Working memory profiles in children with ADHD, dyslexia and comorbid ADHD-dyslexia: a structured literature review based on Baddeley and Hitch's multicomponent model

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ABSTRACT

Working memory is important for learning because children often need to keep information available while they read, follow instructions or solve a problem. Children with attention-deficit/hyperactivity disorder (ADHD) and children with dyslexia or reading disability (RD) can both show working memory difficulties, but the patterns are not identical. This structured literature review compared ADHD, dyslexia/RD and comorbid ADHD-dyslexia using the phonological loop, visuospatial sketchpad and central executive from Baddeley and Hitch's multicomponent model. PubMed and the Education Resources Information Center (ERIC) were searched with separate ADHD, dyslexia/RD and combined searches. The revised searches produced 4,039 records. After 609 duplicates were removed, 3,430 unique records were screened. Ninety-four reports were sought for full text, 43 were not retrieved, 51 were assessed and 38 were included in the narrative synthesis. Dyslexia/RD was most consistently associated with phonological or verbal short-term memory difficulties, although broader working memory weaknesses were also reported. ADHD was more consistently associated with central executive demands, with visuospatial storage difficulties in some studies. Comorbid ADHD-RD usually showed a broader, mainly additive pattern rather than a completely separate profile. Reading and reading comprehension had the strongest academic evidence. Evidence for spelling and mathematics was smaller but still showed relevant links with working memory. Overall, the findings support different but overlapping working memory profiles.

Keywords: *ADHD, dyslexia, reading disability, working memory, phonological loop, central executive*

INTRODUCTION

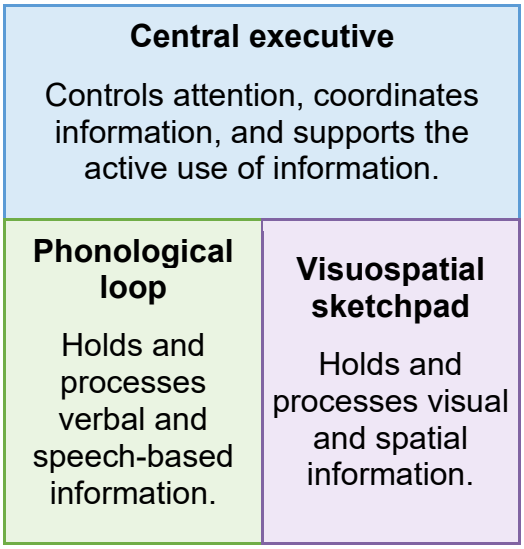
Working memory allows a small amount of information to remain available while it is being used. In school, a child may need working memory to keep sounds in mind while decoding a new word, remember the beginning of a sentence while reaching the end, follow several instructions, or hold numbers while carrying out a calculation. These tasks are different, but they all require information to be stored briefly and sometimes manipulated at the same time. For this reason, working memory is closely connected with learning and academic performance (Baddeley & Hitch, 1974; Gathercole et al., 2006).

This thesis focuses on attention-deficit/hyperactivity disorder (ADHD) and dyslexia or reading disability (RD). ADHD mainly involves difficulties with attention and/or hyperactive-impulsive behaviour, while dyslexia/RD mainly affects the development of accurate or fluent word reading and spelling. The two conditions are different, but they frequently occur together. Direct comparison studies have therefore asked whether the comorbid group simply combines the difficulties found in ADHD and RD, or whether it shows a separate cognitive profile (Poon et al., 2021; Willcutt et al., 2005).

Baddeley and Hitch's multicomponent model is used as the main framework for this review (Baddeley & Hitch, 1974). The analysis in this thesis uses three components: the phonological loop for verbal and speech-based information, the visuospatial sketchpad for visual and spatial information, and the central executive for attention and the active use of information. Baddeley later added the episodic buffer (Baddeley, 2000). That later component is not used as an analysis category in this review. Figure 1 shows the three components used here.

Figure 1.

The three working memory components used as the framework in this thesis, based on Baddeley and Hitch (1974).



The distinction between the components is useful because ADHD and dyslexia do not show one identical working memory pattern. Several studies of dyslexia/RD report weaker verbal or phonological short-term memory, especially when children have to repeat nonwords, retain unfamiliar verbal material or keep serial order in mind (de Carvalho et al., 2014; Kibby, 2009; Kibby & Cohen, 2008). ADHD studies more often report difficulties when information has to be actively controlled, coordinated or updated, although visuospatial storage problems are

also found in some samples (Kofler et al., 2020; Martinussen & Tannock, 2006; Vance et al., 2013).

These patterns are not absolute. Gray et al. (2019) found several working memory profiles among children with dyslexia, developmental language disorder and typical development, and the profiles did not match diagnostic groups perfectly. Cowan et al. (2017) also found that some short-term memory results in dyslexia changed after language and non-verbal ability were taken into account, while serial-order difficulties remained. In ADHD, de Jong et al. (2009) found a clear visuospatial working memory weakness, while Kofler et al. (2020) found the largest weakness in central executive working memory. This variation shows why working memory should not be used as a diagnostic test on its own.

Studies that directly compare ADHD-only, RD-only, comorbid and control groups are especially valuable for the research question. Kibby and Cohen (2008) found reduced verbal short-term memory in RD and reduced visuospatial short-term memory in ADHD, with the comorbid group showing both patterns. Willcutt et al. (2005) found that the comorbid group largely showed the combination of weaknesses found in the two single-disorder groups. Poon et al. (2021) likewise reported an additive pattern, although the exact working memory domains differed. These studies suggest that comorbidity may be broader without necessarily producing the lowest score on every task.

Academic outcomes are included because working memory may also be related to school learning. In ADHD, higher working memory demands can reduce reading comprehension, and working memory has also been linked with recall of important information from passages (Kofler et al., 2019; Miller et al., 2013). Working memory and processing speed have also been related to reading fluency, spelling and mathematics in children with ADHD (Hulsbosch et al., 2025; Jacobson et al., 2011). In dyslexia/RD, phonological and verbal memory are related to decoding and word reading, while complex working memory has also been related to mathematics (de Carvalho et al., 2014; Gathercole et al., 2006; Knoop-van Campen et al., 2018).

The choice of this topic was also influenced by personal and educational experience. Difficulties experienced by a close family member, together with previous work in education as a teacher, motivated a closer examination of how working memory may affect children with ADHD and dyslexia.

Need of the study

There is a large amount of research on working memory in ADHD and dyslexia, but the studies use different tasks, diagnostic definitions and comparison groups. A verbal span task, a complex working memory task and a visuospatial updating task do not measure exactly the same process. This makes it difficult to compare findings if all working memory measures are treated as one score. Organising the literature around the same three components gives a clearer way to describe both differences and overlap.

The comorbid group is another reason for this review. ADHD and RD often occur together, so studying only one diagnosis at a time can miss part of the research and

educational picture (Willcutt et al., 2005). If ADHD is more strongly related to executive control and RD is more strongly related to phonological storage, children with both conditions may show difficulties in both areas. This possible additive pattern needs to be checked against studies that include the separate groups rather than assumed in advance.

