see, Van Gelderen et al., 2007), for example, L1-Dutch and L2-English use the same alphabetic system and have many other similarities, but even when L1 and L2 are scarcely related (see, Cueva et al., 2022) or not related (see, Pae, 2019). Most of the studies focused on the transition between lower and upper secondary school. In this transition, we can expect L1 foundational language skills to be easily transferable because at this age most students are expected to have mastered language skills in L1. Conversely, the transition between primary and secondary school may reveal a higher difficulty in transferring L1 language skills to L2 reading comprehension. Indeed, if L1 foundational language skills are still suboptimal when entering secondary school, these could act as a barrier for L2 reading comprehension. There are very few results on L1 upper-level language skills and L2-English reading comprehension *between-domains relations*, thus cross-linguistic reading merits further investigation across different school grades and language systems.

On the other hand, a few studies (see Jeon, 2011; Sok et al., 2021) traced L2-English *within-domain relations*. EFL secondary school students' L2-English language skills were found to be closely associated with L2-English reading comprehension. The foundational language skill of vocabulary and the word reading component of morphological awareness in L2-English play a significant role for L2-English reading comprehension. The results by Jeon (2011) suggest a stronger role of the foundational language skill of vocabulary knowledge in L2 than the word reading component of morphological awareness in L2. Within upper-level language skills, L2

listening comprehension makes a significant contribution for L2 reading comprehension in EFL secondary school students with L1 not related with L2-English (e.g., Jeon, 2011; Li & Kirby, 2014). These findings could provide additional support for the Lexical Quality Hypothesis (Perfetti, 2007) and Threshold Hypothesis (Alderson, 1984), that emphasize the need of a basic level of linguistic competence in both L1 and L2 to comprehend expository texts written in English.

Our analysis also highlights that studies address all the most important foundational language skills (i.e., vocabulary and syntactic/grammar knowledge) that are included in the main reading comprehension models (e.g., SVR, Gough & Tunmer, 1986; DIER, Kim, 2017). Conversely, the role of upper-level language skills has been investigated in a limited way. In literature, there is evidence that reading comprehension and reading comprehension difficulties in second language learners are more influenced by listening comprehension than by word reading skills (e.g., Melby-Lervåg & Lervåg, 2014). Results from our systematic review suggest that more research is warranted to understand the role of foundational and upper-level language skills, such as word reading, and discourse-level skills, such as language comprehension (e.g., LAARC & Chiu, 2018), especially measured in L1, for EFL secondary school students' L2-English reading comprehension. Furthermore, the lack of longitudinal studies accounting for both foundational and upper-level language skills and the heterogeneity of measures for the same construct (e.g., breadth and depth of vocabulary knowledge) suggest that the interplay between language skills in L1/L2 and EFL reading comprehension merits more attention from research.

For what concerns the results of the domain of cognition, it can be stated that, despite its contribution to reading comprehension processes, it has not been comprehensively addressed in studies aimed at determining the predictive nature of cognitive variables in L2-English reading comprehension. Moreover, only working memory was investigated, neglecting other relevant cognitive skills for reading comprehension (e.g., attention, inhibition, or shifting). For example inhibition could be useful to manage linguistic information in L2, given the role of inhibition to access vocabulary in L2 (Darcy et al., 2016). Nevertheless, the association between working memory and text comprehension typically found in study on L1 reading (e.g., Baddeley, 2003; Kormos & Sáfár, 2008; Linck et al., 2012; Rouder et al., 2008) was extended to L2 reading (Alloway et al., 2006; Medina et al., 2017).

For what concerns the results of higher-order cognitive and self-regulation factors, the results indicate an underrepresentation of studies analyzing the contribution of these factors in EFL students' reading comprehension. The studies reviewed include only very few measures of higher-order skills. When they do, the predominant variable is metacognitive knowledge (e.g., Schoonen et al., 1998; Van Gelderen et al., 2004), while quite neglecting inference, self-assessment and self-reinforcement. The impact of metacognitive knowledge on L2-English reading comprehension was confirmed. Also, there is evidence that supports the hypothesis of the transfer of skills between L1 and L2 (Goodman, 1971), such as the role played by language-independent skills (i.e., inferential capacity and metacognitive processes). These processes appear, however, to contribute to higher-level comprehension (discriminating, for example, medium and advanced readers), rather than basic-level

comprehension. It remains to clarify which reading strategies are transferable from L1 to L2. For example when we do not know the meaning of a word, we can choose an active strategy such as inferring its meaning from the semantic context or we can look for the meaning of the word in a dictionary, causing an interruption of the representation construction of the text, and presumably an overload of cognitive processes.

Interestingly, there are rare cases of studies investigating both higher-order factors and language skills (i.e., Jeon, 2011; Schoonen et al., 1998; Van Gelderen et al., 2004, 2007) or both higher-order factors and cognitive skills (e.g., Sok et al., 2021) and their association with EFL reading comprehension. Those results seem to suggest that L2-English language skills are more related to L2-English reading comprehension than L1 or L2 cognitive skills or higher-order factors. However, being few and different in study designs or L1–L2 language distance, these results are still far from being conclusive and more research is needed to understand whether EFL reading comprehension might be better supported through an interplay between foundational language, cognitive, and higher-order constructs.

