# Research Review: Language and specific learning disorders in children and their co-occurrence with internalizing and externalizing problems: a systematic review and meta-analysis

Enrica Donolato,[1] (iD) Ramona Cardillo,[2] (iD) Irene C. Mammarella,[2] (iD) and Monica Melby-Lervåg[1] (iD)

[1]Department of Special Needs Education, University of Oslo, Oslo, Norway; [2]Department of Developmental and Social Psychology, University of Padova, Padova, Italy

**Background:** Some studies suggest that children with language and learning disorders (LLDs) show more internalizing and externalizing problems than their peers. However, the available evidence remains inconsistent, especially regarding the conditions under which these psychological problems occur. **Methods:** We performed a meta-analysis of studies comparing children with LLDs and controls on internalizing (53 independent samples, 135 effect sizes) and externalizing problems (37 independent samples, 61 effect sizes) separately. **Results:** Children with LLDs showed higher internalizing (Hedges' $g = 0.36$) and externalizing problems (Hedges' $g = 0.42$) than controls did. The group standardized difference in internalizing problems was moderated by the primary disorder, with children with language disorders showing more internalizing problems than those with reading disorders. The severity of the primary disorder, IQ, and age did not moderate Hedge's $g$ between children with LLDs and controls in internalizing and externalizing outcomes. The same pattern was found for gender as a moderator of Hedge's $g$ in internalizing problems, while findings for externalizing problems were inconclusive. The results were consistent when methodological variables were assessed, also for informant, sample size, and geographical area. Clinical samples with LLDs reported higher internalizing problems respect to those with difficulties, but findings on externalizing outcomes were limited. Similarly, results on the presence of additional symptoms in learning and language, self-concept, and socioeconomic status were inconclusive, as few studies reported this information. Results were robust when publication bias, publication year, and study quality were assessed. **Conclusions:** There is evidence that children with LLDs report higher internalizing and externalizing problems than controls do. Children with language disorders seemed more vulnerable to report more internalizing problems, and clinical samples reported higher problems than those with difficulties. For clinical practice, assessment and interventions should target socioemotional skills to support the psychological well-being of children with LLDs. **Keywords:** Specific learning disorders; language disorders; internalizing problems; externalizing problems; meta-analysis.

## Introduction

In recent years, a growing body of research has investigated whether children with language and/or learning disorders (LLDs) show internalizing and externalizing problems. Although recent meta-analyses indicate elevated levels of internalizing problems in poor readers (Francis, Caruana, Hudson, & McArthur, 2019) and higher internalizing and externalizing behaviors in children with language disorders (Curtis, Frey, Watson, Hampton, & Roberts, 2018; Yew & O'Kearney, 2013; see also Hentges, Devereux, Graham, & Madigan, 2021), the conditions under which these children show these additional psychological challenges are not yet clear (Curtis et al., 2018; Francis et al., 2019). Furthermore, no previous meta-analysis has examined co-occurrence issues between LLDs and internalizing and externalizing problems while assessing study methodological moderators and comparing samples with a clinical profile or difficulties in reading,

mathematics, or language. The use of new meta-analytic techniques to handle dependencies in the data is also relevant in examining the strength of evidence in this area of research. This meta-analysis aims to fill these gaps and provide a better understanding of factors that may contribute to internalizing and externalizing problems in children with LLD.

In the DSM-5 (APA, 2013), 'specific learning disorders' is an umbrella term that covers severe and persistent difficulties in reading, spelling, and/or mathematics that emerge during the first years of formal education. According to the DSM-5, the terms 'reading disorder' or 'dyslexia' and 'mathematical disorders' or 'dyscalculia' may be still used, respectively, in relation to difficulties in word decoding and spelling (Hulme & Snowling, 2016) or in problems in understanding numbers and mathematical concepts (Kucian & von Aster, 2015). Alongside specific learning disorders, children can show language deficits associated with significant impairments in the educational and social areas (Bishop, Snowling, Thompson, Greenhalgh, & the CATALISE-2

---

Conflict of interest statement: No conflicts declared.

consortium, 2017). The DSM-5 categorizes language disorders under the heading 'communication disorders' and defines them as 'persistent difficulties in the acquisition and use of language across modalities (i.e., spoken, written, sign language, or other) due to deficits in comprehension or production' (APA, 2013, p. 42). In this meta-analysis, we refer to reading, mathematical, and language disorders with the term 'primary disorder'.

Internalizing and externalizing problems generally describe inwardly or outwardly focused psychological issues. According to the internalizing–externalizing model underlying the structure of mental disorders (Cosgrove et al., 2011; Krueger, Chentsova-Dutton, Markon, Goldberg, & Ormel, 2003), internalizing and externalizing problems are broad and rather heterogeneous categories to define (e.g., Carragher, Krueger, Eaton, & Slade, 2015). On the one hand, internalizing problems include anxiety and depression, and these have symptoms that are both unique and overlap with each other (i.e., low mood, worry, withdrawal). On the other hand, externalizing problems comprise aggressive and rule-breaking behaviors, conduct problems, oppositional defiance, or a combination of these. In this meta-analysis, we consider internalizing and externalizing problems in terms of symptoms and refer to these challenges with the term 'co-occurrence' when assessed in children with LLDs.

### Factors related to co-occurrence issues between LLDs and psychological problems

The available literature suggests that several variables may account for the co-occurrence of LLDs and internalizing and externalizing problems in children. However, there is a large variability in the results of studies, and findings are inconsistent.

First, the primary disorder may moderate the magnitude of internalizing and externalizing problems. Language processing is fundamental for socioemotional development and academic success (Chow & Wehby, 2018; Hulme & Snowling, 2013). Since children with language disorders have a lower ability to recognize, understand, and self-regulate emotions (Chow, 2018; Salmon, O'Kearney, Reese, & Fortune, 2016), they may be more vulnerable to internalizing and externalizing problems than those with learning disorders. Also, children with learning disorders experience repeated academic failures and social isolation showing an elevated risk to report internalizing and externalizing problems (Elksnin & Elksnin, 2004; Livingston, Siegel, & Ribary, 2018).

Another relevant factor is whether the degree to which children with LLDs showed additional symptoms in other areas than the primary disorder (e.g., reading difficulties for those with language disorder) or higher differences in IQ levels that may result in higher internalizing or externalizing problems with respect to controls (Dewey, 2018; Willcutt, 2019).

Thus, we assessed whether these variables moderated the effect size difference between those with LLDs and controls in internalizing and externalizing problems.

Children's age is another important factor to consider. Available meta-analyses either fail to test whether age moderates the effect size difference between poor readers and controls in internalizing problems (Francis et al., 2019) or show that the difference between children with language problems and controls in problem behaviors increases with children's age (Curtis et al., 2018). Since the extent to which children with LLDs show internalizing and externalizing problems can vary with age (Helland, Røysamb, Wang, Røysamb, Wang, & Gustavson, 2018; Horbach, Mayer, Scharke, Heim, & Günther, 2020; van Daal, Verhoeven, & Van Balkom, 2007), we evaluated whether this variable was a moderator in accounting for the variation in study results.

Little is known about gender as a moderator of the effect size difference between LLDs and controls in internalizing and externalizing problems. On the one hand, boys are more likely to show reading and language difficulties than girls (Lindsay & Strand, 2016; Quinn & Wagner, 2015), with an opposite or balanced gender ratio for mathematical difficulties (Moll, Kunze, Neuhoff, Bruder, & Schulte-Körne, 2014; Morsanyi, van Bers, McCormack, & McGourty, 2018). On the other hand, boys are more prone to displaying externalizing behaviors and girls internalizing problems (e.g., Schulz & Muschalla, 2021; Zahn-Waxler, Shirtcliff, & Marceau, 2008). However, the evidence is limited and inconsistent on whether boys and girls with LLDs show differences in internalizing and externalizing problems (Bornstein, Hahn, & Suwalsky, 2013; Francis et al., 2019; Helland et al., 2018), indicating the necessity to take this variable into account.

