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University students with specific learning disabilities: Insights from instrumental, neuro-psychological and study-related profiles

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Abstract

In recent years, there has been a growing enrolment of students with specific learning disabilities (SLDs) in Italian higher-education programmes, underscoring the need for universities to support these students by identifying their strengths and weaknesses and developing targeted interventions. However, literature focusing on university students with SLDs remains limited. This study aims to describe the profiles of a sample of first-year Italian university students with SLDs, examining aspects such as instrumental skills, neuropsychological profiles and study-related abilities. Our results confirm that instrumental skills in students with SLDs are statistically lower than the normative average, indicating that difficulties in reading and arithmetic seem to persist into adulthood in students with SLDs. Additionally, a detailed neuropsychological assessment reveals significantly lower verbal working memory among students with SLDs, but statistically significant higher scores in visuospatial abilities. Furthermore, the results show that students with SLDs rate lower on learning approach scales; however, no differences were found in study strategies and learning goals. These findings highlight a unique profile among the university students with SLDs and underscore the need for tailored intervention programmes and support services to increase awareness and foster academic success among these students.

KEYWORDS
learning goals, neuropsychological profiles, specific learning disabilities, study approach, study strategies, university students

Key points

- Students with specific learning disabilities (SLDs) exhibit lower instrumental abilities, indicating that their difficulties in reading and arithmetic persist into adulthood.
- Students with SLDs show a reduced use of advanced metacognitive strategies, underlying possible complexity in self-regulated learning activities at university.
- Students with SLDs show lower verbal working memory but higher visuospatial abilities.
- Tailored interventions should address the unique challenges faced by university students with SLDs, considering not only instrumental skills and neuropsychological factors but also study-related abilities, to promote student achievement and well-being.

INTRODUCTION

In recent decades, enhancements in the diagnostic process for specific learning disabilities (SLDs), coupled with increased awareness among educators, parents and school professionals, have significantly improved the accuracy of diagnoses and interventions, as well as the effectiveness of support systems in primary and secondary education. These advancements play a crucial role in facilitating access to higher education for individuals with SLDs, by addressing their needs during their school years (Anthony et al., 2024; Laguillo et al., 2023; Ministero dell'Istruzione, 2022). This positive trend has encouraged a greater number of students with SLDs to enrol in higher education, especially because an Italian law (No. 17/1999) extended the right to higher education to all students, regardless of their physical, mental or sensory conditions. This law (supplemented by the subsequent Decree of the President of the Council of Ministers on 9 April 2001 on 'Measures for the Treatment of the Right to Higher Education') promotes the inclusion of young people with disabilities in higher education by providing universities with specific guidelines for their inclusion policies. Nevertheless, the prevalence of students with SLDs in Italian universities is quite imprecise due to the absence of official data and large-scale prevalence monitoring (Longobardi et al., 2019). On the basis of information collected by SLD services at 19 public universities in Italy (Longobardi et al., 2019), the estimated prevalence ranges from 0.03% to 0.48%. The National Agency for the Evaluation of Universities and Research Institutes (ANVUR, 2022) found an increase in the number of students with disabilities or SLDs in Italian universities, with prevalence rising from 0.27% in 1999/2000 to 1.82% in 2019/2020. While both national and international studies report growing enrolment of students with SLDs (ANVUR, 2022; Del Tufo & Earle, 2020; Newman et al., 2011), research also indicates they tend to have lower levels of academic success, often demonstrating reduced achievement (Casali et al., 2024; Trainin & Swanson, 2005) and facing difficulties with assignments and exams (Becker & McGregor, 2016; McGregor et al., 2016). These challenges could also lead to early dropout or to ending their studies at the Bachelor level (ANVUR, 2022).

In other words, the national context is marked by a growing number of students with SLDs aspiring to attend university. However, national reports suggest that the outlook for academic success does not seem promising in terms of attendance and achievement (ANVUR, 2022; Casali et al., 2024). Examining the Italian context may therefore offer a unique opportunity to identify the obstacles these students face. Previous studies have aimed to characterise and evaluate how students with SLDs differ from their typically developing peers (e.g. Casali et al., 2024; Johnson et al., 2010; Trainin & Swanson, 2005), focusing on factors that appear to shape their academic trajectory, such as neuropsychological profiles (i.e. core cognitive functions that support learning and academic performance), study-related abilities (i.e. the skills and behaviours associated with studying and learning in an academic context) and instrumental abilities (i.e. the specific and practical skills enabling students to effectively meet school or university demands). However, few studies have explored all these dimensions simultaneously within the university student population with SLDs, particularly in the Italian context (Casali et al., 2024). Given this gap, the general aim of the present study is to assess how the neuropsychological, study-related and instrumental abilities of students with SLDs differ from the normative averages of standardised assessment tools. The findings will offer valuable insights into the strengths and weaknesses of these students, providing professionals and policymakers with essential guidance for developing tailored interventions for this specific student population.