Limitations

A few limitations should be acknowledged. Although the present review contributes to filling some gaps in previous reviews, those works were more robust being meta-analyses. In the present review we categorized the studies by type of variables, language distance between L1 and L2-English, and text medium. Unfortunately, the limited pool and variety of included studies did not allow us to use meta-analysis design and techniques to investigate which categories matter more or which variable within each category has the highest impact on EFL reading comprehension.

One methodological limitation of the present review is that most of the studies focused on lower secondary school students, thus results should be interpreted with this specific school population in mind. Future studies should focus on other important school populations covering for example upper secondary school which is considered as a key school transition (Vettori et al., 2021). Concerning the measure of reading comprehension, this review was restricted to expository texts given their relevance for todays' world and lifelong learning; however, narratives are also important and should receive attention, given that secondary school students use this genre to communicate daily.

Moreover, only non-clinical samples of EFL students were included. Therefore, the results cannot be generalized to populations of students with disabilities or neurodevelopmental disorders. It would be important to understand whether the difficulties of a specific population increase or instead, assume a different profile of characteristics, and which language, cognitive, and higher-order factors are involved.

Furthermore, only three of the 27 studies have measured reading comprehension using digital devices (Brevik & Hellekjær, 2018; Brevik et al., 2016; Yeom & Jun, 2020). Several meta-analyses have shown the superiority of paper over digital media in terms of reading comprehension, especially when the texts are expository (Clinton, 2019; Delgado et al., 2018; Florit et al., 2022). However, there is an

under-representation of studies specifically looking at the impact of the medium on the reading comprehension of learners of English as a second language. The only research included in this review that specifically addressed this issue revealed no statistically significant differences between the participants' scores on the reading tests delivered on paper and computer. Nevertheless students preferred taking the test on paper and reported difficulties with the computer mode (Yeom & Jun, 2020).

Finally, as we restricted our attention to EFL secondary school students, this review should be replicated on students learning English as a second language, for instance in recent immigrants in English-speaking countries or disadvantaged populations with low socioeconomic backgrounds. Moreover, results should be extended to students learning languages as L2 other than English.

Conclusions

Despite the limitations, this review contributed to our understanding of which foundational and upper-level language skills, cognitive skills, and high-order cognitive and self-regulation factors in L1 and/or L2 are involved in the comprehension of expository texts in EFL secondary school students. For what concerns implications for research, the reviewed papers covered L1 and/or L2-English language, cognitive, and higher-order factors contributing to L2-English reading comprehension in EFL secondary school students. The studies provided detailed descriptions of sample, measures, and statistical results that support their reliability and validity. Moreover, the different language backgrounds of students included in the reviewed studies allowed us to verify the stability of key language, cognitive, and higher-order factors across different language groups, an important issue for a cross-linguistic perspective. However, some conceptual and methodological concerns need to be highlighted. First, the reviewed studies show a large variety of independent variables and measures, which limits the generalizability of findings. Second, the reviewed studies heavily relied on a single domain (language or cognitive or higher-order) to gain data on the predictive role on L2-reading comprehension. Further research is needed to clarify the simultaneous contribution of L1 and/or L2 foundational and upper-level language skills, cognitive skills, and high-order cognitive and self-regulation factors on reading comprehension of expository texts in L2-English to test the compensation effect. Furthermore, the use of longitudinal research designs would be desirable to identify early predictors. Specifically, given the relevance that these factors have for reading comprehension, we suggest that future research should focus on: depth of vocabulary knowledge and syntactic/grammar skills in L1 for foundational language skills, phonology, orthography, and morphology in L1 for word reading components, discourse-level skills in L1 such as listening comprehension for upper-level language skills, inhibition for cognitive processes, inference-making, reading strategies and self-assessment for the higher-order domain. Finally, it would be desirable to develop future studies that analyze how the textual medium influences the reading comprehension of EFL learners in relation to linguistic and cognitive variables.

For what concerns implications for practice, the findings of this review can inform and guide teachers and school practitioners to support EFL secondary

students' reading comprehension of expository texts in L2-English language. First, our findings suggest that teachers can rely on L1 foundational language skills, such as vocabulary and L1 word reading components such as morphological awareness, regardless of the degree of distance between L1 and L2-English. The reading curriculum could be designed in consideration of the linguistic interdependence for L2 teaching and learning in an EFL context, as outlined by Pae (2019). Second, we found that L2-English language skills (i.e., vocabulary and morphological awareness) are strongly associated with L2-English reading comprehension. Training L2-vocabulary knowledge and L2-morphological awareness should be directly targeted even at the secondary school level, whereas they are generally supported throughout primary school only.

We also identified the importance of working memory, a general cognitive domain ability, and metacognitive knowledge, as higher-order factors that could be integrated into intervention on reading comprehension for secondary school students. For example, assigned L2 expository texts are generally simplified for the EFL population, but research findings on the role of working memory suggests that there is still a risk of cognitive overloading. Higher proficiency EFL students in L2-English not only have higher vocabulary and grammar skills, but also adequate code-and-discourse skills and a higher strategic approach than lower proficiency students.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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