Family socioeconomic status (SES) and children's self-concept also need further attention. Low SES is a risk factor for more aggressive behavior, internalizing problems, and poor language development (Letourneau, Duffett-Leger, Levac, Watson, & Young-Morris, 2013). As low SES is negatively associated with mental health, children with LLDs and a poor socioeconomic background may report a higher occurrence of internalizing and externalizing problems than controls. Moreover, a positive self-concept is associated with lower internalizing and externalizing problems (Sowislo & Orth, 2013; Trzesniewski et al., 2006), and children with LLDs seem to report a poorer self-concept than controls (Lindsay & Dockrell, 2012; McArthur, Filardi, Francis, Boyes, & Badcock, 2020). Thus, internalizing and externalizing problems may be more common in children with LLDs and with a low self-concept.

Methodological factors are also relevant to assessing the consistency of the results. In research, children with LLDs are defined as clinical samples (e.g., those with a clinical diagnosis or a profile

characterized by severe reading, mathematical, and language problems) or as having difficulties in language and learning (e.g., children performing under the 25th percentile in standardized reading, mathematical, or language tasks). Therefore, sample selection is relevant to clarifying whether internalizing and externalizing problems are reported to the same or different extent in these groups.

Another factor to assess is type of informant – the individuals evaluating children's internalizing and externalizing problems. Studies of internalizing and externalizing problems often rely on multi-informant assessments to evaluate children's behaviors across different contexts (e.g., home and school) and to assess differences in parents' and teachers' perceptions of the child's internalizing and externalizing problems (Achenbach, 2018). Since there are inconsistencies between children, parents, and teachers with regard to the reported psychological problems, with low agreement on the evaluation of the internalizing problems and moderate accordance on the externalizing behaviors (Navarro et al., 2020; Salbach-Andrae, Klinkowski, Lenz, & Lehmkuhl, 2009), we assessed this moderator.

Other variables related to methodology include sample size, geographical area, and publication year. It is known that small studies can produce unreliably large effects in both directions and that sample sizes from similar geographical locations can show larger or smaller effects than others (Ingre, 2013; Szucs & Ioannidis, 2017). Early studies often report the largest effects, and publication year is a variable to consider (Jennions & Møller, 2002). All these factors, paired with publication bias – studies with large effects are more likely to be published – can lead to misleading results and therefore need to be tested.

### The current meta-analysis

This meta-analysis addressed the following research questions:

RQ1. To what extent do children with LLDs show higher internalizing and externalizing problems than controls?
RQ2. Is the group standardized difference between LLDs and controls in the internalizing and externalizing problems moderated by the nature of the primary disorder, the severity of the primary disorder, the presence of additional symptoms in learning and language, IQ, age, gender, self-concept, and family SES?
RQ3. Is the group standardized difference between LLDs and controls in the internalizing and externalizing problems moderated by methodological factors, including informant, sample selection (e.g., clinical samples defined as reporting a diagnosis or performance below the 10th percentile *vs* difficulties identified as

showing performance below the 25th percentile), sample size, and geographical area?
RQ4. Is the group standardized difference between LLDs and controls in the internalizing and externalizing problems related to publication bias and publication year? Are results in the meta-analysis consistent after removing studies with a high risk of bias?

## Methods

The meta-analysis was based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher, Liberati, Tetzlaff, & Altman, 2009). It was preregistered in the prospective register of systematic reviews (PROSPERO; Reference: CRD42017074013, available at http://www.crd.york.ac.uk/PROSPERO). Deviations from the protocol are reported in Appendix S1 of the Supporting Information. The full dataset and codes are available in the Open Science Framework (https://osf.io/pejxa/).

### Literature search

Information regarding the literature search and inclusion process is reported in Figure 1. The search process was guided by an information retrieval expert in systematic reviews. The search terms are available in Appendix S1 of the Supporting Information.

### Inclusion and exclusion criteria

First, the studies had to include participants up to 18 years of age with a clinical diagnosis of language impairment (or specific language impairment), developmental dyslexia (or reading disorder), dyscalculia (or mathematical disorder), or with severe language, reading, and mathematical problems (e.g., children performing below the 10th percentile on standardized reading, mathematical, or language tests). Studies assessing children with language, reading, and mathematical difficulties (e.g., those performing below the 25th percentile on standardized tests) were included. Thus, we included samples with a diagnosis provided by specialists according to the DSM-IV or DSM-5 criteria or a clinical profile of LLDs and those referring to children with learning and language difficulties. Studies that defined children as having general learning disorders but failed to report further information about the assessment of this condition were excluded. When participants had neurological or medical conditions, intellectual disabilities, autism, speech difficulties, or communication and pragmatic problems, the study was excluded. Samples with language and reading disorders had to speak English or other languages based on alphabet writing systems.

Second, studies had to report quantitative data on internalizing and/or externalizing problems assessed through standardized self-report tools. Measures of internalizing problems included anxiety, depression, or a combination of these issues, while those of externalizing problems comprised aggressive behaviors, rule-breaking behaviors, conduct problems, oppositional defiance, or their combination. We included studies evaluating internalizing and externalizing symptoms as continuous variables and excluded those on prevalence (e.g., studies assessing internalizing and externalizing problems as a secondary diagnosis).