A final reason for the review is that working memory findings can have different educational meanings. A child may struggle with reading because phonological information is difficult to maintain, because executive control is overloaded during comprehension, or because several weaknesses are present together. The review therefore compares the cognitive profiles first and then considers how the reported working memory measures relate to reading, spelling and mathematics.

Research question, objectives and hypotheses

Research question: How do working memory profiles differ between children with ADHD, dyslexia and comorbid ADHD-dyslexia based on Baddeley and Hitch's multicomponent model?

Objective 1: compare working memory profiles in ADHD, dyslexia/reading disability and comorbid ADHD-dyslexia.

Objective 2: identify which working memory components are most affected in each group.

Objective 3: explore links with reading decoding, spelling/orthography, reading comprehension and mathematical word problems.

Hypothesis A: children with dyslexia/RD are expected to show greater phonological or verbal short-term memory difficulties than children with ADHD.

Hypothesis B: children with ADHD are expected to show greater difficulty on tasks that rely strongly on central executive control.

Exploratory hypothesis: children with comorbid ADHD-dyslexia/RD are expected to show a broader combination of phonological and executive working memory difficulties.

METHOD

Study design and aim

This thesis is a structured literature review with a systematic search and selection process. It is not presented as a formally registered systematic review. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-style reporting aid was used to make the identification, screening, retrieval and final selection of studies transparent (Page et al., 2021). The aim was to compare working memory findings in children with ADHD, dyslexia/RD and comorbid ADHD-dyslexia/RD and to organise the evidence using the phonological loop, visuospatial sketchpad and central executive.

A narrative synthesis was used rather than a meta-analysis. The included studies differed in age, language, diagnostic criteria, working memory tasks and statistical methods. Because of these differences, pooling all results into one effect size was not

considered appropriate for this review. Instead, patterns were compared across studies, with particular attention to direct diagnostic-group comparisons and to studies with clearer methods.

Databases and search strategy

The literature search was carried out in PubMed and the Education Resources Information Center (ERIC). PubMed covered the health and neuropsychology side of the topic, while ERIC added educational literature. PsycINFO, Scopus and Web of Science were not searched. PubMed and ERIC were considered sufficient for this thesis, while the use of only two databases is reported as a limitation.

A PubMed pilot search was first run. It required ADHD, dyslexia and working memory to be present together and returned 101 records. After feedback, the strategy was changed because that search could miss ADHD-only and dyslexia/RD-only studies that were needed to establish the separate profiles. The pilot search was therefore replaced and its 101 records were not added to the final totals.

The revised strategy used three complementary searches in each database. Search A combined ADHD terms with working memory terms. Search B combined dyslexia or reading-disability terms with working memory terms. Search C combined ADHD, dyslexia/RD and working memory terms. PubMed used Medical Subject Headings (MeSH) together with title/abstract terms. ERIC used comparable text terms. No publication-year limit was applied. The six final exports contained 4,039 records.

Revised database search exports

- PubMed A
  - ADHD + working memory: 2,428 records.
- PubMed B
  - dyslexia/RD + working memory: 867 records.
- PubMed C
  - ADHD + dyslexia/RD + working memory: 117 records.
- ERIC A
  - ADHD + working memory: 258 records.
- ERIC B
  - dyslexia/RD + working memory: 337 records.
- ERIC C
  - ADHD + dyslexia/RD + working memory: 32 records.

Inclusion criteria

Studies were eligible when they included children or adolescents younger than 18 years, or when a mixed-age sample allowed the child data to be separated. Eligible diagnostic groups included ADHD, dyslexia/RD, comorbid ADHD-RD and typically developing controls. Single-disorder studies were retained because they were necessary for describing the ADHD and dyslexia profiles before interpreting comorbidity.

Each included report needed at least one working memory or closely related short-term memory measure that could reasonably be mapped to the phonological loop, visuospatial sketchpad or central executive. Original empirical research in English was eligible. Reading decoding, spelling or

orthography, reading comprehension and mathematics were recorded when present, but an academic outcome was not required for inclusion because the first two objectives concern the working memory profile itself.

Exclusion criteria

Adult-only studies, reviews, editorials, opinion papers, conference abstracts and animal studies were excluded. Studies focused mainly on unrelated neurological or psychiatric conditions were excluded when the target ADHD or dyslexia data could not be separated. Intervention studies were excluded when baseline data could not be separated from treatment effects. Neuroimaging studies were only retained when their behavioural working memory findings were directly useful for the research question. The later episodic buffer (Baddeley, 2000) was not used as an inclusion domain because the review was organised around the original three components described above.

Screening and selection procedure

The six database exports were combined before screening. Duplicates were checked using DOI, PMID, ERIC identifiers and normalised title matching. The 4,039 exported records contained 609 duplicates, leaving 3,430 unique records for title and abstract screening. Titles and abstracts were checked for age, diagnostic group, working memory relevance and study type.

After the final eligibility review, 3,336 records were excluded at title/abstract stage and 94 reports were sought for full-text retrieval. Retrieval was kept separate from scientific eligibility. A paper was not excluded simply because the publisher page required payment. Legal open-access sources, repositories, institutional copies and other available full-text sources were searched. Forty-three reports could not be retrieved and were recorded as not retrieved. Fifty-one full texts were assessed. Thirteen reports were excluded after full-text assessment and 38 reports were retained in the final narrative synthesis.

One intervention report, Poon et al. (2024), was retained only for its pre-training data. The baseline comparison included ADHD, RD, ADHD+RD and typically developing groups, and the baseline analyses could be separated from the training effects. The treatment effects are therefore not used to describe the natural working memory profiles.

Data extraction and synthesis

For each included report, the author and year, participant groups, sample information, working memory measures, the component of the working memory model, academic outcomes, main findings and important methodological limitations were extracted. Studies that directly compared the diagnostic groups were given more weight when describing the profiles. Direct four-group or closely matched comparisons were especially important for the research question, while single-disorder studies were used to clarify individual components and academic outcomes.

The synthesis was grouped into four areas: the ADHD working memory profile, the dyslexia/RD profile, the comorbid profile, and academic outcomes. A finding was described as more consistent when it

appeared across several independent studies using different samples or tasks. A single significant result was not treated as evidence that a component was universally impaired in a diagnosis. When studies disagreed, the disagreement was retained in the synthesis.

Measures were mapped to the model according to the main demand of the task rather than only the label chosen by the original authors. Simple verbal span, digit span forward and nonword repetition were treated mainly as phonological-loop or verbal short-term-memory measures. Visual or spatial span and spatial storage tasks were treated mainly as visuospatial-sketchpad measures. Tasks that required simultaneous storage and manipulation, updating, coordination or backward recall were treated mainly as central-executive measures. Some studies included tasks that could not be assigned cleanly to only one component; in those cases the original description was retained and a precise component interpretation was not forced.