Neuropsychological characteristics of young adults with SLDs

A crucial factor associated with the diagnosis of SLDs is neuropsychological difficulties, which represent both a marker of the diagnosis itself and a risk factor for learning. Indeed, there is growing evidence to show that students with SLDs exhibit difficulties in different neuropsychological abilities such as working memory (Peng & Fuchs, 2016) and visuospatial (Chamberlain et al., 2018) and verbal abilities (Del Tufo & Earle, 2020). Working memory represents a limited-capacity cognitive system responsible for storing and processing information during task execution (Baddeley, 1996), and it is a cognitive system that is greatly involved in learning throughout development (e.g. Allen et al., 2019; Peng & Fuchs, 2016). Studies consistently show that students with SLDs display weakness in working memory (Peng & Fuchs, 2016; Swanson & Hsieh, 2009; Swanson & Siegel, 2011; Willcutt et al., 2007). For instance, Peng and Fuchs (2016) showed that individuals with learning difficulties tend to exhibit difficulties in verbal and numerical working memory. Similarly, Liebel and Nelson (2017) found that university students with SLDs have weaker auditory working memory compared to a control group. Additionally, they found that auditory working memory in students with SLDs was weaker than their visual working memory.

Another cognitive skill commonly discussed in relation to SLDs is visuospatial abilities, which enable individuals to process, organise and manipulate spatial representations and relationships between and within objects (Newcombe & Shipley, 2014; Uttal et al., 2013). Some authors (e.g. Gilger et al., 2016) suggest that the relative advantage of SLDs in this domain is a matter of debate, and further studies are needed to explore this topic.

A recent meta-analysis by Chamberlain et al. (2018) showed that students with SLDs tend to have lower visuospatial abilities than their peers. However, the authors noted significant heterogeneity in the literature, highlighting that greater visuospatial abilities might be observed in individuals placed in educational contexts that require strong visuospatial and creative thinking for academic success. Therefore, further exploration of SLDs in the university context could reveal unique patterns related to this issue.

Difficulties in the language domain are equally relevant when considering students with SLDs. For instance, Hall and Barnes (2017) showed that lexical-semantic difficulties are associated with compromised semantic fluency, and these two difficulties are more likely among students with more severe disabilities. In their study, the authors found that difficulties in the lexical-semantic system associated with SLDs might persist into young adulthood, even among those who have managed their disability well enough to pursue university studies. Furthermore, Del Tufo and Earle (2020) show that difficulties experienced in phonological abilities are similar to those experienced in childhood.

Synthesis research on neuropsychological profiles in young adults with SLDs show a consistent impairment in working memory (Peng & Fuchs, 2016; Swanson & Siegel, 2011; Willcutt et al., 2007) and difficulties in the language domain (e.g. Del Tufo & Earle, 2020). However, compared to younger student populations, university students with SLDs remain underexplored in the literature, particularly regarding the inconsistencies found in their visuospatial abilities relative to typically developing students (Chamberlain et al., 2018). This gap underscores the need for more comprehensive investigations that consider not only these factors but also academic, motivational and instrumental abilities, which may also influence academic success.

Study-related abilities

As the enrolment of students with SLDs in higher education in Italy is a relatively recent (but growing) phenomenon, little is known about study-related abilities among Italian students with SLDs (Casali et al., 2024; Matteucci & Soncini, 2021; Pellegrino et al., 2023). Different studies have tried to evaluate strengths and opportunities in study-related abilities that university students with SLDs must have to obtain good results during their university education, together with weaknesses and obstacles (MacCullagh et al., 2017; Mortimore & Crozier, 2006; Olofsson et al., 2012; Pino & Mortari, 2014). In fact, evidence shows that factors such as study-related abilities are crucial for supporting the academic success of students with SLDs. In particular, study approaches (i.e. the individual's typical and stable methods of learning, processing, storing and retrieving information), study strategies (i.e. specific actions that students employ to solve problems or achieve goals) and learning goals (i.e. objectives that individuals set for themselves, such as mastery-orientated versus performance-orientated goals) (De Beni et al., 2014), are central to success in university (Ben-Eliyahu, 2019); however, only a few studies have focused on students with SLDs (Ben-Naim et al., 2017). In this context, evidence seems to indicate that students with SLDs display fewer study strategies (e.g. Kirby et al., 2008; Mortimore & Crozier, 2006) and approaches (e.g. Holzer et al., 2009; Kirby et al., 2008) than their peers without SLDs. Furthermore, evidence also shows that adolescents with SLDs might not set competence-orientated goals that are commonly associated with positive outcomes (Diseth et al., 2012; Mega et al., 2014; Roebken, 2007), but instead focus solely on performance-orientated objectives (Baird et al., 2009). Conversely, recent data suggest that university students with SLDs exhibit study strategies and learning goals that are similar to those of their peers without SLDs (Casali et al., 2024). Given these sparse and mixed results, further studies are necessary to better understand the profiles of students with SLDs, taking into account their study-related abilities and neuropsychological profiles.