Third, eligible studies had to be reported in English and report cross-sectional or longitudinal data on internalizing and externalizing problems in children with LLDs and a comparison group of typically developing children or normative data on the outcomes of interest. Interventions were eligible whether
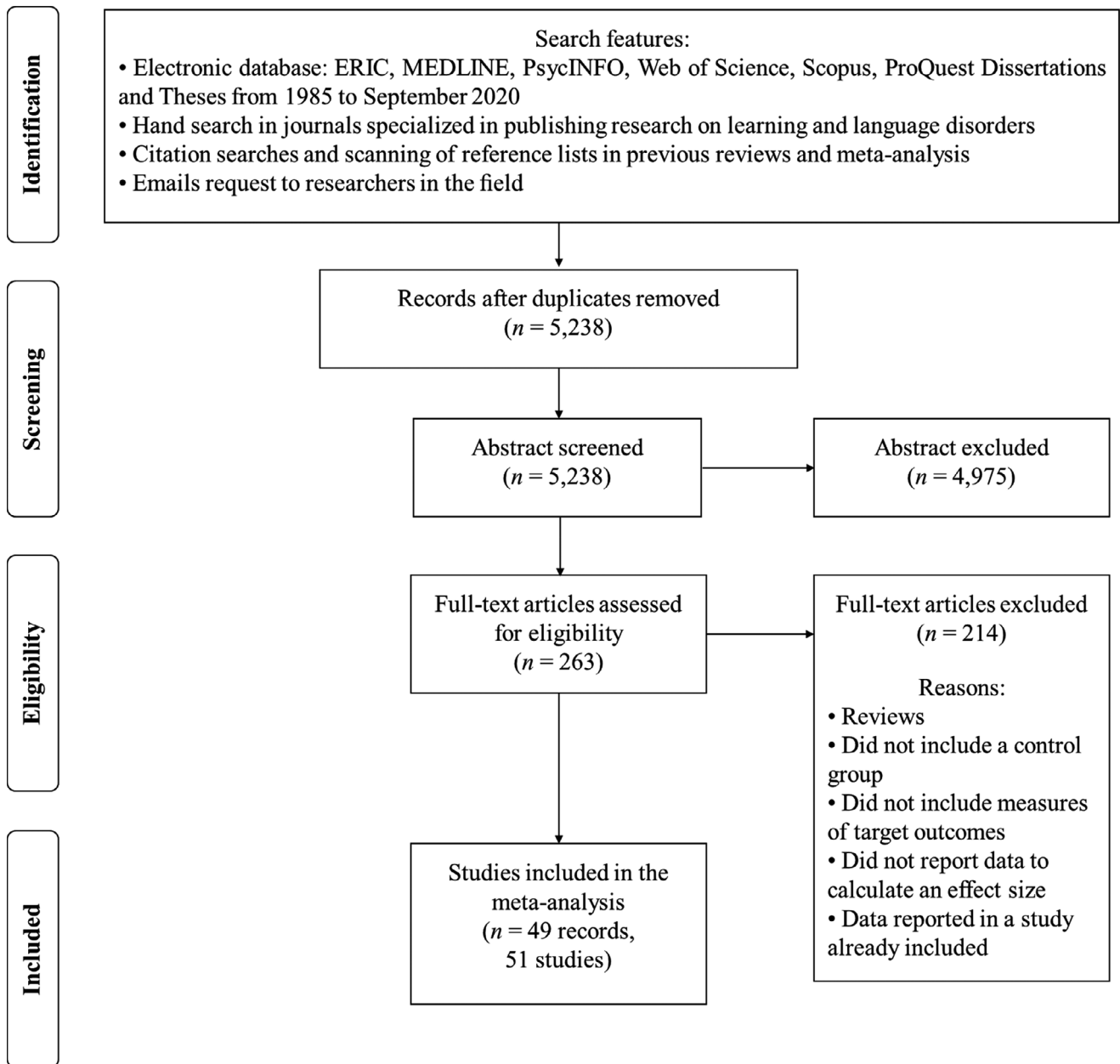
**Figure 1** Flow diagram for the search and study selection

studies reported preintervention data and participants were unselected for internalizing and externalizing measures.

*Moderators. Primary disorder:* Studies of children with language impairment, specific language impairment, or language difficulties were coded as 'language', and those of children with dyslexia, reading disorders, reading difficulties, or dyscalculia or mathematical disorders were coded as 'reading' and 'mathematics', respectively. This classification was conducted according to the clinical diagnosis and/or the assessment regarding children's performance on language, reading, or mathematics standardized tasks provided by the author/s.

*Severity of the primary disorder:* The means and standard deviations of participants' performance on tests evaluating the primary disorder were coded for the clinical and control groups together with sample sizes. Measures of language included standardized tests assessing receptive and expressive language, vocabulary, morphology, syntax, and listening comprehension skills. Measures of reading and mathematics comprised standardized tools assessing reading, such as word and pseudoword decoding and reading achievement, or mental and written calculation and mathematical achievement tests. When multiple indexes were reported (e.g., scores for time and accuracy), a composite score was calculated. An effect size assessing the differences in severity of the primary disorder between the two groups was then performed. Negative effect sizes showed the disadvantage of children with LLDs compared with controls.

*Additional symptoms in learning and language:* Children's scores on standardized tests in areas other than the primary disorder were coded. When children showed language impairment, specific language impairment or language difficulties, information on their performance in reading and/or mathematics was coded. Similarly, when a study included children with dyslexia, reading disorders, reading difficulties, data on their mathematical and/or language skills were

retrieved. *Vice versa,* when a sample had dyscalculia or mathematical disorders, scores on reading and/or language skills were considered when available. The means and standard deviations of the performance in reading, language, or mathematical tasks were coded with information on sample size for the clinical and control groups to calculate effect size. Negative effect sizes indicated that children in the clinical group performed worse than controls.

*IQ:*   Children's performance on the total IQ derived from the WISC-R, WISC-III, WISC-IV, Raven's Colored Progressive Matrices, and the Culture Fair Intelligence tests was coded. The means, standard deviations, and sample size in the two groups were considered to calculate effect size. Negative effect sizes indicated that children with LLDs reported lower IQs than controls, although all children scored above the cutoff for intellectual disability (QI > 70).

*Age:*   The mean age of the overall sample (i.e., children with LLDs and controls) was considered.

*Gender:*   The proportion of boys in the clinical sample was coded.

*Self-concept:*   Information on self-report questionnaires to evaluate global self-worth was considered. The means and standard deviations for the clinical group and controls were coded to calculate effect size.

*SES:*   Family SES was assessed as a continuous (i.e., Hollingshead Four-Factor Index of Socioeconomic Status) or categorical (i.e., 'low', 'medium', and 'upper-middle') variable.

*Informant:*   The categories 'self-ratings' (i.e., children's self-evaluations), 'parents' ratings', and 'teachers' ratings' of internalizing and externalizing problems were coded.

*Sample selection:*   This moderator was coded as 'clinical' or 'difficulties'. The category 'clinical' referred to a clinical diagnosis provided by specialists according to the DSM-IV or DSM-5 criteria and those with severe language, reading, and mathematical problems (e.g., children performing below the 10th percentile in standardized tests assessing reading, mathematical, or language skills). The category 'difficulties' applied to studies that comprised children with language and learning difficulties (e.g., participants performing below the 25th percentile).

*Sample size:*   The sample size of the clinical group was coded as 'small' ($N \leq 50$) or 'large' ($N > 50$).

*Geographical area:*   On the basis of the sample location, the studies were classified as 'Europe', 'the United States', and 'Others'.

*Coding procedure and reliability.*   To calculate an effect size, the means, standard deviations, and sample size for the outcomes of interest were coded for the children with LLDs and controls. When this information was missing, the *t*-value and *F*-values were coded. The author/s of studies that failed to report this information were contacted to retrieve the data. The comparison of effect sizes in each group was calculated using Hedges' *g* formula (Hedges & Olkin, 1985). A positive Hedges' *g* indicated that the clinical group had more internalizing or externalizing problems than the controls.

When multiple data points were available, we coded the time point in which the LLD was defined. When children were identified at the beginning of a longitudinal study with similar information for each data point, data for the first time point

were coded. We also carefully examined studies from the same author/s and projects. When studies had a high sample overlap, suggesting they were derived from the same project, we coded studies reporting additional information and/or measures relevant to our meta-analysis.

A random sample of 80% of the main outcomes was double coded to establish coding reliability; the intercoder correlation (Pearson's) was higher than .800. Any disagreements were resolved by discussion and by consultation of the original article.

*Data analytic plan.*   We used a robust variance estimation (RVE) analysis (Hedges, Tipton, & Johnson, 2010) to handle effects and variance estimates related to study dependencies. An RVE model allows for clustering of standard errors in a general linear model and thus statistically weights studies and corrects for dependencies without requiring knowledge of within-study covariance (Hedges et al., 2010; Tanner-Smith & Tipton, 2014). We used a hierarchical model weighting scheme with correction for small samples because dependencies in studies in our dataset were nested.

We performed the analysis using *robumeta* and *metafor* packages in R statistical software (Fisher & Tipton, 2015; Tipton & Pustejovsky, 2015; Viechtbauer, 2010). When degrees of freedom were lower than 4, the results were considered unreliable (Fisher & Tipton, 2015; Tanner-Smith & Tipton, 2014). Heterogeneity among studies was evaluated through τ and Ω (Fisher & Tipton, 2015). With regard to categorical moderators, multiple-contrast hypothesis tests were conducted using the approximate Hotelling's $T^2$ test proposed in Tipton and Pustejovsky (2015) and implemented using the Wald-test function in the *Clubsandwich* package (Pustejovsky, 2017).