Behavioural working-memory ratings were also treated cautiously. For example, the Behavior Rating Inventory of Executive Function (BRIEF) working-memory or behavioural-regulation scales describe everyday executive difficulties rather than the same process measured by a laboratory span task. These measures were used as supporting evidence for executive working-memory problems, but they were not treated as interchangeable with direct central-executive tests. This distinction was important in studies such as Poon et al. (2021) and Kibby et al. (2021).

Generative AI was used as a support tool to help organise notes and summarise information from selected studies. The study findings and references were checked against the original sources, and the final interpretation and conclusions were made by the author.

Quality check

The revised JBI critical appraisal tools were used as a guide for the quality check, with the tool chosen according to study design. For most reports, the analytical cross-sectional JBI guidance was used. Quasi-experimental guidance was used for task-manipulation or intervention reports when appropriate, and cohort guidance was used for the longitudinal dyslexia study. The quality check looked at eligibility criteria, participant descriptions, diagnostic and working memory measures, confounding, outcome measurement and analysis (Barker et al., 2024; Barker et al., 2025; Barker et al., 2026).

No numerical JBI cut-off was used to remove studies. Instead, simple summary labels of low, some or higher concerns were used to show how much caution was needed when interpreting each report. These labels are summary labels used in this thesis; they are not official JBI scores. Common concerns included small samples, mixed learning-disorder groups, medication or comorbidity effects, and cross-sectional designs. The study overview and the quality notes are provided in Appendices A and B.

RESULTS

Study selection

The final study-selection flow is shown in Appendix C. The revised PubMed and ERIC searches produced 4,039 records. After 609 duplicates were removed, 3,430 unique records were screened. A total of 3,336 records were excluded at title/abstract stage. Ninety-four reports were sought for full text, 43 could not be retrieved, 51 were assessed for eligibility, 13 were excluded after full-text assessment, and 38 reports were included in the narrative synthesis.

The included reports were published between 1999 and 2026. The evidence included direct ADHD-RD-comorbidity comparisons, ADHD-only studies, dyslexia/RD-only studies and studies focused on academic outcomes. Sample sizes ranged from small experimental groups of fewer than 40 children to studies with several hundred participants. English-, German- and Chinese-speaking samples were represented, among others. Appendix A summarises all 38 included reports.

Characteristics of the included evidence

The 38 reports did not contribute equally to every part of the research question. ADHD was represented by many experimental and single-disorder studies. Fewer studies directly compared the comorbid group with the separate ADHD and RD groups. Dyslexia/RD studies often used verbal span, nonword repetition or broader language and memory batteries. Direct comparison studies were especially useful because they showed whether a weakness was more closely related to one diagnosis or was shared by both.

The studies also differed by publication period. Older studies often used smaller groups and fewer memory tasks. More recent studies more often used larger samples, multicomponent batteries or statistical models that separated different parts of working memory. The newer evidence did not replace the older findings, but it showed more variation. Central executive difficulty in ADHD and phonological difficulty in RD remain useful overall patterns, but they are not present in exactly the same way in every study.

Working memory profile in ADHD

The ADHD evidence most consistently pointed to difficulty when working memory required active executive control. Kofler et al. (2020) provided one of the clearest examples. In 172 clinically evaluated children aged 8 to 13 years, ADHD was associated with very large central executive working memory deficits, smaller visuospatial short-term memory deficits and no clear phonological short-term memory deficit. The central executive measure also covaried with ADHD symptom severity. This pattern supports the idea that the central executive is an important part of the ADHD profile, while also showing that visuospatial storage can be affected.

Several smaller experimental studies support the same executive pattern. Kofler et al. (2010) manipulated central executive and storage demands and found that central executive demands accounted for inattentive behaviour in children with ADHD even at relatively low load. Orban et al. (2018) found

that central executive working memory explained a substantial part of the increased inattention shown by boys with ADHD during classroom-like instruction. Rapport et al. (2009) similarly linked increased activity level to central executive demand rather than to storage/rehearsal alone. These studies are small, but they connect working memory demand with observable ADHD behaviour rather than only with test scores.

Other ADHD studies show that the profile cannot be reduced to the central executive alone. De Jong et al. (2009) reported a visuospatial working memory deficit that was specific to the ADHD-only group in a direct ADHD-RD comparison. Marzocchi et al. (2008) found visual working memory, planning and cognitive-flexibility weaknesses in ADHD, while RD showed far fewer executive deficits. Vance et al. (2013), in a much larger sample, found impaired spatial working memory in ADHD with or without anxiety. More recently, Coclici et al. (2026) found evidence that the visuospatial problem in ADHD may be more related to spatial storage than to spatial processing.

The study by Martinussen and Tannock (2006) also supports a mixed executive-visuospatial profile. ADHD-only children showed visuospatial storage weaknesses together with verbal and visuospatial central executive weaknesses. However, the comparison groups with reading/language learning disorders showed broader deficits across storage and central executive measures. This study is useful but must be interpreted cautiously because RD and language impairment were combined in some groups.

Not every study found a unique ADHD working memory pattern. Holmes et al. (2014) compared children with ADHD, children identified for low working memory and typically developing children. The ADHD and low-working-memory groups had similar working memory and executive profiles, while ADHD was distinguished more by impulsive behaviour. This finding is important because it shows that a working memory deficit is not specific to ADHD and should not be used as a diagnostic marker by itself.

Working memory profile in dyslexia / reading disability

The dyslexia/RD evidence showed the clearest and most repeated pattern for verbal and phonological short-term memory. Kibby and Cohen (2008) found that children with RD had reduced verbal short-term memory but relatively intact visual short-term memory and central executive performance. Kibby (2009) examined the verbal short-term memory deficit in more detail and found that children with RD performed particularly poorly for less familiar words and nonwords. Phonological awareness, phonological storage and articulation rate contributed differently depending on the material, and verbal short-term memory was related to decoding of novel items.

De Carvalho et al. (2014) reached a similar conclusion in students with dyslexia. The dyslexia group had poorer decoding and poorer phonological short-term memory on pseudoword repetition. The relation with broader digit-span working memory was less clear, which again suggests that phonological storage may be more consistent

than a general working memory deficit. Berninger and Abbott (2013) also found that verbal working-memory markers associated with dyslexia remained present even when children differed strongly in verbal reasoning ability.

Several studies broaden this picture. Cowan et al. (2017) found serial-order memory difficulties in dyslexia across verbal and, under some conditions, spatial material. The phonological nonword-repetition difference became weaker after matching for language and non-verbal intelligence, whereas some serial-order difficulties remained. Gathercole et al. (2006) found weaker complex working memory as well as weaker visuospatial short-term memory among children with reading disabilities. Gray et al. (2019) found that children with dyslexia were distributed across several working memory profiles rather than belonging to one single memory class.