The present study

Given the lack of studies targeting university students at the beginning of their university careers, especially in the national context, more data are needed to address differences in instrumental, neuropsychological and study-related factors between students with SLDs and their neurotypical peers. This is particularly significant given that, according to current knowledge, the neurobiological patterns of SLDs can change during an individual's development (Hatcher et al., 2002; Swanson & Hsieh, 2009). Indeed, although these difficulties can be mitigated through compensatory strategies during development, thereby reducing their negative impact on students' learning experiences and daily lives (Deshler, 2005), they remain resistant to treatment and cannot be fully eliminated (Trainin & Swanson, 2005). Research in this area could also enable the development of interventions aimed at promoting well-being, academic success and enjoyment during university education.

Based on the theoretical framework, this study addresses the following research question: how do students with SLDs differ from the normative average of standardised, validated assessments regarding instrumental, neuropsychological and study-related abilities? In pursuit of this aim, we specified the following hypotheses:

- We hypothesise that university students with SLDs exhibit lower instrumental abilities (i.e. arithmetic fact

retrieval and reading skills) compared to the normative average, as evidence suggests that difficulties in these aspects tend to persist into adulthood (Casali et al., 2024; Trainin & Swanson, 2005). Nonetheless, these difficulties may evolve over time and can be mitigated through compensatory strategies developed by the students themselves (George & Pech-Georgel, 2017; Hatcher et al., 2002; Swanson & Hsieh, 2009).

- Considering neuropsychological abilities, we expect to find lower working memory levels in students with SLDs (Peng & Fuchs, 2016; Swanson & Siegel, 2011; Willcutt et al., 2007) relative to the normative average. However, we do not specify hypotheses concerning verbal and visuospatial abilities due to inconsistent findings in the literature (Chamberlain et al., 2018; Del Tufo & Earle, 2020; Operto et al., 2021).
- Considering study-related abilities, we do not expect statistically significant differences in study strategies between students with SLDs and the normative average, largely due to the interventional support students with SLDs typically receive following diagnosis (Casali et al., 2024). Nevertheless, we hypothesise that students with SLDs will exhibit lower levels of study approach and competence-orientated learning goals. Indeed, prior findings suggest that students with SLDs display reduced engagement in behaviours related to regulating and monitoring learning (e.g. asking questions during lectures, managing exam demands, and using metacognitive skills) as well as lower competence-orientated learning goals (Baird et al., 2009; Diseth et al., 2012; Holzer et al., 2009; Kirby et al., 2008; Mega et al., 2014; Mortimore & Crozier, 2006; Roebken, 2007).

METHOD

Participants

Before conducting the study, we carried out an a priori power analysis using G*Power (Faul et al., 2007). Specifically, given the planned statistical approach of comparing participants with SLDs to the normative mean of standardised instruments, we intended to conduct two-tailed one-sample *t*-tests, assuming a medium effect size (Cohen's $d = 0.50$), a statistical power of 0.80 and an alpha level of 0.05. The a priori power analysis indicated that a sample of 34 participants would be sufficient for the planned analyses.

The inclusion criteria for the sample required a documented SLD diagnosis and enrolment in the first year of university. Based on these criteria, 70 undergraduate students with SLDs were initially recruited. We then applied exclusion criteria to remove participants whose additional conditions could confound our analyses, including low IQ, other neurodevelopmental disorders (e.g. ADHD, autism spectrum disorder), acute psychiatric syndromes or incomplete evaluation. As a result, 10 participants were excluded: two had IQ scores below 70, four had a comorbid diagnosis of SLDs and ADHD, and four did not complete the evaluation. Thus, the final sample consisted of 60 participants ($M_{age} = 19.97$, $SD_{age} = 1.98$, $MIN_{age} = 18$, $MAX_{age} = 31$, 32 females, 28 males). All the participants were enrolled in the first year of university. Data collection was conducted in conjunction with the diagnosis follow-up at the Children's Hospital Burlo Garofolo. All the participants come from the north-east of Italy. All the students were white and native Italian speakers, or fluent in Italian (based on the WAIS Verbal Comprehension; Orsini & Pezzuti, 2013). The sample reflects the demographic composition of the Italian university population (ISTAT, 2016), which comprises a very small proportion of students from other EU countries (2.3%) or non-EU countries (2%).