*Publication bias:*   First, we used contour-enhanced funnel plots and conducted Egger's tests for asymmetry in the funnel plot after aggregating the effect sizes at the study level (Egger, Smith, Schneider, & Minder, 1997). Significant results for Egger's test indicate an asymmetry in the funnel plot, and it is thus possible to perform the PET-PEESE analysis, which consists of a precision effect test and a precision effect estimate using the standard error in the meta-regression (Egger et al., 1997).

Second, we assessed publication year as a continuous moderator of internalizing and externalizing problems via the RVE model.

Third, we assessed study quality with the Joanna Briggs Institute (JBI) *critical appraisal checklist for cross-sectional studies* (Moola et al., 2020). The scale comprises eight items assessing the inclusion criteria for the definition of the sample, clarity of the sample description, use of objective and standard criteria to define the primary disorders, identification and control for confounding factors, validity of the outcome measures, and statistical analysis suitability. Each item was rated as 'yes' (1 point), 'no', 'unclear', or 'not applicable' (0 points). Item 7 was duplicated to evaluate the validity and reliability of internalizing and externalizing measures separately. The score for each study was calculated on the proportion of 'yes' responses for the possible maximum score and rated for a *high, moderate,* or *low* risk of bias according to the percentage of the achieved score (high-bias = lower than 49%; moderate-bias = from 50 to 69%; low-bias = higher than 70%). After evaluating the studies, we assessed whether results in the meta-analysis were consistent after removing studies rated as 'high risk of bias'.

## Results

With regard to internalizing problems, the meta-analysis included 50 studies with 53 independent samples and 135 effect sizes. The samples included a total of 3,359 children with LLDs (*M* = 64.59,

SD = 61.31, range 12–289) and 11,893 controls (M = 247.78, SD = 808.34, range 15–5463), with a mean age of 10.31 years ($M_{\text{age in months}}$ = 123.77, SD = 37.30, 65% boys). The estimated group standardized difference was positive and significant (g = 0.363, 95% CI [0.291, 0.435], k = 135, m = 53, df = 34.6, p < .001), indicating that children with LLDs had more internalizing problems than did the controls. Results were also associated with variation in the true effect sizes (τ = 0.21 and Ω = 0).

With regard to externalizing problems, the meta-analysis comprised 35 studies with 37 independent samples and 61 effect sizes. The samples included 2,336 children with LLDs (M = 68.71, SD = 71.30, range 11–289) and 9,363 controls (M = 302.03, SD = 991.92, range 17–5,463), with a mean age of 9.29 years ($M_{\text{age in months}}$ = 111.45, SD = 39.77, 67% boys). A positive and significant group standardized difference was found (g = 0.420, 95% CI [0.347, 0.494], k = 61, m = 37, df = 20.4, p < .001), showing that children with LLDs had elevated externalizing problems compared with controls. Variation in the true effect sizes was present (τ = 0 and Ω = 0.20).

Note that the effect sizes for internalizing (Hedges' g = 0.36) and externalizing (Hedges' g = 0.42) problems indicated that 64.1% and 66.3% of children with LLDs were above the mean of the control group (Cohen's U3) for these psychological issues and that there was a 60% and 61.7% chance, that a child picked at random from the LLD group had a higher score than a child randomly selected from the control group for internalizing and externalizing problems, respectively (Magnusson, 2021). Thus, internalizing and externalizing problems seemed to be more common in children with LLDs than controls.

### Moderator analysis

We first evaluated the severity of the primary disorder, the presence of additional symptoms in learning

and language, IQ, age, gender, self-concept, and SES as continuous moderators of the group standardized difference in internalizing and externalizing problems (see Table 1). As for the internalizing problems, none of the considered variables accounted for heterogeneity among studies. The results showed that testing the severity of the primary disorder, IQ, age, and gender as moderators of the group standardized difference showed no significant effects in the internalizing problems. Findings concerning the presence of additional symptoms in learning and language, self-concept, and SES were inconclusive as the degrees of freedom were lower than 4. A similar pattern emerged when these variables were assessed as moderators of Hedges' g in the externalizing problems. Results on the severity of the primary disorder, IQ, and age were no significant, while those on additional symptoms in learning and language, gender, and SES were inconclusive. Only a few studies examining externalizing problems reported data on self-concept (m = 3, k = 3), and it was not possible to assess this variable. When studies considered children with reading or mathematical disorders, only the assessment of mathematical and reading symptoms was reported. For children with language disorders, the evaluation of additional symptoms in learning focused, instead, on reading. Thus, none of the included studies reported the assessment on all three areas (reading, mathematics, and language).

Second, we tested the primary disorder, SES, informant, sample selection, sample size, and geographical area as categorical moderators of the group standardized difference in the internalizing and externalizing problems (see Table 2). As for the internalizing problems, some variables contributed to explain heterogeneity among studies. Firstly, the primary disorder was a significant moderator of the group standardized difference in the internalizing problems. The results showed that children with

**Table 1** Continuous moderator analysis

|  | k | m | τ | Hedges' g [95% CI] | df | p |
|---|---|---|---|---|---|---|
| *Internalizing problems* | | | | | | |
| Severity of the primary disorder | 71 | 28 | 0.27 | −.109 [−.242, .025] | 6.62 | .094 |
| Additional symptoms in learning and language | 24 | 9 | 0.21 | −.590 [−1.510, .330] | 1.53 | .096 |
| IQ | 86 | 31 | 0.22 | −.088 [−.387, .212] | 12.7 | .538 |
| Age | 135 | 53 | 0.21 | −.001 [−.003, .001] | 13.2 | .315 |
| Gender (% of M) | 107 | 42 | 0.23 | .090 [−.535, .714] | 6.32 | .740 |
| Self-concept | 26 | 8 | 0.01 | .195 [−1.345, 1.735] | 1.76 | .605 |
| SES | 28 | 11 | 0.15 | −.101 [−.653, .452] | 1.93 | .506 |
| *Externalizing problems* | | | | | | |
| Severity of the primary disorder | 33 | 19 | 0.01 | −.073 [−.168, .021] | 6.71 | .107 |
| Additional symptoms in learning and language | 6 | 5 | 0.01 | −.215 [−1.020, .591] | 1.86 | .350 |
| IQ | 28 | 16 | 0.01 | .273 [−.254, .800] | 6.72 | .259 |
| Age | 61 | 37 | 0.01 | .001 [−.002, .002] | 10.4 | .958 |
| Gender (% of M) | 51 | 31 | 0.01 | .404 [−.029, .836] | 3.34 | .060 |
| SES | 16 | 8 | 0.01 | .228 [−.265, .720] | 1.24 | .127 |

k = number of effect sizes; m = number of independent samples; τ = variation in effect sizes between studies; g = beta; 95% CI = 95% confidence interval; df = degrees of freedom; p = p-value.