These findings do not contradict the phonological pattern, but they suggest that it should be interpreted cautiously. Overall, the evidence suggests that phonological or verbal short-term memory is the most consistent area of weakness in dyslexia/RD, but not the only possible area. Differences in language ability, task demands, age and the way RD is defined can change the size and form of the working memory deficit.

Working memory profile in comorbid ADHD and dyslexia / RD

The direct comparison studies generally supported a broader and mainly additive profile in comorbid ADHD-RD. Kibby and Cohen (2008) gave a clear example: the RD group had weaker verbal short-term memory, the ADHD group had weaker visuospatial short-term memory, and the comorbid group showed both types of difficulty. Willcutt et al. (2005), using a much larger sample, also found that the comorbid group mostly combined weaknesses reported separately for RD and ADHD rather than showing a completely new neuropsychological pattern.

Poon et al. (2021) compared predominantly inattentive ADHD (ADHD-I), RD, ADHD-I+RD and typically developing children across verbal, visuospatial and behavioural working memory. RD was associated with verbal and visuospatial working memory difficulty, ADHD-I with behavioural working memory difficulty, and the comorbid group showed an additive pattern with particularly strong behavioural working memory problems. Kibby et al. (2021) also supported a multiple-deficit interpretation. Phonological-loop weaknesses were more specific to RD and behavioural regulation weaknesses more specific to ADHD, while the comorbid group was not consistently worse than both single-disorder groups.

Tiffin-Richards et al. (2008) found both separation and overlap. Dyslexia was related to language and phonological short-term memory, ADHD to switching, and both conditions affected an executive manipulation task. Van De Voorde et al. (2010), however, found general working memory problems mainly in RD and ADHD+RD rather than ADHD-only. These differences show why the additive pattern should be described as a tendency rather than a rule that every comorbid child must show every deficit.

Recent Chinese studies add to the same general picture. Wei et al. (2025) found poorer verbal and visuospatial working memory and response inhibition in children with ADHD+RD than in children with ADHD alone, and lower executive-function performance was related to greater Chinese reading difficulty. In the pre-training data from Poon et al. (2024), both ADHD and RD were related to central executive difficulty, while RD was also linked with poorer verbal working memory. The baseline visuospatial result was less clear. These findings again show overlap across components rather than a perfectly separate pattern for each diagnosis.

Working memory and academic outcomes

Reading was the most strongly represented academic outcome. In ADHD, Kofler et al. (2019) experimentally increased concurrent working memory demands during reading. Reading comprehension declined in both groups, but the decrease was larger in children with ADHD even after foundational reading skills and comorbid RD were controlled. Miller et al. (2013) found that children with ADHD had particular difficulty recalling central information from passages, and working memory explained the largest unique part of this centrality deficit. Jacobson et al. (2011) also found that working memory and processing speed predicted oral reading fluency in ADHD.

In dyslexia/RD, the link with reading was more often phonological. De Carvalho et al. (2014) found poorer pseudoword repetition together with poorer decoding. Kibby (2009) found that verbal short-term memory contributed to decoding when words were unfamiliar and had to be decoded rather than recognised. Knoop-van Campen et al. (2018) found that working memory predicted word-reading efficiency indirectly through phonological awareness. These studies connect phonological storage with the processes that support reading rather than suggesting a simple one-to-one relation between one memory score and reading ability.

Spelling and orthographic outcomes were less common than reading outcomes, but they were not absent. Hulsbosch et al. (2025) found that processing speed and working memory formed part of the pathway between inattention and academic achievement, with processing speed also contributing to spelling. Van Rijthoven et al. (2022) found that verbal learning predicted spelling across children with and without dyslexia, while verbal working memory was considered alongside phonological and semantic factors. Berninger and Abbott (2013) showed that dyslexia-related working-memory markers remained present even in children with high verbal reasoning, alongside differences in reading and spelling.

The final study set also included several studies on mathematics. Gaye et al. (2024) found that performance across all three memory areas used in this thesis was related to math skills, and the measures together explained a substantial proportion of variance in math achievement. Sturm et al. (2018) found that auditory-verbal working memory speed predicted math computation in youth with ADHD. Gathercole et al. (2006) found that poorer mathematics in children with RD was associated with complex working memory, phonological short-term memory and phonological

awareness. Hulsbosch et al. (2025) also linked cognitive processing with mathematics in ADHD. However, these studies mainly assessed general mathematics or computation; little evidence specifically isolated mathematical word problems.

Answer to the hypotheses

Hypothesis A was supported overall. Across direct comparisons and dyslexia-only studies, dyslexia/RD was more consistently linked with phonological or verbal short-term memory than ADHD. This pattern was especially clear in Kibby and Cohen (2008), Kibby (2009), de Carvalho et al. (2014) and Willcutt et al. (2005). The support is not absolute because some RD studies also found complex, executive or visuospatial weaknesses.

Hypothesis B was broadly supported, but less cleanly than Hypothesis A. ADHD was repeatedly associated with central executive working memory, particularly in Kofler et al. (2020), Kofler et al. (2010), Orban et al. (2018) and Martinussen and Tannock (2006). At the same time, several direct studies found important visuospatial storage weaknesses, and some studies did not find a unique executive deficit. The ADHD profile is therefore interpreted as executive-heavy rather than purely central executive.

The exploratory hypothesis was also supported in a general way. Children with comorbid ADHD-RD often showed difficulties across more than one working memory area, and the pattern frequently resembled the combination of the two single-disorder profiles. However, the comorbid group was not always the weakest group on every task, and some studies found shared deficits across all diagnostic groups. Overall, the comorbid group tended to show a broader and mainly additive pattern.

Quality check summary

The JBI-guided quality check did not show one single problem across all studies. For this thesis, 10 reports were given a low-concern summary label, 20 were given some concerns and eight were given higher concerns. Larger studies with clearly described groups and several working memory measures generally carried more weight in the synthesis. Examples include Willcutt et al. (2005), Kofler et al. (2020), Poon et al. (2021), Hulsbosch et al. (2025) and Vance et al. (2013). These labels are used only to guide interpretation and should not be read as formal JBI scores.

The most common concerns were small samples, uneven group sizes, mixed diagnostic categories, medication or comorbidity effects, and cross-sectional designs. Some ADHD experiments were useful for understanding mechanisms but had very small samples. Studies that combined RD with language impairment were kept with a clear caveat. Chen et al. (2025) was used only as supporting evidence because its main focus was neuroimaging. No report was excluded only because of the quality label used in this thesis.

Discussion

The research question asked how working memory profiles differ between children with ADHD, dyslexia and comorbid ADHD-dyslexia when the evidence is organised with Baddeley and Hitch's multicomponent

model. The studies show a difference in emphasis, but not a strict separation. Dyslexia/RD is most consistently linked with phonological or verbal short-term memory. ADHD is more consistently linked with executive working memory demands, while visuospatial storage is also affected in a meaningful subgroup of studies. Comorbid ADHD-RD usually combines or overlaps these difficulties rather than forming a completely separate working memory profile.