The study received approval from the ethical committees of the University of Trieste and the Children's Hospital Burlo Garofolo. The study was conducted in compliance with the Declaration of Helsinki, the ethical guidelines of the Italian Association of Psychology, and the ethical code of the Italian Register of Professional Psychologists. Written informed consent was obtained before assessing the students. They participated voluntarily and were informed that they could withdraw from the study if they felt distressed during the assessment activities.

Regarding diagnosis (see Table 1), 26 have a single impairment diagnosed (either dyslexia, dysgraphia, dyscalculia or dysorthography), and 34 have a mixed form of

TABLE 1 Descriptive characteristics of the sample investigated.

			Age		
ICD-10 diagnosis	***N***	$N_{Females}$	**M (SD)**	**Median**	**Min–max**
Dyslexia	16	10	19.56 (0.96)	19.5	18–21
Dysorthography	2	0	19.50 (0.71)	19.5	19–20
Dysgraphia	4	0	20.00 (2.16)	19.5	18–23
Dyscalculia	4	3	20.25 (1.89)	19.5	19–23
Mixed SLD	34	19	20.15 (2.39)	19.5	18–31

Abbreviations: M, mean age; Min–Max, minimum and maximum age of the participants; *N*, total number for each diagnosis; $N_{Females}$, number of females for each diagnosis; SD, age standard deviation.

SLD with two or three impairments (e.g. dyslexia and dyscalculia). Moreover, our data show a higher frequency of students with dyslexia compared to other diagnostic categories, which display similar frequencies, supporting that the present sample is sufficiently representative of the diagnostic distribution of the Italian SLD population (Ministero dell'Educazione, 2022).

According to the Regional Health System and the Italian Ministry of Health's policies, the diagnosis is made using the ICD-10 diagnostic classification system, which includes subtypes for specific reading, spelling, arithmetic and mixed types. This category is known as 'Specific Developmental Disorders of Scholastic Skills' (ICD-10 code: F81). The diagnosis of SLD must be provided by the local health authority or by private professionals (e.g. psychologists, neuropsychiatrists) and subsequently approved by the local health authority.

Procedure

Participants were contacted by telephone from the list of patients awaiting SLD diagnosis renewal at the Children's Hospital Burlo Garofolo. During the phone call to schedule the meeting for the follow-up, they were asked about their willingness to participate in research conducted by the Hospital and the University, focusing on students who intended to continue their education at the university level.

Participants underwent two separate evaluation sessions conducted in close temporal proximity. Students completed the instrumental skills and neuropsychological abilities assessments in the first session, followed by the study-related abilities evaluation in the second session. The initial session was conducted individually by a professional psychologist specialising in SLDs in a quiet room at the hospital. It included an anamnesis, an evaluation of instrumental skills, and a neuropsychological assessment, lasting between 60 and 90 min. Within one week, participants were invited to complete an online survey assessing their study-related abilities. They received a code and a link to access and fill in the questionnaire. All items in the online questionnaire were mandatory to prevent missing data. If a participant left any item unanswered, the system would flag the specific question and prevent further progress until a response was provided.

Materials

All the instruments used are standardised, valid and reliable (see details of each instrument's standardisation below), and are widely utilised in both Italian and international health systems for diagnostic assessments. In this context, it is important to note that the instruments were standardised on samples of Italian adults and Italian university students. Below, we provide demographic information regarding those validation samples, including their size. To enhance the reader's understanding and comply with the instruments' copyright restrictions, we converted participants' raw scores into standardised Z-scores according to the respective instrument manuals. This procedure allowed us to derive a score for each participant indicating how far their performance or score deviates (in Z-score units) from the normative mean (Z = 0).

Instrumental skills

Reading abilities

Reading abilities were assessed using the Passage Reading task of the VALS battery (George & Pech-Georgel, 2017). According to the authors, the instrument was normed on a sample of 200 Italian adults (M = 31, SD = 10.5). Each participant was asked to read the text entitled 'The bar under the sea' aloud, aiming to do so as quickly and accurately as possible. While reading, the experimenter measured the time taken and errors made by the participant. The reading speed was calculated in syllables per second, and then the score was compared with the normative scores.

Arithmetic facts

Arithmetic facts were assessed using the Numerical Facts task from the LSC-SUA battery (Montesano et al., 2020). This instrument was standardised on a sample of 667 Italian university students (M = 22.94, SD = 4.79). Participants were presented with 30 numerical facts that involved addition, subtraction and multiplication (e.g. 6 × 8, 100 × 100). Participants had to solve each item mentally in no more than three seconds. One point was awarded for each correct answer, and the raw scores could range from 0 to 30. The reliability of the measure is good (Cronbach's $\alpha = 0.76$).