**Table 2** Categorical moderator analysis

| | k | m | τ | F | Hedges' g [95% CI] | df | p |
|---|---|---|---|---|---|---|---|
| *Internalizing problems* | | | | | | | |
| Primary disorder | 135 | 53 | 0.22 | 3.78 | | | .048 |
|   Mathematics | 18 | 8 | | | .283 [.070, .496] | 5.71 | .018 |
|   Reading | 77 | 27 | | | .310 [.212, .409] | 18.22 | <.001 |
|   Language | 40 | 18 | | | .494 [.376, .612] | 9.94 | <.001 |
| SES | 56 | 21 | 0.24 | 0.42 | | | .682 |
|   Low | 16 | 6 | | | .505 [.236, .773] | 3.21 | .009 |
|   Medium | 33 | 11 | | | .442 [.229, .655] | 7.60 | .002 |
|   High | 7 | 4 | | | .278 [−.740, 1.295] | 1.77 | .328 |
| Informant | 135 | 53 | 0.21 | 1.50 | | | .251 |
|   Child | 65 | 31 | | | .321 [.207, .434] | 20.86 | <.001 |
|   Parents | 52 | 29 | | | .368 [.270, .467] | 19.89 | <.001 |
|   Teachers | 18 | 12 | | | .508 [.298, .718] | 7.07 | <.001 |
| Sample selection | 105 | 43 | 0.20 | 4.52 | | | .045 |
|   Clinical | 40 | 17 | | | .414 [.301, .528] | 10.00 | <.001 |
|   Difficulties | 65 | 26 | | | .269 [.173, .365] | 17.20 | <.001 |
| Sample size | 135 | 53 | 0.21 | 0.46 | | | .831 |
|   Small | 59 | 22 | | | .354 [.220, .487] | 21.60 | <.001 |
|   Large | 76 | 31 | | | .370 [.285, .455] | 15.60 | <.001 |
| Geographical area | 135 | 53 | 0.22 | 0.70 | | | .511 |
|   Europe | 69 | 29 | | | .397 [.290, .504] | 19.41 | <.001 |
|   United States | 53 | 16 | | | .313 [.213, .414] | 10.09 | <.001 |
|   Other | 13 | 8 | | | .358 [−.043, .759] | 5.86 | .071 |
| *Externalizing problems* | | | | | | | |
| Primary disorder | 61 | 37 | 0.01 | 1.25 | | | .338 |
|   Mathematics | 8 | 4 | | | .260 [−.075, .595] | 2.91 | .089 |
|   Reading | 25 | 15 | | | .434 [.342, .526] | 6.92 | <.001 |
|   Language | 28 | 18 | | | .454 [.319, .589] | 9.62 | <.001 |
| SES | 25 | 13 | 0.01 | 0.57 | | | .641 |
|   Low | 11 | 6 | | | .584 [.249, .920] | 2.71 | .013 |
|   Medium | 11 | 5 | | | .507 [.394, .620] | 2.36 | .002 |
|   High | 3 | 2 | | | .340 [−1.626, 2.310] | 1.00 | .272 |
| Informant | 61 | 37 | 0.01 | 2.25 | | | .161 |
|   Child | 8 | 7 | | | .597 [.270, .924] | 4.45 | .006 |
|   Parents | 41 | 28 | | | .362 [.268, .456] | 15.68 | <.001 |
|   Teachers | 12 | 12 | | | .491 [.356, .626] | 8.55 | <.001 |
| Sample selection | 45 | 27 | 0.01 | 3.02 | | | .111 |
|   Clinical | 20 | 11 | | | .468 [.360, .575] | 4.23 | <.001 |
|   Difficulties | 25 | 16 | | | .363 [.256, .470] | 7.43 | <.001 |
| Sample size | 61 | 37 | 0.01 | 0.77 | | | .388 |
|   Small | 33 | 21 | | | .381 [.263, .499] | 15.18 | <.001 |
|   Large | 28 | 16 | | | .443 [.343, .543] | 9.02 | <.001 |
| Geographical area | 61 | 37 | 0.01 | 0.68 | | | .525 |
|   Europe | 25 | 18 | | | .462 [.344, .580] | 9.59 | <.001 |
|   United States | 24 | 10 | | | .415 [.284, .546] | 4.91 | <.001 |
|   Other | 12 | 9 | | | .325 [.071, .580] | 5.73 | .021 |

k = number of effect sizes; m = number of independent samples; τ = variation in effect sizes between studies; F = AHT-F test; g = Hedges' g; 95% CI = 95% confidence interval; df = degrees of freedom; p = p-value.

language disorders reported higher internalizing problems than those with reading disorders (β = 0.183; p = .017), while no significant difference was found between children with language disorders and mathematical disorders (β = 0.211; p = .062) or between those with reading and mathematical disorders (β = 0.027; p = .787). Also, there was a significant effect of sample selection as a moderator of the group standardized difference in the internalizing problems, with higher effects for clinical groups than for those with difficulties (β = 0.145; p = .045). Testing SES, informant, sample size, and geographical area as moderators of the group standardized difference in the internalizing problems showed no significant effects (e.g., the effect sizes across the levels of each moderator were comparable). Studies on children with low and high SES were limited compared with those on medium SES, and results on this moderator were inconclusive to draw any conclusion (e.g., the degrees of freedom were too low).

As regard externalizing problems, slightly different results emerged. Examining the primary disorder, informant, sample selection, sample size, and geographical areas as moderators of Hedges' g in the externalizing outcomes showed no significant effects. As for the primary disorder, studies assessing externalizing problems in children with mathematical disorders were limited compared to those

focusing on children with language and reading disorders. As a result, findings for mathematical disorder, assessed as a moderator level of the categorical variable 'primary disorder', were inconclusive. Finally, findings on SES were indecisive as the degrees of freedom were lower than 4.

### Publication bias

First, a visual inspection of the funnel plots showed a reasonable symmetry (Figures S1 and S2). This was confirmed by Egger's test for internalizing ($\beta$ = 2.56, $SE$ = 1.42, $Z$ = 1.80, $p$ = .072) and externalizing problems ($\beta$ = −0.58, $SE$ = 1.14, $Z$ = −0.51, $p$ = .607), indicating that publication bias related to small-study effects had little influence across outcomes. As Egger's test was no significant, we did not perform the PET-PEESE analysis.

Second, the analysis of the publication year showed this variable to be a no significant moderator of group standardized difference for the internalizing ($g$ = 0.002, 95% CI [−0.008, 0.012], $k$ = 131, $m$ = 52, $df$ = 16.8, $p$ = .697) and externalizing ($g$ = −0.002, 95% CI [−0.015, 0.011], $k$ = 61, $m$ = 37, $df$ = 13.2, $p$ = .746) problems.

Third, the assessment of study quality indicated that only a few studies showed a high risk of bias for internalizing (three studies, $m$ = 4) and externalizing (four studies, $m$ = 6) outcomes. Most studies in the meta-analysis presented a medium risk of bias for internalizing (28 studies, $m$ = 29) and externalizing (19 studies, $m$ = 20) problems, while other studies showed a low risk of bias (internalizing: 18 studies, $m$ = 19; externalizing: 12 studies, $m$ = 11). One unpublished study was not evaluated as the data were shared by the authors and a study description was not available for independent rating.

Finally, we performed the main analysis with the high risk of bias studies removed to assess the consistency of our results. The estimated group standardized difference remained positive and significant for internalizing ($g$ = 0.368, 95% CI [0.293, 0.443], $k$ = 125, $m$ = 48, $df$ = 30.9, $p$ < .001) and externalizing problems ($g$ = 0.436, 95% CI [0.359, 0.513], $k$ = 55, $m$ = 31, $df$ = 17.1, $p$ < .001). Results were also consistent for all the continuous and categorical moderators (see Tables S1 and S2). Note the primary disorder and sample selection were confirmed as a significant moderators of the group standardized difference in the internalizing problems. The same pattern emerged for sample selection in the externalizing problems, but the results were inconclusive as the degree of freedom for the category 'clinical' was lower than 4.

