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Development of a cognitive-linguistic assessment battery for L1 Italian learners of L2 Chinese with and without literacy impairments

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Abstract: This paper outlines the design and development of an experimental test intended to evaluate the cognitive-linguistic factors that influence the acquisition of Chinese as a second language (L2) literacy among native (L1) Italian secondary school students. The study focuses specifically on learners with reading and writing impairments, as well as learners with diagnosed developmental dyslexia. These learners form a group known as "impaired readers". The performance of this group is then compared with that of typically developing learners (TDLs). The theoretical framework is based on the multiple deficit model of developmental dyslexia and research on Chinese native (L1) readers. The battery includes tasks targeting phonological awareness, orthographic processing, rapid automatised naming (RAN), working memory, visual attention and morphological awareness. These tasks have been adapted from assessments used with L1 Chinese learners and meticulously tailored for L1 Italian learners of L2 Chinese. This manuscript presents the comprehensive rationale, structure and detailed adaptation process of the assessment battery, alongside its data collection methodology. This foundational work establishes a robust methodological tool for future empirical investigations, with the ultimate aim of informing targeted interventions and educational strategies through analysis of the collected dataset. A subsequent publication will present a comprehensive report of the findings from administering the battery and their implications.

Keywords: literacy impairments, cognitive-linguistic skills, Chinese L2 acquisition, cross-linguistic research, educational interventions

Zusammenfassung: In diesem Papier wird das Design und die Entwicklung eines experimentellen Testverfahrens zur Bewertung kognitiv-linguistischer Faktoren, die den Erwerb chinesischer Lese- und Schreibfähigkeiten bei Schülern der Sekun-

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darstufe mit Italienisch als Zweitsprache beeinflussen, umrissen. Der Fokus der Studie liegt insbesondere auf Lernenden mit Lese- und Rechtschreibschwierigkeiten sowie auf Lernenden mit diagnostizierter entwicklungsbedingter Dyslexie. Diese Gruppe wird als "leistungsschwache Leser" (impaired readers) bezeichnet. Ihre Leistung wird anschließend mit der von typisch entwickelnden Lernenden (TDLs) verglichen. Der theoretische Rahmen basiert auf dem Multiple-Deficit-Model der Entwicklungsdyslexie sowie auf Forschungsarbeiten zu chinesischen Muttersprachlern (L1). Die Testbatterie umfasst Aufgaben, die das phonologische Bewusstsein, die orthografische Verarbeitung, die schnelle automatisierte Benennung (RAN), das Arbeitsgedächtnis, die visuelle Aufmerksamkeit und das morphologische Bewusstsein testen. Diese Aufgaben wurden von Messinstrumenten adaptiert, die bei chinesischen L1-Lernenden verwendet werden, und sorgfältig auf den Kontext italienischer L1-Lernender von Chinesisch als L2 zugeschnitten. Das Manuskript präsentiert die umfassende Begründung, die Struktur und den detaillierten Anpassungsprozess der Testbatterie sowie die Methodik zur Datenerhebung. Diese Grundlagenarbeit etabliert ein robustes methodologisches Werkzeug für zukünftige empirische Untersuchungen, um durch die Analyse des gesammelten Datensatzes gezielte Interventionen und Bildungsstrategien zu ermöglichen. In einer nachfolgenden Publikation werden die Ergebnisse der Testdurchführung und deren Implikationen umfassend berichtet.

Schlüsselwörter: Lese- und Schreibschwierigkeiten, kognitiv-linguistische Fähigkeiten, Chinesisch als L2, translinguale Forschung, Bildungsinterventionen

Resumen: Este artículo describe el diseño y desarrollo de una batería experimental destinada a evaluar los factores cognitivo-lingüísticos que influyen en la adquisición de la lectoescritura china entre estudiantes de secundaria cuya lengua materna (L1) es el italiano. El estudio se centra específicamente en estudiantes con dificultades de lectura y escritura, así como en aquellos con dislexia diagnosticada. Estos estudiantes conforman un grupo conocido como "lectores con dificultades de lectoescritura". Posteriormente, el rendimiento de este grupo se compara con el de los aprendices con desarrollo típico. El marco teórico se basa en el modelo de déficits múltiples de la dislexia y en investigaciones sobre lectores nativos de chino. La batería incluye tareas destinadas a evaluar la conciencia fonológica, el procesamiento ortográfico, la denominación rápida automatizada (RAN), la memoria de trabajo, la atención visual y la conciencia morfológica. Dichas tareas se han adaptado de evaluaciones utilizadas con hablantes nativos de chino y se han ajustado meticulosamente para el contexto de estudiantes italófonos de chino L2 en la escuela secundaria. Este manuscrito presenta la justificación, la estructura y el proceso detallado de adaptación de la batería de evaluación, junto con su metodología de recopilación de

datos. Este trabajo sentará las bases de una herramienta metodológica sólida para futuras investigaciones empíricas, con el objetivo final de informar sobre intervenciones y estrategias educativas específicas a partir del análisis de los datos recopilados. En una publicación posterior se presentará un informe exhaustivo de los resultados obtenidos tras la aplicación de la batería y sus implicaciones.

Palabras clave: dificultades de lectoescritura, habilidades cognitivo-lingüísticas, adquisición de chino como L2, investigación translingüística, intervenciones educativas

Abstract: Il presente contributo illustra lo sviluppo e la progettazione di una nuova batteria sperimentale finalizzata all'analisi dei predittori linguistico-cognitivi che influenzano l'acquisizione della letto-scrittura in cinese come L2 da parte di studenti italofoni delle scuole secondarie di secondo grado. Lo studio si concentra, nello specifico, su apprendenti con difficoltà nella letto-scrittura e su apprendenti con diagnosi di dislessia, che insieme compongono il gruppo dei "lettori atipici". Le performance di quest'ultimo gruppo di apprendenti sono state inoltre confrontate con quelle di un gruppo di controllo costituito da apprendenti con sviluppo tipico. Il modello teorico di riferimento, per quanto riguarda la ricerca sulla dislessia, è basato sulla presenza di molteplici deficit linguistico-cognitivi. L'inclusione delle diverse misure linguistico-cognitive nella batteria sperimentale si basa inoltre su studi sull'acquisizione della letto-scrittura per gli apprendenti cinesi L1. La batteria è composta da task che mirano alla valutazione della consapevolezza fonologica, ortografica e morfologica, della denominazione rapida automatizzata (RAN), della memoria di lavoro e, infine, dell'attenzione visiva. Questi task sono stati poi adattati al contesto di apprendimento degli studenti italofoni di cinese L2. Il presente contributo introduce le ragioni dello studio, il processo di adattamento e la struttura della batteria, nonché la metodologia adottata per la raccolta dei dati. Questo studio fornisce quindi un rigoroso strumento metodologico che può essere utilizzato per future indagini empiriche con l'obiettivo di supportare l'elaborazione di strategie didattiche e interventi mirati, basati sull'analisi del dataset raccolto. In una futura pubblicazione, verranno presentati i risultati empirici completi di questo studio e le loro implicazioni.