Neuropsychological abilities

The neuropsychological assessment included subtests evaluating verbal comprehension, visual-perceptual abilities and working memory from the WAIS battery (Orsini & Pezzuti, 2013), an instrument that was standardised on a sample of 1424 Italian adults (M = 36,4, SD = 9.8). The reliability of the neuropsychological scales is good (Cronbach's α ranging from 0.70 to 0.90).

Verbal comprehension

Verbal comprehension was evaluated using the Vocabulary subtest. The subject is asked to give a definition for 26 terms (e.g. 'apple' or 'inauspicious'). The answers are then scored by the examiner, who assigns a

score from 0 to 2 points for each item based on the accuracy of the answer. The total raw score can range from 0 to 52.

Visual-perceptual abilities

Visual-perceptual abilities were evaluated using the Drawing with Cubes subtest. Cubes are shown and provided to the participant. Some have two red and two white faces, and some have two half-white and half-red faces. Two-dimensional figures are then shown to the participants, and they are asked to reproduce the figures with the cubes provided. The experimenter assigned the score, checking both the accuracy of reproduction and the execution time. The score could range from 0 (incorrect figure or answers out of time) to 7.

Working memory

Working memory was tested using the Digit Memory subtest. Participants were presented with three numerical span tasks. In the first task, the participant was asked to listen to number series (which increase in length) and repeat them immediately afterwards. In the second task, the participant was asked to listen to the number series read by the experimenter and repeat them starting from the last number read. In the last task, the subject participant was to rearrange the number series heard and recite the numbers from smallest to largest. In the three tasks the number of digits to be remembered gradually increased, from a minimum of two to a maximum of nine. Each numerical span task consisted of pairs of items belonging to the same level of difficulty (i.e. the numerical series had the same length). If the participant made a mistake in recalling the correct sequence for both items of the same level, the participant was stopped and asked to proceed to the next task.

Study-related abilities

The evaluations presented are part of the AMOS (De Beni et al., 2014), an instrument that assesses study-related abilities in high school and university students. According to the authors, the instrument was normed on a sample of Italian students (M = 20.76, SD = 2.00) comprising upper secondary school students (n = 361) and university students (n = 488).

Study strategy questionnaire (SSQ)

The questionnaire comprises 39 statements regarding the strategies typically employed by students for studying. Participants were asked to indicate on a seven-point Likert scale (1 = 'never'; 7 = 'always') the degree to which they agreed with each statement (e.g. 'Underlining during the first reading'). The raw score of the instrument could range from 39 to 273 points, with higher scores being associated with better study strategies. This questionnaire has good reliability (Cronbach's $\alpha = 0.80$).

Study approach questionnaire (SAQ)

The questionnaire consists of 50 items proposed as statements. Participants were asked to rate how much they agreed with each statement using a five-point Likert scale (1 = 'never'; 5 = 'always'). The items referred to five different dimensions related to how the individual approaches learning activities: organisation (e.g. 'In the early afternoon, I plan all the things I have to do'), process (e.g. 'When studying, I try to present the contents in my own words'), self-evaluation (e.g. 'After a written exam, I know whether it went well or not'), preparing for exams (e.g. 'I try to anticipate what kind of exam awaits me') and metacognition (e.g. 'When an exam goes wrong, I try to understand the reasons why I failed'). The raw score of the instrument could range from 50 to 250 points, with higher scores corresponding with a better approach to study. The reliability of this questionnaire appears to be good (Cronbach's $\alpha = 0.80$).

Learning goals

This evaluates participants' goal orientation. The sub-scale consists of four scenarios (e.g. 'In a learning situation you prefer to tackle tasks that are quite difficult and that you face as challenges to measure your skills'), each featuring two distinct actions to choose, reflecting the participants' learning goals. Higher scores indicate a stronger tendency in participants to set challenge-orientated goals. The scale has good reliability (Cronbach's $\alpha = 0.78$).

RESULTS

Before running the analyses, we transformed the raw scores of each measure (instrumental skills, neuropsychological abilities and study-related abilities) into Z-scores using the norms provided by the instruments. Descriptive statistics are reported in Table 2.

Comparisons with normative scores

In order to assess how the instrumental skills, neuropsychological profiles and study-related abilities of the participants varied compared to the normative average, we conducted a series of one-sample t-tests. This procedure allowed us to compare our results with the mean of the normative sample (Z = 0). We also conducted p-values corrections for multiple comparisons due to the several one-sample t-tests, using the procedure of Benjamini and Yekutieli (2001). Effect sizes (Cohen's

TABLE 2 Descriptive statistics of the measures (transformed into Z-scores) used in the study.