The dyslexia result is the clearest part of the synthesis. Several independent studies found verbal short-term memory, nonword repetition or phonological storage weaknesses in RD (de Carvalho et al., 2014; Kibby, 2009; Kibby & Cohen, 2008). Direct comparison studies strengthen this conclusion because the phonological weakness was often stronger in RD than in ADHD-only groups (Kibby et al., 2021; Willcutt et al., 2005). This supports Hypothesis A. At the same time, Cowan et al. (2017), Gathercole et al. (2006) and Gray et al. (2019) show why the conclusion should remain specific: dyslexia can also involve serial-order, complex or visuospatial memory weaknesses, and not every child with dyslexia has the same profile.

The ADHD findings are less consistent than the dyslexia findings. Kofler et al. (2020) found a large central executive deficit, and several experimental studies linked higher executive working memory demand with inattention, hyperactivity or classroom behaviour (Kofler et al., 2010; Orban et al., 2018; Rapport et al., 2009). This supports Hypothesis B. Other studies, however, found important visuospatial working memory or storage weaknesses (de Jong et al., 2009; Marzocchi et al., 2008; Vance et al., 2013). Coclici et al. (2026) adds evidence that, in one ADHD sample, the visuospatial difficulty was more related to storage than to processing. The ADHD profile therefore has a stronger executive tendency, but it is not limited to the central executive.

One possible reason for the different ADHD findings is that working memory tasks are not pure measures. A single task can require attention, processing speed, inhibition, storage, updating and motivation at the same time. A low score does not automatically identify one isolated cognitive mechanism. Medication status and comorbidity also matter. For example, Kibby and Cohen (2008) found that the visuospatial short-term memory weakness in ADHD was especially noticeable when children were off stimulant medication. Martinussen and Tannock (2006) showed that language-learning difficulties could broaden the working memory profile. These factors make it reasonable that different studies emphasise different components.

The comorbidity findings fit an additive or multiple-deficit explanation better than a completely new cognitive subtype. Willcutt et al. (2005) found that the RD+ADHD group showed the combination of deficits in the two single-disorder groups. Kibby and Cohen (2008) found a similar combination across verbal and visuospatial short-term memory. Poon et al. (2021) described additive deficits across the working memory domains they measured, and Kibby et al. (2021) found more support for a multiple-deficit explanation than for a phenocopy or cognitive-subtype account. This does not mean that the comorbid group must always have the lowest score. Instead, it means that

difficulties can be distributed across more areas.

The final academic-outcome evidence includes reading, spelling and mathematics. Reading and reading comprehension have the clearest and most direct support. Kofler et al. (2019) found that increasing working memory demand reduced comprehension more strongly in children with ADHD, while Miller et al. (2013) linked working memory with the ability to keep central ideas from a passage available. In dyslexia, the link is more often between phonological memory and decoding or word-reading efficiency (de Carvalho et al., 2014; Kibby, 2009; Knoop-van Campen et al., 2018). These findings suggest that similar reading problems can be related to different memory demands.

Spelling and mathematics are supported by fewer studies, but they should no longer be described as almost absent. Hulsbosch et al. (2025) found working memory and processing-speed pathways related to reading, spelling and mathematics in a large ADHD sample. Gaye et al. (2024) found that all three working-memory/short-term-memory components were related to math skills. Sturm et al. (2018) linked auditory-verbal working memory with math computation, and Gathercole et al. (2006) linked complex memory and phonological short-term memory with mathematics in children with RD. The limitation is that these studies do not specifically answer every part of Objective 3. In particular, evidence for orthography as a separate outcome and mathematical word problems remains limited.

Baddeley and Hitch's model was useful because it separated verbal storage, visuospatial storage and executive control instead of treating working memory as one ability. It also made the direct ADHD-RD comparisons easier to organise. However, some tasks use several processes at the same time, and behavioural rating scales do not measure exactly the same thing as laboratory central executive tasks. The model is therefore used as a simple organising framework, not as a claim that each diagnosis fits into one separate memory component.

The findings may be useful for thinking about learning demands, but this thesis does not make clinical or treatment recommendations.

One educational implication of these findings is that difficulty with a classroom task should not automatically be interpreted as lack of interest or effort. It may also be useful to consider what the task is asking the child to keep in mind or manage at the same time.

For example, some tasks place strong demands on retaining verbal information, while others require several pieces of information to be coordinated at once. Teachers could use this as a simple way of thinking about learning demands and consider whether instructions, information or tasks can be presented in another way when a child repeatedly struggles. This is not intended as a diagnostic framework or as a specific teaching intervention, but as a way of recognising that similar classroom difficulties may have different underlying learning demands.

At group level, children with dyslexia may have more difficulty when unfamiliar verbal

information has to be kept in mind during reading, while children with ADHD may have more difficulty when several pieces of information have to be managed at the same time. Children with both conditions may face both kinds of demand. These are general patterns from the literature, not recommendations for an individual child. Working memory findings should therefore be considered together with reading, language, attention and other learning information (Gray et al., 2019).

This review has several strengths. The revised search did not require ADHD and dyslexia to appear in the same article, so single-disorder studies could be included together with comorbid comparisons. PubMed and ERIC gave complementary health, neuropsychology and educational coverage. The selection process was documented from 4,039 exports to 38 included reports, and access problems were kept separate from scientific eligibility. The final synthesis also includes a structured quality check rather than treating all studies as equally strong.

There are also important limitations. Only PubMed and ERIC were searched, so relevant studies indexed only in PsycINFO, Scopus or Web of Science may have been missed. Forty-three potentially relevant reports could not be retrieved legally and were not included in the synthesis. This is a substantial limitation and means the final evidence set may not represent every eligible study. The review is therefore best understood as a structured literature review with a systematic search and selection process, not as a formally registered systematic review.

A second limitation is heterogeneity. The studies used different definitions of dyslexia, reading disability and language-learning disorder. ADHD samples differed in subtype, medication status, age and comorbid conditions. Working memory tasks also varied widely. Some studies used direct span measures, some used complex memory tasks, some used behavioural ratings, and others used experimental load manipulations. These differences are the main reason a narrative synthesis was used rather than a meta-analysis.

A third limitation concerns the balance of the evidence. The literature is richer for reading than for spelling, orthography and mathematical word problems. Some of the strongest ADHD mechanism studies also used small samples, often with more boys than girls. Several dyslexia studies included language impairment or used diagnostic definitions that are not identical. Future studies would be stronger if they used the same working memory battery across ADHD-only, dyslexia-only, comorbid and typically developing groups and then followed the children across several academic outcomes.

The conclusions were based on patterns across several studies, not simply on counting significant results. Dyslexia was not described as mainly phonological because of one nonword-repetition result, and ADHD was not described as mainly executive because of one updating result. The wording was kept only when similar patterns appeared in different samples and task types. Conflicting results were used to make the conclusions more cautious. This is why terms such as more consistently,

tendency and mainly additive are used instead of absolute statements.