Parole chiave: difficoltà della letto-scrittura, abilità linguistico-cognitive, acquisizione del cinese L2, ricerca cross-linguistica, interventi educativi

1 Introduction

This study investigates the impact of developmental dyslexia and literacy impairments, as manifested in a transparent first language (L1, Italian), on the acquisition of Chinese as a second language (L2). Although a foundational understanding of dyslexia across languages historically centered on the Phonological Deficit Hypothesis (Ramus, 2003; Callens at al., 2012; Bradshaw et al., 2021), the field is increasingly shifting toward a multifactorial perspective. A recent Delphi study of dyslexia experts (Carroll et al., 2025) highlighted the consensus that developmental dyslexia is a neurodevelopmental disorder characterized by a highly heritable reading disability that often presents as unexpected given other cognitive abilities. The multifactorial view posits that dyslexia is not caused by a single, isolated deficit but rather by the cumulative effect of multiple, interacting cognitive weaknesses, including phonological processing difficulties, rapid automatized naming (RAN) deficits, and oral language weaknesses. This multifactorial view emphasises that a key feature of dyslexia in all languages is difficulty acquiring reading and writing fluency, and that the disorder persists throughout development despite changes in its manifestation. Consequently, as highlighted by the Delphi study, a crucial consensus is that a comprehensive evaluation should be based on 'converging evidence from multiple risk factors' rather than a single criterion (Carroll et al., 2025). This is particularly relevant in cross-linguistic studies, as the behavioral manifestation of these multiple deficits is profoundly shaped by the orthographic depth of the writing system. Orthographic depth refers to the consistency and predictability of the mapping between a language's spelling and its sounds, influencing whether readers rely more on a phonological (nonlexical) pathway in consistent orthographies, like Italian, or a lexical (orthographic) pathway in inconsistent orthographies, like English (Ziegler & Goswami, 2005). For example, Italian, with its highly transparent orthography, typically sees dyslexia expressed primarily as an impairment in reading speed and fluency, with fewer errors of accuracy compared to opaque orthographies such as English (Barbiero et al., 2012). In contrast, learning Chinese, which relies on a morpho-syllabic writing system (DeFrancis, 1989), introduces a different set of cognitive demands. While Pinyin (the alphabet-based transcription system of Chinese characters) involves phonological processing, reading characters requires strong visual-orthographic skills, awareness of radicals, and morphological processing (Shu et al., 2003).

This is crucial for understanding how dyslexia impacts L2 acquisition. The multiple-deficit framework for this study is not only based on the latest expert consensus from the Delphi study but also on established research on dyslexia in Chinese L1 readers, which consistently employs a multifactorial approach to assessment (McBride, 2018; Zhang et al., 2023, among others). Therefore, in a learning context

involving L1 impaired readers whose first language is alphabet-based, understanding the acquisition of L2 Chinese necessitates considering the interplay of L1 phonological deficits, the distinct orthographic and phonological features of Chinese, and the principles of cross-linguistic transfer.

This multiple-deficit framework provides a comprehensive and flexible model for our study, allowing us to examine how a constellation of cognitive weaknesses in L1 Italian learners interacts with the distinct demands of the Chinese writing system.

In Italy, there has been a steady growth in interest in teaching and learning L2 Chinese, with an increasing number of secondary schools incorporating it into their curricula (Favaloro, 2017; Gabbianelli & Formica, 2017; Rossi, 2017). However, research into how learners with specific learning disorders, particularly dyslexia, acquire Chinese literacy in this context remains scarce (Verzì & Roccaforte, 2024). Most of the existing literature focuses on L1 Chinese children, whereas little is known about how dyslexia impacts the acquisition of a typologically distinct orthography such as Chinese in adolescent learners with transparent L1 backgrounds, such as Italian (Verzì, 2023). The Chinese writing system has substantial differences from the transparent, phoneme-based orthography of Italian (Giaconi et al., 2019). This raises critical questions as to whether Italian learners with dyslexia experience similar reading difficulties in Chinese to those in their first language or if the structural features of Chinese offer compensatory advantages. A similar question was explored in a study by Kuester-Gruber et al. (2023), who investigated German-speaking children with and without dyslexia as they learnt Chinese. The researchers found that, although dyslexic children showed no significant differences to the control group in terms of their eye movements when naming Chinese characters, their overall accuracy in naming these characters remained significantly lower. These results imply that a morpho-syllabic script like Chinese may not offer a simple compensatory advantage against underlying phonological deficits, as these core difficulties can still significantly hinder accurate L2 performance despite the employment of alternative processing strategies.

To further explore the cognitive-linguistic profiles of L1 impaired readers in the context of L2 Chinese acquisition, this study has developed and assessed a comprehensive cognitive-linguistic test battery designed for Italian secondary school learners of L2 Chinese. The assessment battery includes tasks adapted from recent studies of dyslexia in L1 Chinese children from different Chinese-speaking societies (Pan et al., 2024) and of Chinese literacy acquisition for both L1 and L2 learners (Chang et al., 2022; Yang et al., 2021). These tasks assess phonological, orthographic and morphological awareness, as well as rapid automatised naming (RAN) and visual attention.

This paper primarily aims to detail the development, rationale and structure of a novel cognitive-linguistic assessment tool. Designed to evaluate literacy skills in

learners of L2 Chinese in Italian secondary schools, with and without dyslexia or undiagnosed literacy impairments, the paper focuses on the rigorous development, adaptation and pilot validation of the assessment tool. The empirical findings and their implications, derived from the battery's administration, will be reported in a dedicated subsequent publication. Specifically, this paper seeks to answer the following questions regarding the comprehensive cognitive-linguistic test battery:

1. What is the theoretical rationale and overall structure of the comprehensive cognitive-linguistic test battery designed to evaluate L2 Chinese literacy skills in Italian secondary school learners with and without dyslexia or undiagnosed literacy impairments?
2. How were the various tasks within the battery adapted for Italian L1 learners of L2 Chinese, taking into account specific cross-linguistic considerations?