### Discussion

The results of this meta-analysis revealed important findings. First, our meta-analysis indicated that children with LLDs showed elevated levels of internalizing and externalizing problems when compared with controls (RQ1). This is consistent with the results of previous meta-analyses that have assessed internalizing and/or externalizing problems in poor readers and children with language disorders separately (Curtis et al., 2018; Francis et al., 2019). Importantly, the finding was also reliable for both internalizing and externalizing problems after removing studies with a high risk of bias.

Second, our findings revealed that the primary disorder was a significant moderator, and children with language disorders showed higher internalizing problems than those with reading disorders. However, no differences were found between children with mathematical disorders and those with language or reading disorders. These results were consistent after removing studies with a high risk of bias (RQ2). Note that internalizing and externalizing problems are studied far less in children with mathematical disorders than in those with reading and language disorders. As for the internalizing problems, the effect size that emerged in children with mathematical disorders was closer to the effect found in those with reading rather than language disorders, but the confidence interval was wider and results less certain in those with mathematical problems. Some studies have investigated brain structure and functionality in children with LLDs and have found overlapping brain characteristics with those involved in internalizing and externalizing problems (e.g., Langer, Benjamin, Becker, & Gaab, 2019; Nachshon, Farah, & Horowitz-Kraus, 2020). In addition, the interaction with family socioeconomic disadvantage and individual factors (e.g., children's emotional regulation, school frustration, low self-esteem) can account for internalizing and externalizing problems in children with LLDs (Carpenter & Drabick, 2011; Hughes, Sciberras, & Goldfeld, 2016; Livingston et al., 2018). These factors may be especially relevant for children with language disorders, as language problems are related to low activation in different areas of the brain (Mayes, Reilly, & Morgan, 2015) and to poorer emotional regulation and social skills (Chow, 2018; Salmon et al., 2016).

Internalizing and externalizing problems were consistent across different levels of severity of the primary disorder and variation in the normal IQ range, also once removing studies at a high risk of bias (RQ2). This indicated that additional weaknesses in these areas failed to account for study variation in internalizing and externalizing problems. Similarly, internalizing and externalizing problems were consistent across children of different ages. These findings differ from those in a meta-analysis on behavioral problems in children with language disorders (Curtis et al., 2018). However, in our study, we used a stricter definition of language disorders and included children with reading disorders (results were consistent when the analysis was

performed in these two groups separately). Note that this does not exclude the possibility that internalizing problems can vary across time in those with LLDs. In addition, this is the first meta-analysis to find that internalizing problems were consistent across different proportions of boys and girls with LLDs. However, future studies need to further assess whether boys and girls with LLDs report externalizing problems to a different extent.

Third, the results were consistent across methodological variables (RQ3). Internalizing and externalizing problems were identified in a similar way by children, parents, and teachers, showing the consistency of the results across informants. This can indicate that parents and teachers recognize internalizing and externalizing problems in their children with LLDs. The results for sample selection showed that clinical samples reported elevated internalizing problems compared to children with difficulties. The consistency of internalizing and externalizing problems across different levels of the severity of the primary disorder and the greater occurrence of internalizing symptoms in the clinical groups may suggest that internalizing problems develop as secondary challenges in children with LLDs, and especially in clinical samples. This strengthens the difference between a clinical profile and language and learning difficulties, with the latter often assessed on a single measure or a selection based on psychometric cutoffs only. A peculiarity of clinical samples is the occurrence of significant language and learning deficits interfering with academic and daily life activities (see Mammarella, Toffalini, Caviola, Colling, & Szűcs, 2021), and this could account for elevated internalizing problems in children with clinical profiles when compared to those with difficulties. However, this may only be the case for children with language disorders; we lacked the power to perform this analysis on this group and children with reading disorders separately. Moreover, it is unclear whether this pattern characterizes externalizing problems, and future studies need to evaluate this point. Finally, internalizing and externalizing problems were consistent across small and large sample sizes and geographical areas. All findings hold when the analysis was performed without studies with a high risk of bias.

## Study strengths and limitations

To the best of our knowledge, this is the first meta-analysis to examine the co-occurrence between LLDs and psychological internalizing and externalizing problems while assessing several moderators. We also used RVE models to correct for dependencies in the data and to produce estimates that were more reliable. Overall, our findings were consistent across informant, sample size, and geographical area, and were reliable once publication bias and study quality were evaluated. Nonetheless, some limitations

should be mentioned. First, the results from the moderator analysis may be related to and partially explained by other variables; therefore, third variables could provide a better explanation of the results. Second, the use of different tasks to identify children with learning and language problems may have affected the results. Although we excluded studies that defined reading disorders using reading comprehension tasks and mathematical disorders using problem-solving tests only, a few studies ($N = 3$) lacked information on the tasks used to assess children with LLDs. Third, we only found two unpublished studies that met our inclusion criteria, so there could be an overestimation of effects related to publication bias. Future research should consider and further assess these issues.

## Recommendations for research and clinical practice

Despite these minor limitations, this meta-analysis holds several implications for future research. First, additional studies are required to assess internalizing and externalizing problems in children with mathematical disorders. Second, future studies assessing internalizing and externalizing problems in children with LLDs need to report the assessment of additional symptoms in learning and language, gender, self-concept, and family SES. Third, further longitudinal studies should examine the development and stability of these problems over time. Such studies, whether conducted on siblings or twins with and without LLDs, can provide data on genetic and environmental contributions to the development of internalizing and externalizing problems in children with LLDs (Dewey, 2018; Willcutt, 2019; see also Helland, Røysamb, Brandlistuen, Røysamb, Brandlistuen, Melby-Lervåg, & Gustavson, 2020).

In addition, our results have implications for clinical practice. First, practitioners need to be aware that children with LLDs, and especially those with language disorders, may show internalizing and externalizing problems, and thus, they need to assess possible signs of additional issues in these areas. Second, participation in school-based intervention studies targeting socioemotional skills, including self-awareness, self-management, relationship skills, and decision making, may be beneficial for promoting the psychological well-being of children with LLDs, as in the typical population (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Taylor, Oberle, Durlak, & Weissberg, 2017). Furthermore, a combination of psychological support, socioemotional training, and mentoring activities may reduce the risk of reporting internalizing and externalizing problems and support positive adjustment (Haft, Chen, LeBlanc, Tencza, & Hoeft, 2019).

Overall, there is evidence indicating that children with LLDs report more internalizing and externalizing problems than their peers. Those with language disorders seemed more vulnerable to report

internalizing problems, and clinical samples showed more internalizing problems when compared with those with difficulties in language and learning. With regard to clinical practice, this indicates that it is essential to assess these problems in children with LLDs to support their psychological well-being.

## Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

**Appendix S1**. Methods.
**Figure S1**. Funnel plot for studies on internalizing problems.
**Figure S2**. Funnel plot for studies on externalizing problems.

**Table S1**. Continuous moderator analysis without studies at high risk of bias.
**Table S2**. Categorical moderator analysis without studies at high risk of bias.
**Appendix S2**. Dataset.

## Acknowledgements

## Correspondence

Monica Melby-Lervåg, Department of Special Needs Education, University of Oslo, Oslo, Norway; Email: monica.melby-lervag@isp.uio.no

---

### Key points

- What we know is that children with language and reading disorders report higher internalizing and externalizing problems than their peers.
- What is new is that children with language, reading, and mathematical disorders reported higher internalizing and externalizing problems than their peers did. As for internalizing problems, children with language disorders reported higher problems than those with reading disorders, and clinical samples reported higher problems than those with difficulties.
- What is relevant is that assessment and interventions should target socioemotional skills to support the psychological well-being of children with language and learning disorders.