Overall, the findings are better described as different but overlapping tendencies than as one working memory test for each diagnosis. Dyslexia/RD shows a stronger phonological-verbal tendency. ADHD shows a stronger executive tendency, with visuospatial difficulty in several studies. Comorbidity is usually broader and mainly additive. Individual children can still differ considerably from the average pattern of their group.

Conclusion

This review compared working memory in children with ADHD, dyslexia/RD and comorbid ADHD-RD using the phonological loop, visuospatial sketchpad and central executive. Thirty-eight reports were included in the final narrative synthesis. The clearest dyslexia/RD finding was weaker phonological or verbal short-term memory. ADHD was more consistently associated with central executive demand, although visuospatial storage difficulties were also found in several studies. The comorbid group generally showed a broader combination of weaknesses rather than a completely separate profile.

Hypothesis A was supported overall. Hypothesis B was also broadly supported, but the ADHD profile was less component-specific than expected. The exploratory hypothesis was supported as a general additive or multiple-deficit pattern, although comorbid children were not always the weakest group on every task.

Reading and reading comprehension provided the strongest academic evidence. Spelling and mathematics were represented by fewer studies, but both showed links with working memory. Evidence specifically focused on orthography and mathematical word problems remained limited. Overall, ADHD, dyslexia/RD and comorbidity show different but overlapping working memory tendencies. Baddeley and Hitch's model is useful for organising these differences, but the evidence does not support using one working memory component as a simple diagnostic marker.

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APPENDIX

Appendix A. Included study overview

Table 1 summarises the 38 reports included in the final narrative synthesis. The table is an overview; the Results and Discussion sections provide the interpretation used to answer the research question.

Abbreviations used in Appendices A and B: ADHD = attention-deficit/hyperactivity disorder; ADHD-I = predominantly inattentive ADHD; RD = reading disability; TD = typically developing; WM = working memory; STM = short-term memory; EF = executive function; DLD = developmental language disorder; LI = language impairment; DCD = developmental coordination disorder; BRIEF = Behavior Rating Inventory of Executive Function; JBI = Joanna Briggs Institute.

Table 1.

Studies included in the final synthesis

Study	Sample and working memory focus	Main contribution to the synthesis
Poon et al. (2021)	ADHD-I n=29, RD n=78, ADHD-I+RD n=31, TD n=64 (N=202) WM: Verbal, visuospatial and behavioural working memory	RD was associated with verbal and visuospatial weaknesses; ADHD-I with behavioural working-memory weakness; the comorbid group showed an additive/broader pattern. Outcome: Reading difficulties and group profile
Kibby et al. (2021)	RD, ADHD, RD+ADHD and TD; ages 8–12 (N=263) WM: Phonological loop, cognitive EF/working memory and BRIEF ratings	Phonological-loop problems were more related to RD, behavioural regulation more related to ADHD, and the comorbid group was not consistently worse than both single-disorder groups. Outcome: Basic reading, inattention and executive functioning
Kofler et al. (2019)	ADHD vs non-ADHD; ages 8–13 (N=78) WM: Concurrent working-memory load during reading	Increasing working-memory demand caused a larger reading-comprehension decline in ADHD, even after basic reading skills and comorbid RD were considered. Outcome: Reading comprehension and reading speed
Gray et al. (2019)	TD, dyslexia, DLD and dyslexia+DLD; second graders (N=302) WM: Thirteen-task battery covering central executive, phonological and visuospatial processes	Children with dyslexia did not form one single working-memory profile; the study supports heterogeneity within reading disorders. Outcome: Reading and oral language

Study	Sample and working memory focus	Main contribution to the synthesis
Miller et al. (2013)	ADHD n=27 vs reading-matched controls n=27 (N=54) WM: Working memory among cognitive predictors of passage recall	Working memory explained the largest unique part of the ADHD centrality deficit in reading comprehension. Outcome: Reading comprehension
Kibby & Cohen (2008)	RD n=23, ADHD n=30, RD+ADHD n=30, controls n=30 (N=113) WM: Verbal STM, visuospatial STM and central-executive measures	RD showed clearer verbal STM weakness, ADHD clearer visuospatial STM weakness, and the comorbid group showed both tendencies. Outcome: Reading disability and memory profile
Tiffin-Richards et al. (2008)	ADHD n=20, dyslexia n=20, comorbid n=20, controls n=19; ages 10–14 (N=79) WM: Phonological STM, manipulation and switching	Dyslexia was linked more strongly with phonological/language weakness, ADHD with switching, while an executive manipulation task was affected by both. Outcome: Reading/spelling-related language processing
Martinussen & Tannock (2006)	ADHD n=62, ADHD+RD/LI n=32, RD/LI n=15, controls n=34 (N=143) WM: Verbal and visuospatial storage plus central-executive tasks	ADHD was associated with visuospatial storage and verbal/visuospatial executive weaknesses; the RD/LI groups showed broader storage and executive problems. Outcome: Learning-disorder profile
Willcutt et al. (2005)	ADHD n=113, RD n=109, RD+ADHD n=64, neither n=151 (N=437) WM: Verbal working memory and broader neuropsychological functions	RD groups showed stronger verbal working-memory weakness; ADHD showed inhibition/processing-speed weaknesses and some verbal-WM difficulty; comorbidity was mainly a combination of deficits. Outcome: Comorbidity and reading disability
Wei et al. (2025)	ADHD-only n=80 and ADHD+RD n=80 (N=160) WM: Verbal and visuospatial working memory plus inhibition	The ADHD+RD group performed more poorly than the ADHD-only group on verbal and visuospatial working memory and response inhibition. Lower executive-function performance was related to greater Chinese reading difficulty. Outcome: Chinese reading and ADHD-RD comorbidity
Kofler et al. (2020)	Clinically evaluated children ages 8–13 (N=172) WM: Central executive, phonological STM and visuospatial STM in a bifactor model	ADHD showed a large central-executive deficit and a smaller visuospatial-storage weakness, with little evidence for a phonological-storage deficit. Outcome: ADHD working-memory profile
de Carvalho et al. (2014)	Children with dyslexia and controls; grades 3–8 (N=115) WM: Pseudoword repetition and digit-span measures	Dyslexia was associated with poorer decoding and phonological STM; broader digit-span associations were less consistent. Outcome: Reading/decoding
Van De Voorde et al. (2010)	ADHD n=19, RD n=17, ADHD+RD n=21, controls n=19 (N=76) WM: Working memory, response	Working-memory problems were clearer in RD/comorbid groups than in ADHD alone, showing that an isolated executive-ADHD

