The behavioural and emotional profile of children with comprehension weaknesses

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Abstract

Purpose: Children with reading difficulties are at heightened risk of behavioural and emotional problems. However, these associations have predominantly been examined for children who struggle with decoding aspects of reading. This study asked whether children with reading comprehension weaknesses relative to their decoding skills also show higher prevalence of behavioural and emotional problems.

Method: Preregistered analyses compared the externalising and internalising scores of 931 children with comprehension weaknesses and 4422 typical readers previously identified from Avon Longitudinal Study of Parents and Children (James et al., 2023), with additional exploratory analyses to further compare to 1353 children with decoding weaknesses. Multilevel growth models were used to compare parent-report scores at ages 9, 11, and 13, alongside self-reported internalising scores at ages 10, 12 and 13.

Results: Children with comprehension weaknesses showed no differences in the prevalence or trajectory of internalising and externalising symptoms to their peers without reading difficulties. Exploratory analyses confirmed that children with comprehension weaknesses had fewer externalising problems than those with decoding weaknesses, and that females in this group had fewer self-reported depressive symptoms at the first test point.

Conclusion: Associations between reading difficulties and behavioural or emotional problems are largely constrained to decoding weaknesses. Children with relative reading comprehension weaknesses do not appear to share this broader risk profile.

Children with reading difficulties are at elevated risk for behavioural problems, such as those linked to inattention and conduct-related difficulties (Donolato et al., 2022), as well as emotional problems linked to anxiety and mood disorders (Francis et al., 2019). However, reading difficulties are typically defined by measures of decoding and word reading, meaning we know little about the psychosocial profiles of children who struggle with reading comprehension. We aimed to fill this knowledge gap.

The Simple View of Reading reminds us that both decoding and language comprehension skills are necessary for reading success (Hoover & Gough, 1990). Difficulties with reading comprehension might stem from primary problems in decoding, in language comprehension, or both. While the behavioural and emotional profile of 'poor comprehenders' has not been considered, it has been examined in children with developmental language disorders. We begin by summarising this evidence alongside findings from children with poor decoding. Together, these literatures allow us to situate the profile of children with reading comprehension difficulties in the context of these respective groups.

Behavioural problems can be captured by measures of *externalising* symptoms: outward-facing psychological issues that are behaviourally disruptive. The term broadly captures traits associated with ADHD, conduct disorder, and oppositional defiant disorder, alongside addiction and substance-related disorders later in development. Both children with language difficulties (Curtis et al., 2018) and those classified as poor readers (Carroll et al., 2005) show elevated levels of externalising symptoms, as supported by a recent meta-analysis of children with language and learning disorders (Donolato et al., 2022). Similar associations are observed with continuous measures of language (Chow et al., 2018; Hentges et al., 2021) and reading abilities (Pickren et al., 2024), indicating that they are not necessarily restricted to the most severe cases.

Internalising problems describe inward-facing psychological issues related to the self, broadly capturing negative emotional traits that characterise anxiety and depressive disorders. Children with language disorders appear at greater risk for internalising problems than those with reading difficulty (Donolato et al., 2022), but increased levels have been robustly demonstrated in both disorders relative to children without reading/language difficulties (Francis et al., 2019; Hentges et al., 2021; Yew & O'Kearney, 2013). These associations are also reflected in the wider population, with individual studies supporting a negative association between reading/language ability and internalising symptoms (e.g., Boyes et al., 2018;

McArthur et al., 2022; Tamayo et al., 2024). Indeed, children identified for having behavioural and emotional difficulties frequently have mild language impairments (Hollo et al., 2014).

The present study

Children with reading comprehension weaknesses typically have low oral language and poor literacy outcomes, characteristics shared with both reading and language disorders (Bishop et al., 2009; Snowling & Hulme, 2021). Considering that children with reading and language disorders are both at elevated risk for internalising and externalising problems, we thought it a likely hypothesis that children with comprehension weaknesses would be similarly at risk for adverse outcomes.

However, there were also reasons to consider that children with comprehension weaknesses might be spared from these outcomes. One possibility might relate to the severity of relevant impairments. For example, if language is a major contributor, children with poor reading comprehension often have milder language impairments that would not meet diagnostic criteria for Developmental Language Disorder (James et al., 2023, 2025; Nation et al., 2004). While associations exist across the spectrum of reading and language abilities, associations tend to be stronger in clinically diagnosed populations (Donolato et al., 2022). Relatedly, difficulties with reading comprehension are often described as more hidden than difficulties with decoding or severe language impairment (Nation et al., 2004). This hidden profile could plausibly protect children with comprehension problems from the social and peer problems identified as mediating factors for children with poor language or decoding (Menting et al., 2011; Petersen & LeBeau, 2021; Toseeb et al., 2020; Yew & O'Kearney, 2015).