---

## References

Achenbach, T.M. (2018). Multi-informant and multicultural advances in evidence-based assessment of students' behavioral/emotional/social difficulties. *European Journal of Psychological Assessment, 34*, 127–140. https://doi.org/10.1027/1015-5759/a000448

American Psychiatric Association, DSM-5 Task Force (2013). *Diagnostic and statistical manual of mental disorders: DSM-5TM (5th ed.).*

Bishop, D.V.M., Snowling, M.J., Thompson, P.A., Greenhalgh, T., & the CATALISE-2 Consortium (2017). Phase 2 of CATALISE: A multinational and multidisciplinary Delphi consensus study of problems with language development: Terminology. *Journal of Child Psychology and Psychiatry, 58*, 1068–1080. https://doi.org/10.1111/jcpp.12721

Bornstein, M.H., Hahn, C.S., & Suwalsky, J.T. (2013). Language and internalizing and externalizing behavioral adjustment: Developmental pathways from childhood to adolescence. *Development and Psychopathology, 25*, 857–878. https://doi.org/10.1017/S0954579413000217

Carpenter, J.L., & Drabick, D.A. (2011). Co-occurrence of linguistic and behavioural difficulties in early childhood: A developmental psychopathology perspective. *Early Child Development and Care, 181*, 1021–1045. https://doi.org/10.1080/03004430.2010.509795

Carragher, N., Krueger, R.F., Eaton, N.R., & Slade, T. (2015). Disorders without borders: Current and future directions in the meta-structure of mental disorders. *Social Psychiatry and Psychiatric Epidemiology, 50*, 339–350. https://doi.org/10.1007/s00127-014-1004-z

Chow, J.C. (2018). Comorbid language and behavior problems: Development, frameworks, and intervention. *School Psychology Quarterly, 33*, 356–360. https://doi.org/10.1037/spq0000270

Chow, J.C., & Wehby, J.H. (2018). Associations between language and problem behavior: A systematic review and correlational meta-analysis. *Educational Psychology Review, 30*, 61–82. https://doi.org/10.1007/s10648-016-9385-z

Cosgrove, V.E., Rhee, S.H., Gelhorn, H.L., Boeldt, D., Corley, R.C., Ehringer, M.A., ... & Hewitt, J.K. (2011). Structure and etiology of co-occurring internalizing and externalizing disorders in adolescents. *Journal of Abnormal Child Psychology, 39*, 109–123. https://doi.org/10.1007/s10802-010-9444-8

Curtis, P.R., Frey, J.R., Watson, C.D., Hampton, L.H., & Roberts, M.Y. (2018). Language disorders and problem behaviors: A meta-analysis. *Pediatrics, 142*, e20173551. https://doi.org/10.1542/peds.2017-3551

Dewey, D. (2018). What is comorbidity and why does it matter in neurodevelopmental disorders? *Current Developmental Disorders Reports, 5*, 235–242. https://doi.org/10.1007/s40474-018-0152-3

Durlak, J.A., Weissberg, R.P., Dymnicki, A.B., Taylor, R.D., & Schellinger, K.B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development, 82*, 405–432. https://doi.org/10.1111/j.1467-8624.2010.01564.x

Egger, M., Smith, G.D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ, 315*, 629–634. https://doi.org/10.1136/bmj.315.7109.629

Elksnin, L.K., & Elksnin, N. (2004). The social-emotional side of learning disabilities. *Learning Disability Quarterly, 27*, 3–8. https://doi.org/10.2307/1593627

Fisher, Z., & Tipton, E. (2015). Robumeta: An R-package for robust variance estimation in meta-analysis. https://arxiv.org/abs/1503.02220

Francis, D.A., Caruana, N., Hudson, J.L., & McArthur, G.M. (2019). The association between poor reading and internalising problems: A systematic review and meta-analysis. *Clinical Psychology Review*, *67*, 45–60. https://doi.org/10.1016/j.cpr.2018.09.002

Haft, S.L., Chen, T., LeBlanc, C., Tencza, F., & Hoeft, F. (2019). Impact of mentoring on socio-emotional and mental health outcomes of youth with learning disabilities and attention-deficit hyperactivity disorder. *Child and Adolescent Mental Health*, *24*, 318–328. https://doi.org/10.1111/camh.12331

Hedges, L.V., & Olkin, I. (1985). *Statistical methods for meta-analysis*. San Diego, CA: Academic Press.

Hedges, L.V., Tipton, E., & Johnson, M.C. (2010). Robust variance estimation in meta-regression with dependent effect size estimates. *Research Synthesis Methods*, *1*, 39–65. https://doi.org/10.1002/jrsm.5

Helland, S.S., Røysamb, E., Brandlistuen, R.E., Melby-Lervåg, M., & Gustavson, K. (2020). A common family factor underlying language difficulties and internalizing problems: Findings from a population-based sibling study. *Journal of Learning Disabilities*, *53*, 399–409. https://doi.org/10.1177/0022219420911634

Helland, S.S., Røysamb, E., Wang, M.V., & Gustavson, K. (2018). Language difficulties and internalizing problems: Bidirectional associations from 18 months to 8 years among boys and girls. *Development and Psychopathology*, *30*, 1239–1252. https://doi.org/10.1017/S0954579417001559

Hentges, R.F., Devereux, C., Graham, S.A., & Madigan, S. (2021). Child language difficulties and internalizing and externalizing symptoms: A meta-analysis. *Child Development*, *92*, 1–25. https://doi.org/10.1111/cdev.13540

Horbach, J., Mayer, A., Scharke, W., Heim, S., & Günther, T. (2020). Development of behavior problems in children with and without specific learning disorders in reading and spelling from kindergarten to fifth grade. *Scientific Studies of Reading*, *24*, 57–71. https://doi.org/10.1080/10888438.2019.1641504

Hughes, N., Sciberras, E., & Goldfeld, S. (2016). Family and community predictors of comorbid language, socioemotional and behavior problems at school entry. *PLoS One*, *11*, e0158802. https://doi.org/10.1371/journal.pone.0158802

Hulme, C., & Snowling, M.J. (2013). *Developmental disorders of language learning and cognition*. John Wiley & Sons.

Hulme, C., & Snowling, M.J. (2016). Reading disorders and dyslexia. *Current Opinion in Pediatrics*, *28*, 731–735. https://doi.org/10.1097/MOP.0000000000000411

Ingre, M. (2013). Why small low-powered studies are worse than large high-powered studies and how to protect against "trivial" findings in research: Comment on Friston (2012). *NeuroImage*, *81*, 496–498. https://doi.org/10.1016/j.neuroimage.2013.03.030

Jennions, M.D., & Møller, A.P. (2002). Relationships fade with time: A meta-analysis of temporal trends in publication in ecology and evolution. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, *269*, 43–48. https://doi.org/10.1098/rspb.2001.1832

Krueger, R.F., Chentsova-Dutton, Y.E., Markon, K.E., Goldberg, D., & Ormel, J. (2003). A cross-cultural study of the structure of comorbidity among common psychopathological syndromes in the general health care setting. *Journal of Abnormal Psychology*, *112*, 437–447. https://doi.org/10.1037/0021-843X.112.3.437

Kucian, K., & von Aster, M. (2015). Developmental dyscalculia. *European Journal of Pediatrics*, *174*, 1–13. https://doi.org/10.1007/s00431-014-2455-7

Langer, N., Benjamin, C., Becker, B.L., & Gaab, N. (2019). Comorbidity of reading disabilities and ADHD: Structural and functional brain characteristics. *Human Brain Mapping*, *40*, 2677–2698. https://doi.org/10.1002/hbm.24552