Measure	Mean	SD	SE	Median	Skewness	Kurtosis
Instrumental skills						
Arithmetic facts	−1.484	1.199	0.155	−1.449	0.173	−0.768
Reading errors	−1.935	1.885	0.243	−1.783	−0.647	−0.271
Reading speed	−3.126	1.389	0.179	−3.031	−0.030	−0.610
Neuropsychological abilities						
Working memory	−0.744	0.716	0.092	−0.670	0.104	−0.148
Visuospatial abilities	0.505	1.064	0.137	0.500	−0.349	0.090
Verbal abilities	−0.172	0.826	0.107	−0.330	1.042	2.193
Study-related abilities						
Study strategies	0.003	1.277	0.174	−0.109	−0.124	−0.509
Study approach	−2.531	1.300	0.177	−2.499	0.028	−0.961
Goals of learning	−0.075	1.163	0.158	0.192	−0.723	−0.899

Abbreviations: SD, standard deviation; SE, standard error.

TABLE 3 Results of the one-sample *t*-tests considering instrumental skills, neuropsychological abilities and study-related abilities.

Measure	*t*	*df*	95% CI	*p*	*p* corr.	*d*
Instrumental skills						
Arithmetic facts	−9.584	59	[−1.793, −1.174]	<0.001***	<0.001***	−1.237
Reading errors	−7.952	59	[−2.422, −1.448]	<0.001***	<0.001***	−1.027
Reading speed	−17.429	59	[−3.485, −2.767]	<0.001***	<0.001***	−2.250
Neuropsychological abilities						
Working memory	−8.049	59	[−0.929, −0.559]	<0.001***	<0.001***	−1.039
Visuospatial abilities	3.676	59	[0.230, 0.780]	0.001**	0.002**	0.475
Verbal abilities	−1.612	59	[−0.386, 0.042]	0.112	0.409	−0.208
Study-related abilities						
Study strategies	0.016	53	[−0.346, 0.351]	0.987	1.000	0.002
Study approach	−14.309	53	[−2.885, −2.176]	<0.001***	<0.001***	−1.947
Learning goals	−0.472	53	[−0.392, 0.243]	0.639	1.000	−0.064

Abbreviations: 95% CI, 95% confidence interval; *d*, Cohen's *d*; *df*, degrees of freedom; *p*, *p*-value; *p* corr, Benjamini and Yekutieli (2001) corrected *p*-values; *t*, one-sample *t*-test statistics.
**$p<0.01$; ***$p<0.001$.

d) for one-sample *t*-tests are also reported: small effect $d=0.20$; medium effect $d=0.50$; large effect $d=0.80$. The results are shown in Table 3 and graphically in Figure 1.

The results concerning instrumental skills showed that participants with SLDs had a significantly lower score compared to the normative mean in the measures of arithmetic facts ($t[59]=-9.584$, 95% CI [−1.793, −1.174], $p<0.001$, Cohen's $d=-1.237$), reading errors ($t(59)=-7.952$, 95% CI [−2.422, −1.448], $p<0.001$, Cohen's $d=-1.027$) and reading speed ($t(59)=-17.429$, 95% CI [−3.485, −2.767], $p<0.001$, Cohen's $d=-2.250$).

Results related to neuropsychological abilities showed that participants had a significantly lower score than the normative average in working memory ($t[59]=-8.049$, 95% CI [−0.929, −0.559], $p<0.001$, Cohen's $d=-1.039$) and a significantly higher score in visuospatial abilities ($t[59]=3.676$, 95% CI [0.230, 0.780], $p=0.001$, Cohen's $d=0.475$). The participants did not significantly differ from the normative group average in verbal abilities ($t[59]=-1.612$, 95% CI [−0.386, 0.042], $p=0.112$, Cohen's $d=-0.208$).

Regarding study-related abilities, participants did not display a significant difference in score from the normative average regarding study strategies ($t[53]=0.016$, 95% CI [−0.346, 0.351], $p=0.987$, Cohen's $d=0.002$). Conversely, participants had a significantly lower score compared to the normative average in study approach ($t[53]=-14.309$, 95% CI [−2.885, −2.176], $p<0.001$, Cohen's $d=-1.947$). No statistically significant difference was found for students with SLDs compared to the normative average for learning goals ($t[53]=-0.472$, 95% CI [−0.392, 0.243], $p=0.639$, Cohen's $d=-0.064$).

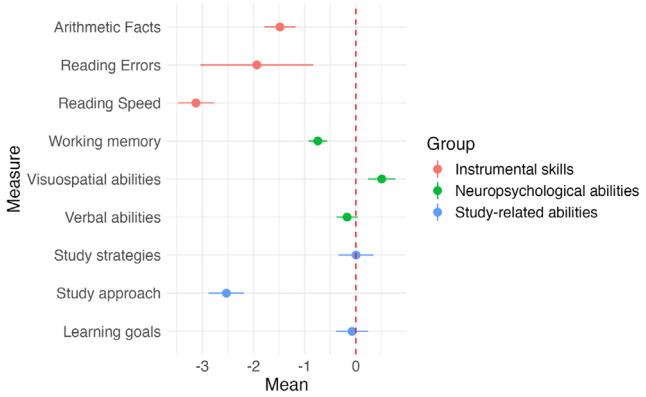

FIGURE 1 Graphical representation of one-sample *t*-test results relative to the normative average, displaying the means and confidence intervals of the measures.