Study	Sample and working memory focus	Main contribution to the synthesis
	inhibition and within-subject variability	pattern is not universal. Outcome: Direct disorder comparison
de Jong et al. (2009)	ADHD n=24, ADHD+RD n=29, RD n=41, controls n=26 (N=120) WM: Visuospatial working memory, inhibition and lexical measures	Visuospatial working-memory weakness was more specific to ADHD than to RD in this comparison. Outcome: ADHD versus RD differentiation
Marzocchi et al. (2008)	ADHD n=35, RD n=22, TD n=30 (N=87) WM: Visual working memory and executive-function tasks	ADHD showed broader executive/visual-working-memory weaknesses, whereas RD showed a more limited profile on these executive measures. Outcome: ADHD versus reading disability
Mettler et al. (2024)	Typical language n=165, dyslexia n=81, dyslexia+DLD n=43; ages 7–9 (N=289) WM: Phonological working memory	Dyslexia groups differed from typical-language children in phonological working memory, while sentence-production outcomes did not map simply onto diagnosis. Outcome: Sentence production/language
Kofler et al. (2011)	Boys with ADHD and typically developing boys (N=39) WM: Central executive and storage subsystems	Central-executive weakness was linked indirectly with social problems in ADHD. Outcome: Social functioning; supporting ADHD mechanism
Rapport et al. (2009)	Boys with ADHD n=12 and TD n=11 (N=23) WM: Central-executive and subsystem load manipulations	Hyperactivity increased particularly when central-executive demands were high, supporting an executive-load interpretation of ADHD behaviour. Outcome: ADHD behaviour under cognitive load
Norrelgen et al. (1999)	ADHD n=9, ADHD+DCD n=13, controls n=19 (N=41) WM: Phonological working-memory load during speech discrimination	The ADHD+DCD group was particularly sensitive to phonological-memory load. Outcome: Speech/language processing
Hulsbosch et al. (2025)	Children with ADHD; ages 6–12 (N=504) WM: Working memory and processing speed	Working memory and processing speed were related to academic achievement; processing speed had especially clear links with mathematics/spelling pathways. Outcome: Academic achievement, mathematics and spelling
Gaye et al. (2024)	Clinically evaluated children; ages 8–13 (N=186) WM: All three working-memory components	All three components were related to mathematics and together explained a substantial part of math-skill variance. Outcome: Mathematics
van Rijthoven et al. (2022)	Dyslexia n=54 and controls n=36 (N=90) WM: Verbal working memory with learning/consolidation measures	Verbal learning/consolidation differed in dyslexia; learning measures were associated more clearly with spelling than with reading. Outcome: Spelling and reading
Sturm et al. (2018)	Children with ADHD; ages 8–15 (N=281) WM: Auditory-verbal WM,	Auditory-verbal working memory was a significant predictor of math computation in

Study	Sample and working memory focus	Main contribution to the synthesis
	visuospatial WM and processing speed	pediatric ADHD. Outcome: Mathematics computation
Jacobson et al. (2011)	ADHD n=41 and controls n=21; ages 9–14 (N=62) WM: Working memory/verbal span and processing speed	Working memory and processing speed contributed to reading-fluency performance in ADHD. Outcome: Reading fluency
Coclici et al. (2026)	ADHD n=65 and controls n=74; approximately ages 9–17 (N=139) WM: Spatial working-memory storage versus processing	ADHD was characterised more by poor spatial storage than by a general spatial-processing deficit. Outcome: ADHD visuospatial profile
Chen et al. (2025)	Boys with ADHD n=23 and controls n=23 (N=46) WM: Spatial working memory / n-back with neuroimaging morphology	The study included a spatial n-back working-memory task, but its main focus was brain morphology. It is therefore used only as supporting evidence for the ADHD spatial-working-memory discussion. Outcome: ADHD spatial working memory; supporting evidence only
Chung et al. (2018)	Chinese adolescents with dyslexia subgroups n=50 and controls n=25 (N=75) WM: Verbal working memory and cognitive-linguistic measures	Both dyslexia groups performed below controls on most cognitive-linguistic measures, including a verbal working-memory measure. The typical-functioning dyslexia group showed broader deficits than the high-functioning group. Outcome: Reading, spelling and cognitive-linguistic profile
Knoop-van Campen et al. (2018)	Dyslexia n=50 plus a large typically developing comparison sample (N=663 total) WM: Working memory and phonological awareness	Working memory was related to word reading largely through phonological awareness, supporting an indirect phonological pathway. Outcome: Word reading
Orban et al. (2018)	Boys with ADHD n=32 and TD n=30 (N=62) WM: Central executive and phonological STM during classroom instruction	Central-executive processes explained a substantial part of observed inattentive behaviour during instruction. Outcome: Classroom inattention
Cowan et al. (2017)	Second-grade children with dyslexia, dyslexia+language impairment and TD WM: Verbal/spatial serial-order short-term memory	Some phonological-memory differences depended on matching, but serial-order weaknesses remained, showing that dyslexia memory difficulty is not reducible to one simple storage measure. Outcome: Dyslexia memory mechanism
Holmes et al. (2014)	ADHD n=83, low-WM n=50, TD n=50 (N=183) WM: Working memory and executive functions	Children with ADHD and children selected for low working memory showed partly similar cognitive profiles, while ADHD showed more behavioural impulsivity. Outcome: ADHD/low-WM comparison
Berninger & Abbott (2013)	Dyslexia with superior verbal reasoning n=33 versus dyslexia with	Working-memory/phonological markers of dyslexia remained even in children with high

Study	Sample and working memory focus	Main contribution to the synthesis
	average verbal reasoning n=31 (N=64) WM: Verbal working-memory markers	verbal reasoning. Outcome: Reading/spelling and giftedness
Vance et al. (2013)	ADHD n=163, ADHD+anxiety n=243, anxiety n=69, controls n=116 (N=591) WM: Spatial working memory	ADHD was associated with spatial-working-memory impairment; anxiety did not produce a simple additive worsening. Outcome: ADHD spatial working memory
Kofler et al. (2010)	ADHD n=15 and TD n=14 (N=29) WM: Central executive plus storage/rehearsal capacity under load	Inattentive behaviour increased with central-executive demand, supporting an executive mechanism beyond simple storage limits. Outcome: ADHD inattention
Alderson et al. (2010)	ADHD n=14 and TD n=13 (N=27) WM: Central executive, phonological, visuospatial WM and inhibition	Central-executive/visuospatial working-memory weaknesses helped explain the relationship between ADHD and inhibition performance. Outcome: ADHD executive control
Kibby (2009)	RD n=18 and controls n=18 (N=36) WM: Verbal STM/phonological loop	Children with RD were especially weak for less-frequent/nonwords, and verbal STM was related to decoding. Outcome: Reading/decoding
Gathercole et al. (2006)	Children with reading disabilities; ages 6–11 (N=46) WM: Complex working memory and visuospatial/phonological STM	Reading severity was related to complex working memory, while mathematics was related to complex WM and phonological STM. Outcome: Reading and mathematics
Poon et al. (2024)	ADHD n=26, RD n=38, ADHD+RD n=24, TD n=32 (N=120) WM: Baseline central executive, verbal and visuospatial working memory only	Only the pre-training comparison is used. ADHD and RD were related to central executive difficulty, and RD was also linked with poorer verbal working memory; the baseline visuospatial result was less clear. Training effects are not used in the natural-profile synthesis. Outcome: Chinese word reading and baseline group profile

Appendix B. Quality considerations guided by JBI

The revised JBI tools were used as a guide for considering study design and possible sources of bias. The labels low concerns, some concerns and higher concerns are simple summary labels created for this thesis; they are not official JBI scores. They were used to make the narrative synthesis more cautious, not as a numerical exclusion rule.