2 Dyslexia in the Italian educational context

In the Italian education system, learners with dyslexia are formally recognised as part of a broader category of students with specific learning disorders (SLDs), which also encompasses dysgraphia, dysorthography and dyscalculia. This categorisation is defined in Article 1 of Law No. 170/2010 (Italian Parliament, 2010), landmark legislation that addresses the rights and support of students with SLDs specifically. According to the latest report by the Italian Ministry of Education, students with certified SLDs represented around 6 % of the school population during the 2022/23 academic year. Dyslexia was the most frequently diagnosed condition, accounting for 36 % of all SLD diagnoses. Prevalence rates also show regional variability, peaking in northern Italy and remaining markedly lower in the south (Italian Ministry of Education and Merit [MIM], 2024). The legal and institutional framework for SLD support is anchored in Law 170/2010, which formally recognises dyslexia as a neurodevelopmental condition that can significantly impact academic achievement despite adequate cognitive abilities and instruction. Article 3 of Law No. 170/2010 establishes the right of students with SLDs to personalised educational strategies and equal opportunities (Italian Law 170/2010). Diagnostic procedures for dyslexia are usually carried out after the second year of primary school, which is typically around the ages of 7–8. These must be conducted by public health services or accredited private specialists, as outlined in Italian Law 170/2010, Art. 3. Once diagnosed, students are entitled to a Personalised Didactic Plan (PDP) that outlines compensatory tools and dispensational measures in accordance with national and regional guidelines (Italian Law 170/2010, Art. 5; MIM, 2024). The law also mandates teacher training, early identification protocols, and close collaboration with families (Italian Parliament, 2010; Art. 4; MIM, 2024).

3 Differences in dyslexia manifestation and cognitive-linguistic correlates in L1 Italian and Chinese

Research indicates that in transparent orthographies such as Italian, dyslexia primarily manifests as a deficit in reading fluency and speed rather than accuracy (Tressoldi et al., 2001; Zoccolotti et al., 1999). This is largely due to the highly consistent grapheme-phoneme correspondence in Italian, which enables most dyslexic individuals to decode accurately, albeit often at a significantly slower pace. However, beyond reading, dyslexia in Italian is frequently associated with spelling problems (Bigozzi et al., 2015).

In contrast, Chinese is a morphosyllabic writing system that presents a very different set of cognitive and linguistic demands, resulting in a distinct dyslexia profile in first-language learners. While Chinese characters are morpho-syllabic units, processing them involves intricate interactions between visual-orthographic, phonological and morphological components (Shu et al., 2003). Recent research, including a comprehensive review by Zhang et al. (2023), has identified several critical cognitive-linguistic predictors of both typical and dyslexic readers in Chinese. These include phonological awareness, orthographic processing, morphological awareness, rapid automatised naming (RAN) and spelling skills. While deficits in phonological awareness and RAN are often considered 'language universal' across script types, deficits in orthographic and morphological processing are 'modulated to some degree by the linguistic properties of Chinese', making them more 'language specific' for Chinese (Zhang et al., 2023).

Understanding these cognitive-linguistic skills is vital.

- Phonological awareness: Unlike in alphabetic languages, where phonemic awareness is paramount, Chinese phonological awareness involves sensitivity to the sound structure of spoken language at syllable, onset-rime and, critically, tone levels (McBride et al., 2018). The ability to discriminate or produce lexical tones, or 'tone awareness', is a powerful predictor of character reading ability, often surpassing segmental awareness (Li et al., 2012). Deficits in these areas, particularly in tonal processing, are characteristic of L1 Chinese dyslexia and are usually evaluated using oral tasks (Shu et al., 2003; Zhang et al., 2023).
- Orthographic awareness: This refers to sensitivity to the visual structure and regularities of Chinese characters. It encompasses the ability to recognise common radicals and phonetic components and to understand their positional regularity and visual distinctiveness (Perfetti & Liu, 2005; Shu et al., 2003). Unlike the phoneme-based system of Italian, Chinese relies heavily on character re-

cognition. Although semantic-phonetic compounds form a significant proportion of the language, their phonetic components do not consistently provide accurate phonological cues, particularly during the early stages of learning (Zhou & Marslen-Wilson, 2009). The large number of radicals and phonetic components indicates high orthographic complexity (Perfetti & Liu, 2005). Dyslexia in Chinese often manifests in the presence of difficulties with accurate character recognition and visual-orthographic processing (McBride-Chang et al., 2005; Zhang et al., 2023).

- Morphological awareness: Due to the morphological transparency of many Chinese characters and compound words, morphological awareness — the explicit recognition and manipulation of meaning units (morphemes) — plays a significant role in Chinese reading development (Ku & Anderson, 2003). It is a robust predictor of character reading and vocabulary in native Chinese speakers, often explaining variance beyond phonological and orthographic skills (McBride et al., 2018; Shu et al., 2006). Deficits in this area are commonly observed in Chinese dyslexia (Kalindi & Chung, 2018).
- Rapid Automatized Naming (RAN): RAN assesses the speed with which familiar visual stimuli (e.g. characters, digits, pictures) are retrieved and named (Wolf & Bowers, 1999). RAN is a consistently strong and independent predictor of reading fluency and accuracy in L1 Chinese children, distinguishing dyslexic readers from those without dyslexia (Ho et al., 2004; Georgiou et al., 2008). Its cross-linguistic predictive power highlights its fundamental role in efficient lexical access (Lin et al., 2020; Kalindi & Chung, 2018; Zhang et al., 2023).
- Working memory and visual attention: These general cognitive abilities are also crucial. Working memory (e.g. phonological working memory) is essential for retaining and processing information during the recognition of complex characters and multi-character words (Yang et al., 2019). Visual attention refers to the efficiency of visual processing, which is measured through a visual search task. This task assesses how quickly and accurately an individual can locate a target item among distractors (Liu et al., 2015), a crucial skill for navigating the visual complexity of the Chinese writing system.

In summary, while the multiple-deficit model remains a core explanatory framework, the behavioural manifestations of dyslexia differ significantly between Italian and Chinese due to the distinct demands of their respective orthographies. Italian has a transparent phoneme-based orthography, whereas Chinese has a complex morpho-syllabic system. Italian dyslexia primarily affects reading fluency, whereas Chinese dyslexia often involves difficulties with character recognition accuracy, nuanced phonological processing (including tones) and morphological awareness. It is important to understand these differences in first language to

predict and analyse the challenges faced by Italian L1 impaired readers acquiring L2 Chinese.

4 Theoretical considerations for L2 Chinese literacy acquisition in adolescence

Understanding how developmental dyslexia manifests in L2 literacy acquisition presents unique complexities, particularly when examining a typologically distinct language such as Chinese, with a focus on adolescent learners. This area of research differs significantly from the extensive studies primarily conducted on L1 dyslexia in alphabetic languages.