DISCUSSION

In recent years, there has been a growing number of students with SLDs enrolling in university programmes (ANVUR, 2022; Del Tufo & Earle, 2020; Newman et al., 2011). In response, universities need to support these students by identifying both the areas in which they struggle and the strategies best suited to address those challenges (Longobardi et al., 2019; Pellegrino et al., 2023). To this end, the scientific literature has proposed and developed interventions aimed at supporting students with SLDs, leading to the implementation of assistive tools and teaching practices that take account of their specific profiles (Pellegrino et al., 2023; Zeng et al., 2018), as well as more structured intervention models designed to enhance academic success by focusing on the particular difficulties these students face (Johnson et al., 2023). Considering the national context, more studies are needed to acquire specific information concerning instrumental skills, neuropsychological profiles and study-related abilities of this specific group of students, especially at the beginning of the university period (Casali et al., 2024). Indeed, acquiring information on the cognitive and study-related profiles of students with SLDs would provide crucial insights for university services, which are essential for organising evidence-based intervention activities.

In light of the aim of the present study, we first assessed the instrumental skills of students with SLDs in reading (in terms of errors and speed) and arithmetic facts. The data confirm that students with SLDs produce statistically significantly lower scores in all instrumental skills, with large effect sizes across all measures. These findings obtained for adults with SLDs provide a unique and updated evaluation of skills in arithmetic facts and reading abilities, acquired using valid and reliable tools (e.g. George & Pech-Georgel, 2017). Our data confirm that the difficulties in instrumental abilities (e.g. reading and arithmetic skills) commonly observed in children with SLDs may persist into adulthood (Hatcher et al., 2002; Swanson & Hsieh, 2009). In this context, difficulties in reading and arithmetic may potentially affect academic performance and success, thereby increasing the risk of university dropout (ANVUR, 2022). Recognising the instrumental profiles of adult learners with SLDs can guide educators and institutions to implement targeted accommodations and services (e.g. flexible assessment methods and technology-assisted exams) aimed at supporting instrumental skills during academic tasks, thus sustaining students' learning motivation (Pellegrino et al., 2023; Zeng et al., 2018). Moreover, incorporating inclusive teaching and administrative policies (e.g. sharing recorded lessons and slides, providing administrative orientation, and offering peer support) can help address the specific needs of students with SLDs, fostering equal opportunities for academic success, and promoting a sense of engagement and belonging throughout their academic careers (Becker & McGregor, 2016; Pellegrino et al., 2023).

Second, our goal was to evaluate aspects related to neuropsychological development in individuals with SLDs. On the basis of previous literature, which indicates difficulties in working memory among individuals with SLDs (Peng & Fuchs, 2016; Swanson & Siegel, 2011; Willcutt et al., 2007), we expected to find similar results. Our study supports these findings by revealing statistically significant difficulties in working memory in students with SLDs compared to the normative average. Evidence shows that working memory difficulties can negatively affect the comprehension and retention of instructional content during lectures, making it more challenging to follow the flow of information and take notes (Becker & McGregor, 2016). In the university setting, this can lead to a high cognitive load for students with SLDs, who may struggle to simultaneously process, integrate and retain the presented materials. To alleviate these challenges, trained lecturers can implement strategies designed to reduce cognitive burden, such as providing course materials in advance, offering concept maps or structured outlines, and supporting learning through recorded lectures (Pellegrino et al., 2023). These measures enable students to better prepare for the content and to revisit and consolidate the material in ways and at times that best suit their needs. Regarding visual-perceptual abilities in adults with SLDs, we found statistically higher scores in visuospatial abilities. These results confirm studies on children with SLDs (Operto et al., 2021) that may reflect the wide variability reported in the literature on visuospatial abilities in students with SLDs (Chamberlain et al., 2018). Regarding verbal comprehension, no significant differences were found in verbal abilities compared to the normative sample. This result contrasts with previous findings suggesting that students with SLDs may struggle with

verbal comprehension compared to their peers (Hall & Barnes, 2017; Ransby & Lee Swanson, 2003). However, recent evidence (Del Tufo & Earle, 2020) indicates that individuals with SLDs may not exhibit differences in this specific measure, particularly when assessed under timed conditions. In this context, the lack of differences from the normative average in verbal comprehension may be attributed to the untimed nature of the task used. Future studies should therefore incorporate both timed and untimed measures to further explore this aspect.