Letourneau, N.L., Duffett-Leger, L., Levac, L., Watson, B., & Young-Morris, C. (2013). Socioeconomic status and child development: A meta-analysis. *Journal of Emotional and Behavioral Disorders*, *21*, 211–224. https://doi.org/10.1177/1063426611421007

Lindsay, G., & Dockrell, J.E. (2012). Longitudinal patterns of behavioral, emotional, and social difficulties and self-concepts in adolescents with a history of specific language impairment. *Language, Speech, and Hearing Services in Schools*, *43*, 445–460. https://doi.org/10.1044/0161-1461(2012/11-0069)

Lindsay, G., & Strand, S. (2016). Children with language impairment: Prevalence, associated difficulties, and ethnic disproportionality in an English population. *Frontiers in Education*, *1*, 2. https://doi.org/10.3389/feduc.2016.00002

Livingston, E.M., Siegel, L.S., & Ribary, U. (2018). Developmental dyslexia: Emotional impact and consequences. *Australian Journal of Learning Difficulties*, *23*, 107–135. https://doi.org/10.1080/19404158.2018.1479975

Magnusson, K. (2021). Interpreting Cohen's d effect size: An interactive visualization (Version 2.5.0) [Web App]. R Psychologist. https://rpsychologist.com/cohend/

Mammarella, I.C., Toffalini, E., Caviola, S., Colling, L., & Szűcs, D. (2021). No evidence for a core deficit in developmental dyscalculia or mathematical learning disabilities. *Journal of Child Psychology and Psychiatry*, *62*, 704–714. https://doi.org/10.1111/jcpp.13397

Mayes, A.K., Reilly, S., & Morgan, A.T. (2015). Neural correlates of childhood language disorder: A systematic review. *Developmental Medicine and Child Neurology*, *57*, 706–717. https://doi.org/10.1111/dmcn.12714

McArthur, G.M., Filardi, N., Francis, D.A., Boyes, M.E., Badcock, N.A. (2020). Self-concept in poor readers: A systematic review and meta-analysis. *PeerJ*, *8*. https://doi.org/10.7717/peerj.8772

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D.G. & The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, *6*, e1000097. https://doi.org/10.1371/journal.pmed.1000097

Moll, K., Kunze, S., Neuhoff, N., Bruder, J., & Schulte-Körne, G. (2014). Specific learning disorder: Prevalence and gender differences. *PLoS One*, *9*, e103537. https://doi.org/10.1371/journal.pone.0103537

Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetcu, R. . . . & Mu, P.-F. (2020). Chapter 7: Systematic reviews of etiology and risk. In E. Aromataris, & Z. Munn (Eds.), *JBI manual for evidence synthesis*. https://synthesismanual.jbi.global

Morsanyi, K., van Bers, B.M., McCormack, T., & McGourty, J. (2018). The prevalence of specific learning disorder in mathematics and comorbidity with other developmental disorders in primary school-age children. *British Journal of Psychology*, *109*, 917–940. https://doi.org/10.1111/bjop.12322

Nachshon, O., Farah, R., & Horowitz-Kraus, T. (2020). Decreased functional connectivity between the left amygdala and frontal regions interferes with reading, emotional, and executive functions in children with reading difficulties. *Frontiers in Human Neuroscience*, *14*, 104. https://doi.org/10.3389/fnhum.2020.00104

Navarro, M.C., Orri, M., Nagin, D., Tremblay, R.E., Oncioiu, S.I., Ahun, M.N., . . . & Côté, S.M. (2020). Adolescent internalizing symptoms: The importance of multi-informant assessments in childhood. *Journal of Affective Disorders*, *266*, 702–709. https://doi.org/10.1016/j.jad.2020.01.106

Pustejovsky, J.E. (2017). clubSandwich: Cluster-robust (sandwich) variance estimators with small-sample corrections. https://cran.r-project.org/%0Apackage=clubSandwich

Quinn, J.M., & Wagner, R.K. (2015). Gender differences in reading impairment and in the identification of impaired readers: Results from a large-scale study of at-risk readers. *Journal of Learning Disabilities*, 48, 433–445. https://doi.org/10.1177/0022219413508323

Salbach-Andrae, H., Klinkowski, N., Lenz, K., & Lehmkuhl, U. (2009). Agreement between youth-reported and parent-reported psychopathology in a referred sample. *European Child & Adolescent Psychiatry*, 18, 136–143. https://doi.org/10.1007/s00787-008-0710-z

Salmon, K., O'Kearney, R., Reese, E., & Fortune, C.A. (2016). The role of language skill in child psychopathology: Implications for intervention in the early years. *Clinical Child and Family Psychology Review*, 19, 352–367. https://doi.org/10.1007/s10567-016-0214-1

Schulz, W., & Muschalla, B. (2021). What predicts internal and external mental disorders in adolescent boys and girls? Results from a 10-year longitudinal study. *European Journal of Developmental Psychology*, 1–17, https://doi.org/10.1080/17405629.2021.1890019

Sowislo, J.F., & Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychological Bulletin*, 139, 213–240. https://doi.org/10.1037/a0028931

Szucs, D., & Ioannidis, J.P.A. (2017). Empirical assessment of published effect sizes and power in the recent cognitive neuroscience and psychology literature. *PLoS Biology*, 15, e2000797. https://doi.org/10.1371/journal.pbio.2000797

Tanner-Smith, E.E., & Tipton, E. (2014). Robust variance estimation with dependent effect sizes: Practical considerations including a software tutorial in Stata and SPSS. *Research Synthesis Methods*, 5, 13–30. https://doi.org/10.1002/jrsm.1091

Taylor, R.D., Oberle, E., Durlak, J.A., & Weissberg, R.P. (2017). Promoting positive youth development through school-based social and emotional learning interventions: A meta-analysis of follow-up effects. *Child Development*, 88, 1156–1171. https://doi.org/10.1111/cdev.12864

Tipton, E., & Pustejovsky, J.E. (2015). Small-sample adjustments for tests of moderators and model fit using robust variance estimation in meta-regression. *Journal of Educational and Behavioral Statistics*, 40, 604–634. https://doi.org/10.3102/1076998615606099

Trzesniewski, K.H., Donnellan, M.B., Moffitt, T.E., Robins, R.W., Poulton, R., & Caspi, A. (2006). Low self-esteem during adolescence predicts poor health, criminal behavior, and limited economic prospects during adulthood. *Developmental Psychology*, 42, 381–390. https://doi.org/10.1037/0012-1649.42.2.381

van Daal, J., Verhoeven, L., & Van Balkom, H. (2007). Behaviour problems in children with language impairment. *Journal of Child Psychology and Psychiatry*, 48, 1139–1147. https://doi.org/10.1111/j.1469-7610.2007.01790.x

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, 36, 1–48. https://doi.org/10.18637/jss.v036.i03

Willcutt, E.G. (2019). Behavior and molecular genetic approaches to comorbidity. *Current Developmental Disorders Reports*, 6, 31–36. https://doi.org/10.1007/s40474-019-00162-0

Yew, S.G.K., & O'Kearney, R. (2013). Emotional and behavioural outcomes later in childhood and adolescence for children with specific language impairments: Meta-analyses of controlled prospective studies. *Journal of Child Psychology and Psychiatry*, 54, 516–524. https://doi.org/10.1111/jcpp.12009

Zahn-Waxler, C., Shirtcliff, E.A., & Marceau, K. (2008). Disorders of childhood and adolescence: Gender and psychopathology. *Annual Review of Clinical Psychology*, 4, 275–303. https://doi.org/10.1146/annurev.clinpsy.3.022806.091358