It is important to recognise that L1 and L2 literacy acquisition are fundamentally different processes. L2 learners bring pre-existing cognitive abilities and prior L1 linguistic knowledge, which can facilitate or interfere with L2 learning (Kroll & Sunderman, 2003; Pavlenko, 2005). Furthermore, adolescent L2 learners exhibit different levels of cognitive maturity, metacognitive awareness and learning motivations compared to young children acquiring their L1. While some of the underlying cognitive deficits that are characteristic of L1 dyslexia (e.g. difficulties with phonological processing) are hypothesised to be universal and thus potentially manifest in L2 contexts (Kormos, 2017), the precise manner in which these L2 literacy challenges emerge and evolve is profoundly influenced by the particular L2 learning environment and the specific characteristics of the L2 orthography. This distinction is particularly relevant to the acquisition of L2 Chinese literacy. Despite being researched less extensively than L1 Chinese, Chinese language acquisition poses several unique challenges, including the demanding visual-orthographic processing required for character recognition, the important part played by morphological awareness and the acquisition of lexical tones, which are central to the language's phonological system (Siok & Fletcher, 2001; Liao, 2006). Studies from various contexts, including Asian settings (e.g. McBride-Chang et al., 2005), consistently reveal that even cognitively mature L2 learners encounter specific hurdles not typically present in L1 acquisition. These obstacles frequently stem from limited and less naturalistic exposure to the language, pedagogical methods that differ from immersion and the lack of implicit native language support accessible to L1 learners (Ellis, 2015; Krashen, 1985; Singleton & Ryan, 2004).

This study is specifically designed to address these complexities by focusing on Italian adolescents learning Chinese as an L2. Its aim is to investigate how established L1 impaired reading profiles interact with the distinct challenges in-

herent in L2 Chinese literacy. Given the current limitations in direct research on L2 Chinese dyslexia, this work primarily draws upon foundational L1 Chinese literacy research, particularly concerning core cognitive components of reading. Crucially, future findings will be interpreted through the lens of L2 acquisition theories, thereby acknowledging the fundamental differences in cognitive processing and learning environments between young L1 children and adolescent L2 learners.

5 Chinese L2 Learning context in Italian secondary schools

In Italian secondary schools, Chinese language instruction usually begins at senior high school level (ages 14–19), although a small number of institutions also offer it at middle school level. Students often have limited or no prior exposure to Chinese, learning it in a foreign language context where classroom activities are the main source of exposure to the language (Gabbianelli & Formica, 2017). Compared to other European second languages taught in Italy (e.g. English, Spanish, French and German), the introduction of Chinese as a curricular subject in secondary education is relatively recent. Nevertheless, significant institutional steps towards standardisation have been taken, such as the inclusion of Chinese language teaching in teacher training programmes and national recruitment (Favaloro, 2017). The curriculum usually follows the *Sillabo della Lingua Cinese* (2016), a national guideline that specifies learning objectives and vocabulary progression. Students are expected to reach a proficiency level of at least B1 according to the CEFR by the end of a five-year course. This corresponds to recognising approximately 800–1,200 characters. A key feature of the way Chinese is taught in Italy is the dual focus on Pinyin and character instruction (Rossi, 2017). Pinyin, a romanisation system, is usually introduced at the start of the learning process to help with pronunciation and is used as the main transcription tool. Although character recognition and writing remain central, Pinyin can provide a foundation for pronunciation and basic reading in the early stages. Teachers usually start teaching characters from the beginning, progressing from stroke order and radical components to multi-component characters and compound words (Rossi, 2017). Within this learning environment, error analysis reveals persistent challenges. Rossi (2017) indicates that interlinguistic errors, primarily interference from Italian L1, are common in the first two years and often persist throughout the learning process. Different error types are significantly affected by morphological factors and pedagogical methods, with students often underestimating the importance of phonetics (Rossi, 2017). Students

also report that character recognition and writing are affected by the frequency with which words occur in didactic materials and by the complexity of characters' shapes and number of strokes, leading to significant difficulty in writing characters with 11–13 strokes (Rossi, 2017).

According to Gabbianelli and Formica (2017), there is growing support for communicative-functional approaches that emphasise the importance of establishing a solid, well-structured communication context using visual aids (such as images and videos) and realia to promote motivation and effective learning. This approach also recommends the use of iconic definitions to reduce reliance on L1 translation, encouraging active, situated learning. Notably, pedagogical approaches utilising visual and iconic language and promoting active engagement have been found to be particularly beneficial for students with learning disabilities who may struggle with purely abstract concepts.

Inclusion of dyslexic students in foreign language learning is an important issue in Italian education. However, research concerning how to produce an inclusive foreign language education for L1 dyslexic learners of Chinese as a second language (L2) is lacking (Formica, 2015; Gesù, 2019; Verzì, 2023). Furthermore, most existing assessment tools and teaching strategies are designed for either Chinese L1 speakers or learners of L2s based on alphabetic scripts (e.g. English or other European languages), resulting in a lack of effective resources to support learners of L2 Chinese with dyslexia or reading impairments.

6 Development of a Chinese L2 assessment battery

6.1 Rationale and background

There is still limited research on dyslexic learners of L2 Chinese, especially compared to the extensive literature on dyslexia in L1 Chinese speakers or learners of alphabetic writing systems (e.g. English). This has led to a significant lack of effective resources to support dyslexic learners of non-alphabetic writing systems such as Chinese (Goswami et al., 2011; Kuester-Gruber et al., 2023). This paper addresses this issue by presenting a comprehensive task battery designed to assess the cognitive-linguistic abilities of L1 impaired readers and typically developing Italian learners of L2 Chinese, along with its development and administration procedure. The need for this specialised battery is further emphasised by the lack of existing tools for this specific purpose and context. While previous Italian studies (Formica, 2015; Gesù, 2019) have suggested teaching strategies for first-language Italian learners of second-language Chinese, they have not primarily focused on identifying the precise cognitive and linguistic challenges that predict second-language Chinese reading

and writing difficulties. Other research also acknowledges this gap, highlighting the fundamental need for studies on students with special educational needs (SEN), particularly those with specific learning disabilities (SLD), and their difficulties with character identification in the context of L2 Chinese (Eletti et al., 2021).

The experimental battery aims to comprehensively assess all relevant cognitive-linguistic predictors, employing tasks specifically designed to identify potential deficits, and drawing on prior research on L1 Chinese readers with and without dyslexia (Liu et al. 2015; Yang et al. 2021; Chang et al. 2022; Pan et al., 2024). This study thus makes a significant contribution both theoretically and practically to research on dyslexia and second language acquisition (SLA), shedding light on how specific cognitive-linguistic skills interact and contribute to reading challenges, and laying the foundation for future targeted interventions.

6.2 Experimental battery design

The experimental battery used in this study was meticulously designed to assess cognitive-linguistic skills in both the learners' L1 (Italian) and L2 (Chinese), alongside general cognitive abilities relevant to literacy (see Tab. 1).

For L1 Italian literacy skills, five tasks were included. Four were adapted from the standardized Italian battery **Nuova Batteria per Studenti Universitari e Adulti LSC-SUA** (New Battery for University Students and Adults LSC-SUA) (Cornoldi & Montesano, 2020), and the fifth was a Rapid Automatized Naming (RAN) task.

The reading portion consisted of three tasks. The first, **Word Reading**, required participants to read aloud a total of **112 words** across four lists of varying length and frequency. The second, **Non-Word Reading**, required reading aloud two lists containing a total of **56 non-words**. For both Word Reading and Non-Word Reading tasks, the time taken, the number of errors and the number of syllables per second were recorded and scored.