Table 2.

Quality considerations for included reports

Study	JBI guide used and thesis-level summary label	Main quality consideration
Poon et al. (2021)	analytical cross-sectional Overall: Low concerns	Direct four-group comparison with a relatively large sample; ADHD group was inattentive subtype and the sample was Chinese/Hong Kong.
Kibby et al. (2021)	analytical cross-sectional Overall: Low concerns	Large direct comparison; behavioural ratings and laboratory measures do not measure exactly the same construct.
Kofler et al. (2019)	quasi-experimental Overall: Some concerns	Moderate sample and strong experimental manipulation, but it is not a direct dyslexia-only comparison.
Gray et al. (2019)	analytical cross-sectional Overall: Some concerns	Large multicomponent study, but ADHD was excluded and DLD was an important comparison group.
Miller et al. (2013)	analytical cross-sectional Overall: Some concerns	Small ADHD-control study and no direct RD group, but useful for the academic-outcome question.
Kibby & Cohen (2008)	analytical cross-sectional Overall: Some concerns	Strong direct four-group design; clinical sampling and medication status affect interpretation of the ADHD findings.
Tiffin-Richards et al. (2008)	analytical cross-sectional Overall: Some concerns	Direct four-group comparison, but groups were small, mostly boys, German-speaking, and dyslexia classification was strongly spelling-based.
Martinussen & Tannock (2006)	analytical cross-sectional Overall: Some concerns	Useful component-level comparison, but reading disability was combined with language impairment in some groups.
Willcutt et al. (2005)	analytical cross-sectional Overall: Low concerns	Large direct four-group study with clear relevance to the additive-comorbidity question.
Wei et al. (2025)	analytical cross-sectional Overall: Some concerns	Useful recent comorbidity comparison, but there was no RD-only or typically developing group.
Kofler et al. (2020)	analytical cross-sectional Overall: Low concerns	Large clinically characterised sample and component modelling; useful for separating executive from storage processes.
de Carvalho et al. (2014)	analytical cross-sectional Overall: Some concerns	Direct dyslexia comparison with phonological measures; mainly supports the dyslexia side of the review.

Study	JBI guide used and thesis-level summary label	Main quality consideration
Van De Voorde et al. (2010)	analytical cross-sectional Overall: Higher concerns	Direct four-group design but small diagnostic groups, so it is used mainly as a counterweight to overly simple conclusions.
de Jong et al. (2009)	analytical cross-sectional Overall: Some concerns	Direct group comparison with useful dissociation, although several cognitive domains were tested.
Marzocchi et al. (2008)	analytical cross-sectional Overall: Some concerns	Useful direct comparison, but sample sizes were moderate and tasks span broader executive function.
Mettler et al. (2024)	analytical cross-sectional Overall: Some concerns	Large sample, but no ADHD group and DLD is a relevant comorbidity.
Kofler et al. (2011)	analytical cross-sectional Overall: Higher concerns	Mechanistically useful but small, male-only sample and not focused on academic outcomes.
Rapport et al. (2009)	quasi-experimental Overall: Higher concerns	Very small, male-only experimental sample; useful for mechanism rather than prevalence of a profile.
Norrelgen et al. (1999)	analytical cross-sectional Overall: Higher concerns	Small older study with DCD comorbidity, so it is supporting rather than decisive evidence.
Hulsbosch et al. (2025)	analytical cross-sectional Overall: Low concerns	Large recent ADHD sample; useful for academic links but not a direct dyslexia/comorbidity comparison.
Gaye et al. (2024)	analytical cross-sectional Overall: Low concerns	Good multicomponent academic-outcome study, although it is not a clean three-diagnosis comparison.
van Rijthoven et al. (2022)	analytical cross-sectional Overall: Some concerns	Useful for spelling and verbal-memory processes; does not include ADHD.
Sturm et al. (2018)	analytical cross-sectional Overall: Low concerns	Large ADHD sample with relevant academic outcome, but mathematics is computation rather than specifically word problems.
Jacobson et al. (2011)	analytical cross-sectional Overall: Some concerns	Useful academic link but moderate sample and no dyslexia-only group.
Coclici et al. (2026)	analytical cross-sectional Overall: Low concerns	Relatively large direct comparison that helps refine visuospatial findings in ADHD.
Chen et al. (2025)	analytical cross-sectional Overall: Higher concerns	Small male-only sample and primary neuroimaging focus; only the relevant behavioural result is used.
Chung et al. (2018)	cohort Overall: Some concerns	Longitudinal value and relevant dyslexia groups, but modest sample and Chinese-language context.
Knoop-van Campen et al. (2018)	analytical cross-sectional Overall: Some concerns	Large comparison base; mediation is cross-sectional and should not be read as proof of causation.
Orban et al. (2018)	quasi-experimental Overall: Some concerns	Useful ecologically oriented mechanism study, but male-only and not a direct RD comparison.
Cowan et al. (2017)	analytical cross-sectional Overall: Some concerns	Detailed mechanism study with language-impairment subgroup; interpretation requires care because matching changes some effects.
Holmes et al. (2014)	analytical cross-sectional Overall: Low concerns	Useful large comparison showing overlap between low WM and ADHD without treating WM as diagnostic.

Study	JBI guide used and thesis-level summary label	Main quality consideration
Berninger & Abbott (2013)	analytical cross-sectional Overall: Some concerns	Useful dyslexia subgroup evidence, but no typically developing or ADHD comparison group.
Vance et al. (2013)	analytical cross-sectional Overall: Low concerns	Very large sample with clear ADHD comparison; anxiety comorbidity is outside the main thesis question but helps test specificity.
Kofler et al. (2010)	quasi-experimental Overall: Higher concerns	Very small experimental sample; strong mechanism but limited generalisability.
Alderson et al. (2010)	analytical cross-sectional Overall: Higher concerns	Very small sample; useful mechanism evidence but not strong enough to define the whole ADHD profile.
Kibby (2009)	analytical cross-sectional Overall: Higher concerns	Small sample but direct RD-control evidence with a clear verbal-memory focus.
Gathercole et al. (2006)	analytical cross-sectional Overall: Some concerns	Small-to-moderate RD sample but useful because it links multiple WM measures with both reading and mathematics.
Poon et al. (2024)	quasi-experimental Overall: Some concerns	Intervention study included only for separable pre-training data; training effects are excluded from the natural-profile synthesis.

Appendix C. PRISMA-style study-selection flow

This flow is used as a reporting aid for the structured literature review. It is not presented as evidence that the thesis is a formally registered systematic review.

Figure 2.

Final study-selection flow for the revised PubMed and ERIC searches.