Considering study-related abilities, results also indicated that, in terms of study strategies involving specific actions students use to solve problems or achieve goals, students with SLDs do not differ statistically from the normative average. Similarly, we found no statistically significant differences in learning goals, indicating that students with SLDs show a mastery-oriented approach to learning that is comparable to the normative average. These findings align with recent evidence suggesting that students with SLDs employ study strategies and set learning goals similar to those of their peers without SLDs (Casali et al., 2024). However, they exhibited significantly lower levels of study approach compared to their peers, indicating a reduced use of advanced metacognitive strategies essential for monitoring and regulating learning (e.g. asking questions during lectures, adopting a metacognitive approach to studying materials). In this context, students with SLDs may have developed a repertoire of study strategies and goal-setting abilities throughout their schooling, potentially stemming from interventions following their initial diagnosis (Casali et al., 2024; Holzer et al., 2009). Yet, with regard to their approach to learning, these students may lag behind their peers in organisation, self-assessment and metacognitive skills at the beginning of their university education (Casali et al., 2024; Holzer et al., 2009; Zeng et al., 2018).

Various studies have shown that targeted interventions aimed at providing students with SLDs with self-regulation strategies, increased awareness of their cognitive processes, and enhanced motivation can have a significant impact on their academic success (Johnson et al., 2023; Zeng et al., 2018). Such interventions seek to strengthen students' ability to plan, monitor and evaluate their own study process, thereby fostering greater autonomy and confidence in their abilities. From this perspective, it is crucial to develop services and programmes designed to enhance self-regulated learning by employing specialised personnel who can tailor strategies to each individual's profile. By both addressing areas of weakness and leveraging students' strengths, these measures can help them become better equipped to meet academic demands, reduce stress and pursue a more stable, motivated path toward academic success (Harrison et al., 2012; Troiano et al., 2010; Zeng et al., 2018).

Limitations

The current study is not without limitations, one of which is the cross-sectional nature of the data. Future studies should use longitudinal designs to capture how the aspects assessed in this study interplay over time across different developmental stages, especially between high school and university. Second, the analytical strategy employed in the present study did not enable assessment of the interplay between neuropsychological factors, learning strategies and motivational factors. For this reason, future studies should use larger sample sizes to explore how these factors interact with each other in SLD populations, using correlational methods. A major limitation of the present study is that we considered the population of students with SLDs without distinguishing between specific diagnoses and potential comorbidities. This choice was driven by our a priori inclusion criteria and reflects the high comorbidity often reported among various SLD subtypes (Toffalini et al., 2017; Willcutt et al., 2013), a phenomenon that has sparked ongoing debates on whether SLDs should be viewed as a unitary condition or as distinct subtypes (Toffalini et al., 2017). We acknowledge that not differentiating between sub-diagnoses may limit the specificity of our findings. Therefore, we advise caution in extending our results to single diagnostic categories (e.g. dyslexia vs. dyscalculia), as unique patterns may emerge when each sub-diagnosis is considered separately. Future studies should explore the difficulties associated with each diagnostic subtype and their possible overlaps, to better elucidate whether and how different SLD subtypes might differentially affect instrumental, neuropsychological and study-related abilities. Finally, in the present study we did not include a control group. In this context, it is important to emphasise that the scores obtained by the participants were compared with the normative averages of standardised, valid, reliable instruments that are widely used in research and in the Italian and international healthcare systems.

CONCLUSION

Even acknowledging these limitations, by identifying specific instrumental, neuropsychological and study-related factors in students with SLDs we draw a complex profile of qualities and abilities that could lead to successful university careers, together with weaknesses and difficulties, underlining the crucial role of non-cognitive factors (Feraco et al., 2022; Lavy, 2020). Our data could inform intervention programmes (Pellegrino et al., 2023; Ruch et al., 2020; Zeng et al., 2018) designed for students at the onset of their university careers. Such programmes would focus on developing study approaches and beliefs, as well as recognising

instrumental skills and addressing neuropsychological strengths and challenges. Furthermore, lecturers play a central role in fostering an inclusive learning environment that accommodates the diverse needs of students with SLDs, emphasising the importance of teaching methodologies that offer individual learning styles and providing targeted support where needed (Pellegrino et al., 2023). By addressing these challenges and maximising students' inherent capabilities, we can enhance the academic success and well-being of students with SLDs in university education.

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CONFLICT OF INTEREST STATEMENT

We have no known conflict of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

The study was carried out following the ethical principles set out in the Declaration of Helsinki, the European Union's General Data Protection Regulation (GDPR EU 2016/679), the ethical guidelines of the Italian Association of Psychology and the ethical code of the Italian Register of Professional Psychologists. The study was approved by the ethical committee of the University of Trieste.

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