The third, **Lexical Decision in Articulatory Suppression**, required participants to silently read a list of **120 stimuli** (60 words and 60 non-words) and cross out only the real words while continuously repeating the Italian syllable "LA" aloud within a 60-second time limit. The accuracy score was calculated by subtracting the number of incorrectly marked non-words from the number of correctly identified words.

For the writing assessment, a **Word Dictation** task was administered, where participants wrote down a total of **56 words** dictated by the examiner at a constant pace. The score was based on the number of errors, with one point assigned for each word that was written incorrectly, omitted, or incomplete. Finally, a **RAN** task,

adapted from Pan et al. (2024), measured the speed of naming digits. This task involved one practice trial and eight experimental trials, with the average time across two attempts for each of the eight sequences recorded.

It is important to highlight that while an Italian RAN task was included to assess L1 lexical retrieval speed, Chinese RAN measures were deliberately excluded. This decision was based on the rationale that for L2 learners of Chinese, a rapid naming task involving Chinese characters (especially numbers) would predominantly function as a measure of lexical knowledge and character recognition fluency rather than a pure rapid automatized naming ability. Given the relatively early stage of L2 acquisition (B1.1–B1.2), such a task could disproportionately reflect an individual's accumulated vocabulary and character recognition effort rather than the underlying speed of accessing familiar phonological codes, which is the primary aim of RAN assessment in dyslexia research.

The Chinese language battery, adapted from recent studies on dyslexia in L1 children from different Chinese societies (Pan et al., 2024) and on Chinese literacy acquisition for both L1 and L2 learners (Chang et al., 2022; Yang et al., 2021), consisted of ten tasks categorized as follows: three phonological awareness tasks, two orthographic awareness and working memory tasks, two morphological awareness tasks, and three Chinese literacy tasks focusing on reading accuracy and spelling.

Additionally, a Visual Attention task was part of the overall battery as a general cognitive measure, integrated based on findings from previous studies on Chinese dyslexia in L1 children (Liu et al., 2015).

In developing the Chinese language tasks, a common lexicon suitable for both 4th- and 5th-year students was identified. Characters were selected from the *Sillabo della lingua cinese* (2016), focusing on vocabulary taught up to the end of the third year. This ensured that the test was accessible to all participants, though it was slightly easier for older students. This approach provided a clearer picture of linguistic competencies by age and class, allowing for a fair assessment across different age groups while maintaining consistency in the evaluation process.

Table 1: Overview of Experimental Battery Tasks

Battery Component	Task Category / Name	N	Adaptation Sources
Italian L1 Literacy Skills	Word Reading, Non-Word Reading, Lexical Decision in Articulatory Suppression, Word Dictation, Rapid Automatized Naming (RAN)	**5**	*Nuova Batteria per Studenti Universitari e Adulti LSC-SUA* (Cornoldi and Montesano, 2020); Pan et al. 2024
Chinese L2 Language Battery	Phonological Awareness, Orthographic Awareness,Working Memory, Morphological Awareness, Chinese Literacy (Reading Accuracy and Spelling)	**10**	Recent studies of dyslexia in L1 Chinese children (Pan et al., 2024) and on Chinese literacy acquisition for both L1 and L2 learners (Chang et al., 2022; Yang et al., 2021). The first MA task was originally designed for this study, the second was adapted from Pan et al. (2024)
General Cognitive Measure	Visual Attention Task	**1**	Integrated based on findings from previous studies on Chinese dyslexia in L1 children (Liu et al. 2015).

6.3 Phonological awareness tasks

The phonological awareness tasks were designed to assess participants' ability to recognise and manipulate phonological units within Chinese syllables. Adapted from Pan et al. (2024) and tailored for L2 learners, these tasks included the *Onset detection task*, *Rime detection task*, and *Pinyin writing task*, each of which targeted different aspects of phonological processing. All items were presented to participants via audio files extracted from online dictionaries to ensure accurate and consistent pronunciation.

In the *Onset detection task* participants were asked to identify the initial phoneme (onset) from a set of syllables. The task consisted of one practice item and seven test items: after hearing three syllables, participants had to identify the one with a different onset by circling the corresponding number on the answer sheet. For example, given the syllables /shuō/, /shí/ and /zuǒ/, the participant had to identify /zuǒ/ as having a different onset and circle the corresponding number.

The *Rime detection task* assessed the ability to identify the rime (vowel and any following consonants, if present) in a set of syllables. This task includes one practice item and six test items. The administration procedure mirrored that of the Onset Detection Task: participants listened to three syllables and had to identify the one with a different rime. For example, given the syllables /shí/, /zhōng/, and /chǐ/, they had to

recognize /zhōng/ as having a different rime. For both *Onset detection* and *Rime detection task*, one point was allocated for each correct answer.

These first two phonological awareness tasks provide insight into learners' ability to process and understand the phonological units of Chinese, which are crucial for the decoding skills required to read Chinese characters. Phonological cues are incorporated into the characters, and onsets and rimes are key components in developing reading fluency in Chinese. These skills are essential for improving orthographic learning, where learners can associate auditory rime patterns with their corresponding written forms (Yuan et al., 2022).

The *Pinyin writing task* was designed to assess participants' knowledge of onsets, rimes, and particularly lexical tones, which are essential for accurate spoken Mandarin but often challenging for L2 learners (Hao, 2012). Words were presented orally via audio recordings. The task included one practice item and thirteen test items, comprising eight one-syllable words and five two-syllable words. The task, partly consistent with the original version developed by Lin et al. (2010) but adapted for L2 learners, was evaluated through five different measures: onset and rime accuracy, onset and rime order, and lexical tone accuracy (both precision and position of tones)[1].

6.4 Orthographic awareness and working memory tasks

The orthographic awareness and working memory tasks comprised the *Chinese orthographic choice task* (COCT), adapted from Chang et al. (2022), and the *Chinese delayed copying task*, adapted from Pan et al. (2024), both tailored specifically for L2 learners. It is acknowledged that these tasks inherently involve multiple cognitive processes concurrently, but they were deliberately chosen to target the unique intersection of cognitive and orthographic skills critical for Chinese reading acquisition (Li et al. 2012, 2018; Siok et al. 2009; Tan et al. 2005). Specifically, the Delayed Copying Task assesses memory skills: while it certainly draws on orthographic knowledge, the delay component is intended to primarily stress the visuospatial working memory required to briefly hold and reproduce the complex spatial structure of Chinese characters. In parallel, the Orthographic Choice Task (COCT) specifically measures orthographic awareness by requiring the learner to discriminate between small, visually similar components; its primary function is to gauge the learner's knowledge of legal character structures, making it a targeted measure of

1 The scoring scheme for this task was developed in concordance with the original author of the task, Dr. Lin Dan, cited in text (Lin et al., 2010). For more detailed information on the scoring scheme, interested readers may contact the author of the present paper.

orthographic processing. In Chinese orthography, each character is a configuration of strokes and components. Characters can range from simple to compound, consisting of two or more separate elements. Components, and more specifically radicals, play an important role in distinguishing one character from another and are bound by positional constraints within the character structure. The intricate combination rules and positional regularity of radicals make Chinese orthography one of the most visually complex writing systems (Chen et al. 2011). For example, the components 氵 (water) and 扌 (hand) appear only on the left side, e.g. 汽 qì (gas), 招 zhāo (recruit), while the components 攵 (tap) and 刂 (knife) appear only on the right side, e.g., 敏 mǐn (smart), 釗 zhāo (encourage), and the components 艹 (grass) and 宀 (roof) only appear at the top, e.g. 茶 chá (tea), 富 fù (rich). However, there are also radicals that can occur in more than one position. For example, the radical 女 nǚ (woman) can appear in many different positions: in characters such as 妈 mā (mother) or 她 tā (she), it appears on the left; in the character 妆 zhuāng (put on make-up), it appears on the right; in characters such as 婴 yīng (baby, infant) or 娶 qǔ (marry a woman) the radical appears at the lower part. Similarly, the radical 马 mǎ (horse) can occur in different positions in a character, e.g. compare the following characters: 骑 qí (to ride), 码 mǎ (code or number), 骂mà (to curse). Radical positional regularity determines the legitimacy of Chinese characters; any character that violates these rules is considered illegal. Knowledge of positional regularity is essential for encoding characters effectively and enhances learners' ability to acquire Chinese; Loh et al. 2021). The *Chinese orthographic choice task* (COCT) assesses learners' ability to recognize radical positional regularity. Adapted from Chang et al. (2022), the task evaluates whether participants can identify which of two artificial characters more closely resembles a valid Chinese character based on permissible radical positions. Artificial characters, often used in research on Chinese character acquisition, highlight the importance of radical positioning in lexical processing (Chen and Zhou 1999; Taft et al. 1999; Li et al. 2012). The COCT is a widely used paradigm for assessing orthographic skills using positional information (Cheng 1981; Wang et al. 2005). Participants are presented with a pair of stimuli and asked to intuitively choose the one that looks more like a legitimate Chinese character. In this study, the COCT included one practice item and 20 experimental items. Each pair of stimuli was presented to participants, who identified which artificial character contained radicals in legal positions. To accommodate L2 learners, only pseudo-characters with high-frequency radicals were used, ensuring the task's difficulty was appropriate without being overwhelming. Scores were calculated by assigning one point for each correct response. The *Chinese delayed copying task*, adapted from Pan et al. (2024), was designed to evaluate orthographic processing and working memory by requiring participants to reproduce unfamiliar, low-frequency Chinese characters from memory after a brief presentation. This task in-

cluded one practice item and five experimental items, following Pan et al.'s (2024) original procedure: 1) a ready-check screen, 2) a fixation point, 3) a brief display of the character, and 4) a blank screen. Participants then wrote the character from memory. A key adaptation for the Delayed Copying task, differentiating it from some L1 Chinese or L2 alphabetic language studies, was the extension of the character display time from two seconds (as in the original study) to five seconds. This decision was crucial given the typological distance and visual complexity of Chinese characters for L2 learners. Unlike L1 speakers or learners of alphabetic scripts, L2 learners often encounter Chinese characters that are entirely unfamiliar and visually intricate. The extended display time was implemented to reduce the initial encoding and memorization load, ensuring that the task primarily measured the ability to retain a character's visual form for a short period. This adaptation was also directly supported by preliminary observations during the pilot study, where learners clearly required additional time to process and recall characters effectively. This allowed the task to more accurately capture the targeted visual-orthographic and working memory skills in a realistic L2 context. The characters used were unfamiliar yet not excessively complex, featuring clear radical structures (e.g., 恋 *liàn*, 汞 *gǒng*). This adaptation maintained the challenge while allowing participants to process and reproduce the characters. The scoring system was adapted from Pan et al. (2024) in its principle of assigning a maximum of 2 points per character item, with deductions for errors. Specifically, each copied character was scored on a 3-point scale: 2 points were assigned for a completely correct reproduction of the character; 1 point for a copy with minor errors (e.g., a missing or extra stroke, or slight distortion anywhere within the character components that did not render the character unrecognizable); and 0 points for a copy with two or more significant errors, or if the character was unrecognizable or absent.

6.5 Morphological awareness tasks

The morphological awareness tasks in this study included two types: the *Compound word production task using pictures* and the *Compound word production task using sentences*. These tasks were designed to assess participants' ability to create compound words in Chinese.

In addition to the orthographic features highlighted above, another structural language feature of Chinese that affects typical and dyslexic readers differently is morphology. Morphological awareness is key to vocabulary and reading comprehension, particularly due to the homophonic nature of Chinese and the prevalence of compound words. The role of morphology has been shown to be particularly important for understanding reading acquisition in L1 Chinese learners, both with and

without dyslexia. Specifically, Chinese readers with dyslexia generally tend to perform poorly on morphological awareness tasks, with the most prominent deficits related to homophone processing and lexical compounding (Chung et al. 2010; Chow et al., 2005; Shu et al. 2006; Kalindi and Chung 2018). More specifically, evidence from recent research suggests that awareness of lexical compounding is a relevant predictor of reading acquisition. Consequently, the present experimental battery focused on compound words rather than homophones, following recent findings on the assessment of lexical compounding awareness in learners from different Chinese societies (Pan et al. 2024).

Typically, Chinese words are formed by combining two or more morphemes, so that many words share the same morpheme and are semantically related. Given this structure, Chinese can be considered semantically transparent to some extent, as complex vocabulary can be built by combining morphemes. Furthermore, compound words are very common in Chinese, so it is essential for both L1 and L2 learners to develop a strong morphological awareness in order to understand and use these compounds effectively (Lau et al. 2022).

Thus, the focus on compound words aims to tap into this critical aspect of Chinese morphology and provide valuable insights into how L2 learners process and acquire complex word forms in Chinese.

The *Compound Word Production Task using pictures* was designed to assess learners' ability to morphologically combine two characters to form semantically plausible compound words in Chinese, whether or not the resulting compound is a naturally occurring word in standard Chinese. This objective was to tap into learners' understanding of morphological principles and their capacity to create novel meanings through word compounding, a crucial aspect of Chinese vocabulary acquisition. While learners were often familiar with the individual components, the task was not restricted to existing lexical entries; instead, it encouraged focus on the combinatorial morphological ability to derive new significance from the two presented characters. Participants were presented with pictures[2] representing the requested compounds, along with the individual character components, categorized into noun-noun and resultative compounds. They were then tasked with producing the appropriate compound word in Chinese that matched the image, using the provided components. The task included one practice item and ten experimental items. To support comprehension and reduce extraneous cognitive load, pinyin transli-

2 All the visual stimuli used for this task were generated by the author using an image-generator AI program. Item categories were randomized when presented, and for each compound, components were also randomized.

teration and Italian translations of the individual character components were consistently displayed alongside the characters. For instance, a practice item involved the noun-noun compound 冰山 bīngshān (iceberg). Participants were shown the components 山 shān (mountain) and 冰 bīng (ice), each with its pinyin and translation, followed by a picture of an iceberg and the question: "How would you say this in Chinese?." Another example, an actual experimental item, was the resultative compound 吃饱 chībǎo (eat until full). For this, participants saw the components 吃 chī (eat) and 饱 bǎo (full), accompanied by their pinyin and translations, along with a picture depicting a person appearing very full after eating a lot of food, along with the same question. This task was entirely experimental and, to the best of the researcher's knowledge, has not been used in any previous studies. It was specifically designed to be suitable for younger and less proficient L2 learners, emphasizing the recognition and production of compound words using familiar components. Each correct answer was awarded one point.

The second task type is the *Compound Word Production Task using sentences*. This task was based on a similar one used in Pan et al. (2024) but was adapted and tailored to suit the language proficiency of the L2 learners participating in this study. This adaptation involved providing the descriptive sentences entirely in the participants' L1 (Italian) and including pinyin for example Chinese compound words within the description, to reduce cognitive load associated with L2 reading comprehension. It assesses participants' explicit morphological awareness and their ability to generate appropriate compound words in Chinese after reading a descriptive sentence provided in their L1. Participants were presented with a series of sentences describing compound words. The task included one practice item and ten test items. For each item, they were required to create a new compound word in Chinese based on the description given. For example: "C'è un tipo di casa che si trova sulla montagna, e noi chiamiamo questo tipo di casa 'casa in montagna' (山房 shānfáng, dove 房 fáng = 'casa'). Come chiameremmo in cinese una casa che si trova vicino al mare?" (English translation: "There is a type of house that is located on the mountain, and we call this type of house 'mountain house' (山房, where 房 means 'house'). How would we call a house that is located near the sea in Chinese?"). The expected answer is "海房 hǎifáng ('sea house,' in Italian 'casa al mare')."

The decision to base the analogical reasoning on novel or pseudo-compounds (e.g., 山房) is a deliberate methodological choice to ensure construct validity. The task engages a two-step cognitive process, testing the student's mastery of abstract morphological rules, rather than simple vocabulary recall. This process begins with Decomposition (Analysis): The participant must first successfully break down the structure of the novel example provided (山房) to extract the underlying morphological rule (e.g., Compound = [Location Morpheme] + [Object Morpheme]). Only

after successfully extracting this rule can the participant correctly proceed to Composition (Production), where they apply the rule compositionally to the new scenario, e.g., using *sea* (海) + *house* (房) to generate 海房. This rigorous process ensures that the score reflects the mastery of rule-based word formation ability, providing a cleaner measure of morphological awareness. The task included one practice item and ten experimental items. For both morphological awareness tasks, one point was allocated for every correct answer.

6.6 Chinese literacy tasks

The Chinese literacy tasks in this study included the *Chinese character reading task*, the *Chinese word dictation task*, and the *Chinese word segmentation task*. These tasks were adopted to evaluate various aspects of reading accuracy and spelling proficiency in Chinese, crucial for understanding the literacy development of L2 learners, particularly those with dyslexia.

The *Chinese character reading task* involved presenting participants with a series of high-frequency characters, which they were asked to read aloud. This task assessed learners' ability to accurately recognize and pronounce Chinese characters, and it comprised two practice items followed by ten test items. This measure primarily focused on assessing reading accuracy. Participant performance was scored based on the number of correctly read characters. The scoring scheme is dichotomous: 1 point was allocated for each correct response (Pan et al. 2024), and 0 points were allocated for an error, including any mispronunciation or omission. The final task score is the sum of all correctly read characters. The administration used a fixed duration of three seconds for each character, after which the next character automatically appeared. While this timing constrained the response window for each item, the primary focus of both scoring and subsequent analysis remained exclusively on the accuracy of character recognition and pronunciation, not on processing speed. As demonstrated in Shen and Jiang's (2013) study on adult L2 Chinese learners, character-naming accuracy is a strong predictor of reading comprehension, often more salient than processing speed in early stages. Due to the complex, logographic nature of the script, accurate character recognition fundamentally requires precise memorization of the character's unique visual form and its correct pronunciation, which is critical given the script's limited sound-to-script correspondence (Shen & Jiang, 2013). Furthermore, the choice of single-character reading over entire word reading is supported by research on L1 Chinese readers (Li et al., 2017), which demonstrates that recognizing single characters can be more challenging than reading multiple-character words, as the latter can provide mutual cues that aid recognition.

The *Chinese word dictation task* focused on evaluating the learners' ability to write Chinese words correctly under dictation. Participants were orally presented with Chinese words and were required to write down the corresponding characters. This task included one practice item and ten test items. Writing and spelling proficiency are essential indicators of orthographic knowledge and phonological processing skills: accurate spelling in Chinese requires knowledge of stroke order, radical positions, and the ability to recall and reproduce complex character structures (Shen and Ke 2007). The scoring scheme awarded two points if the participant wrote the entire word correctly, one point if the participant wrote one character correctly or made minor errors in one or both characters (Pan et al. 2024).

In summary, assessing character reading accuracy identifies specific difficulties in character recognition and pronunciation for L1 impaired readers, guiding targeted interventions (Chung et al. 2010). Meanwhile, the evaluation of spelling skills provides insights into orthographic and morphological challenges, informing specialized teaching strategies (Tan et al. 2005).

The *Chinese word segmentation task* was designed to measure participants' reading accuracy and comprehension of the written Chinese text, with a specific focus on word identification fluency and segmentation ability through individual word reading and contextualized word reading. This task is adapted from a similar task used in Pan et al. (2024). However, unlike the original version that used chains of words in English, this version employs Chinese word chains to maintain linguistic consistency. To ensure a standardized approach, the word segmentation task used in Yang (2021), which investigates word segmentation among Chinese L2 learners, was taken as a reference. The task presents both chains of unrelated Chinese words and contextualized Chinese words[3] and requires participants to segment them correctly. This assesses the ability to identify and isolate words in a sequence with and without contextual cues. The test consists of two practice items (one for unrelated words, one for contextualized words) and ten experimental items. Participants are scored on the number of words they segment correctly. The maximum possible score for each subtest is determined by the total number of segmentable words in the test items. The scoring scheme for this task, based on Pan et al. (2024) gives one point for each correctly segmented word. For clarity, examples of segmentation are provided: for individual word chains, 老师医院笔记本椅子 (Correct segmentation: 老师 / 医院 / 笔记本 / 椅子); and for contextualized sentences, 学生每天在操场跑步打篮球 (Correct segmentation: 学生 / 每天 / 在 / 操场 / 跑步 / 打 / 篮球).

3 Contextualized word chains consist of Chinese words presented in a meaningful sequence, where the words collectively form a coherent context (e.g., a simple sentence or phrase). In contrast, unrelated word chains are sequences of Chinese words presented without any logical or semantic connection, resembling a random list of individual words.

7 Application of the battery: Study cohort and pilot test

A total of 80 students (19 males, 61 females) participated in the study. Their mean age was 17 years, 5 months (*SD* = 11 months; range = 16–19 years).

For analytical purposes, participants were categorized into two main groups (see Chart 1): the group of L1 impaired readers (N=20) and the group of typically developing learners (N=60) with no diagnosed learning disabilities, matched to the impaired readers group by age, grade, and general language proficiency, serving as a control group. Due to challenges encountered in recruiting a big enough number of certified dyslexic learners, the impaired readers group included seven participants with a pre-existing clinical diagnosis of dyslexia and thirteen participants identified as impaired readers based on their performance on Italian language tasks. Consistent with diagnostic criteria for dyslexia in Italian children (Sartori et al., 2007; Italian Dyslexia Association, 2009), participants that scored at least 1.5 standard deviations below the mean in a minimum of two out of three Italian reading tasks (word reading, non-word reading, and lexical decision in articulatory suppression) were categorized as "impaired readers".

To ensure the validity of comparisons, all participants had normal or corrected-to-normal vision and were enrolled in their fourth or fifth year of high school. They were expected to have intermediate proficiency in Chinese (B1.1, B1.2) at the beginning of battery administration, according to the *Sillabo della lingua cinese* (2016). Participants had an average of 3 years of Chinese study (for 4th-year students) and 4 years (for 5th-year students), having all begun Chinese instruction at the start of high school. Prior to data collection, teachers were consulted regarding their perceptions of students' general L2 learning difficulties and any unofficial indications of L1 learning difficulties. This consultation aided in the initial selection of a diverse sample, with formal categorization occurring after data analysis.

The ethical approval process was rigorously followed. Recruitment was conducted on a voluntary basis in collaboration with the participating schools, involving head teachers, Chinese language teachers, and parents. All parents provided informed consent through forms clearly explaining the study's scope and aims. The research activities were approved by the Ethics Committee of Ca' Foscari University of Venice.

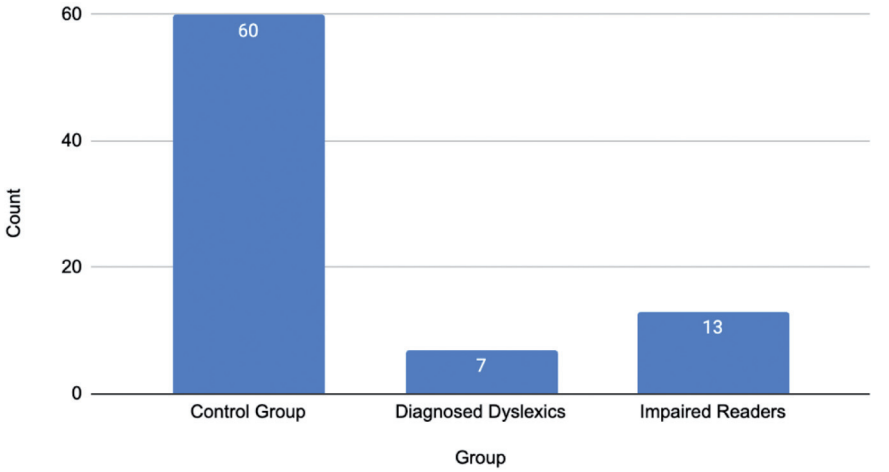

Chart 1: Composition of the Study Cohort (N=80)

Before finalizing the experimental battery, a pilot study was conducted with a small group of 24 learners from one of the selected schools. The primary aims were to assess the tasks' efficiency, reliability, and comprehensibility. The battery's design was thoroughly discussed with experienced L2 Chinese teachers in Italy, whose feedback was instrumental in refining tasks to align with the curriculum and developmental stage of the learners. The pilot study mirrored the final battery design, which encompassed tasks for L1 (Italian) literacy, L2 (Chinese) cognitive-linguistic skills, and general cognitive abilities (see details in Section 6.4). As no significant modifications were made to the battery following the pilot study, the data from its 24 participants were subsequently included in the final analysis.

8 Conclusions, limitations, and future directions

This paper has presented the theoretical and methodological foundations of an experimental battery developed to assess cognitive-linguistic predictors of Chinese literacy acquisition in Italian L2 learners with and without dyslexia. Particular attention has been given to the rationale for task selection and adaptation, with a focus on ensuring cross-linguistic appropriateness and accessibility for L2 learners. The forthcoming stages of this research will be dedicated to the full statistical analysis of the collected data. By laying the groundwork for empirical investigation, this study supports the development of more inclusive and evidence-based assessment and instruction for L1 Italian impaired readers of L2 Chinese.

Despite its contributions, this study presents a number of methodological limitations that offer valuable directions for future research. First, a key limitation is the heterogeneous composition of the impaired readers group, which includes both formally diagnosed dyslexic learners and those identified based on their performance on our L1 assessment. While this approach was necessary due to recruitment challenges, the diverse origins of reading difficulties in this group could potentially influence the findings. This heterogeneity will be addressed in our data analysis by comparing the groups using statistical methods appropriate for unequal sample sizes. Future research should aim to replicate these findings with a larger, clinically homogeneous sample to better isolate the cognitive-linguistic profiles of formally diagnosed dyslexics.

Second, the presence of comorbidities with other specific learning disorders (e.g., dysgraphia, dyscalculia) or factors like social and academic anxiety in some participants could have influenced task performance and complicated the interpretation of certain results. Future studies with larger sample sizes could employ statistical methods to control for these variables or allow for subgroup analyses based on comorbidity profiles, providing clearer insights into their specific impact on L2 Chinese learning outcomes. Third, beyond these clinical complexities, understanding other external factors, such as the interaction of task modality with L2 Chinese exposure, learner motivation, and specific instructional contexts, warrants further investigation.

Furthermore, this study's limitations also relate to the tasks themselves. While each task was designed to measure specific cognitive-linguistic skills, they may not capture the full complexity of these constructs, or may not be perfectly "pure" measures of a single skill. Additionally, the possibility of ceiling or floor effects must be considered, as some tasks may not have been sensitive enough to detect subtle differences in performance among our participants.

Finally, to achieve a more comprehensive evaluation of linguistic abilities relevant to Chinese literacy acquisition, future studies should aim to enhance the battery by integrating additional cognitive-linguistic measures, such as receptive vocabulary tasks or semantic and phonetical radical awareness tasks. Additionally, comparative studies including learners with other L1 backgrounds could offer crucial insight into how typological distance and L1 transfer impact dyslexia in L2 Chinese.

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