To our knowledge, the behavioural and emotional profile of children identified based on reading comprehension difficulty has not been investigated. Understanding the breadth of their difficulties is critical for improving the identification of comprehension problems, and for developing effective and well-rounded support. We addressed this gap by asking whether children with comprehension weaknesses identified at age 9 have a higher prevalence of externalising and internalising behaviours from ages 9-13 years, compared to peers without reading difficulties. Reader groups were identified from a large longitudinal cohort in earlier work using a data-driven approach (James et al., 2023). In brief, we found no support for profiles of isolated decoding and comprehension impairments (see also Psyridou et al., 2021). Instead, the best fitting model—and the one used here—captured *relative* comprehension weaknesses across the spectrum of decoding ability.

Method

Analysis plans and prior experience with the dataset were documented in a preregistration (https://osf.io/ztr97), before preprocessing and analysing any of the outcome variables.

Sample

The Avon Longitudinal Study of Parents and Children (ALSPAC) recruited 14,541 pregnancies in the former Avon area (UK) between April 1991 and December 1992, from whom 13,988 offspring were alive at one year. Later recruitment of eligible children at age 7 increased this total sample size to 14,901. The offspring have been studied ever since via a wide range of questionnaires and clinic assessments (Boyd et al., 2013; Fraser et al., 2013). The study website contains details of all the data that is available through a fully searchable data dictionary and variable search tool (http://www.bristol.ac.uk/alspac/researchers/our-data/). Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC Ethical and Law Committee at the time. Participants can contact the study team at any time to retrospectively withdraw consent for their data to be used. Study participation is voluntary and during all data collection sweeps, information was provided on the intended use of data.

We previously analysed data from 6,846 participants who completed the Neale Analysis of Reading Ability at age 9. Using latent profile analysis, we identified a group of children who had relatively poor comprehension compared to their reading accuracy skills (n = 947; James et al., 2023). We compared this group to children who were not identified as having a reading difficulty (n = 4,516). We excluded participants with missing data across all outcome measures, leaving 931 children with comprehension weaknesses (420 male) and 4422 typical readers (2133 male) for analysis. Reading and language profiles are summarised in Table 1.

Measures

Externalising

Externalising behaviours were measured via parental questionnaire at age 9, 11, and 13 years using the Conduct Problems and Hyperactivity/Inattention subscales of the Strengths and Difficulties Questionnaire (R. Goodman, 1997). Each subscale comprises five behavioural attributes rated as not (0), somewhat (1), or certainly true (2), and summed to a maximum of

10. Omega values calculated in the ALSPAC sample show good internal consistency (>.8; Speyer et al., 2023). The two subscales are summed at each time-point to form an externalising score, as validated for use in the general population (A. Goodman et al., 2010).

Internalising

Parent-report. Internalising behaviours were measured by the Emotional Symptoms and Peer Relationship Problems subscales of the SDQ, at 9, 11, and 13 years, which were scored and summed as above (A. Goodman et al., 2010). Omega values are calculated elsewhere as >.79 (Speyer et al., 2023).

Self-report. Because parent-reported internalising measures can be less valid in adolescence (Moretti et al., 1985), we also analysed self-reported depressive symptoms using the Short Moods and Feelings Questionnaire (SMFQ; Angold et al., 1995), administered at ages 10, 12, and 13 years. This questionnaire includes 13 items regarding feelings and actions over the past 2 weeks, rated as true (2), sometimes true (1), or not true at all (0), summed to a maximum score of 26. Cronbach's alpha shows good internal consistency for these scales in ALSPAC (>.79; Kwong, 2019).

Covariates

As well as testing whether group differences changed across the three test points, we asked whether associations held once sex, socioeconomic status (maternal education, parental occupation) and maternal depression were controlled for.

Maternal education. Mothers were asked during pregnancy about their highest qualifications. Two contrasts compared baseline (no qualifications/CSE only) to (1) O-level and vocational qualifications; and (2) A-level and degree qualifications[1].

Parental occupation. Mothers' and their partners' occupations were recorded and coded into social class categories according to OPCS job codes. We selected the higher-class category of the mother/partner as an index of socioeconomic status, which was contrast-coded to compare manual (III-M Skilled manual; IV Partly-skilled; V Unskilled) to non-manual (I Professional; II Managerial and Technical; III-N Skilled non-manual) occupations.

Maternal depression. Maternal depression was measured when the child was 8 months, using the Edinburgh Postnatal Depression Scale (Cox et al., 1987). The questionnaire

[1] Note that CSE and O-level are national qualifications that are no longer awarded, having been phased out in the late 1980s. CSE captured lower levels of educational attainment than O-level at 16 years. A-level qualifications are typically taken at 18 years and are the gateway to further and higher education.

comprised 10 items rating frequency over the past 7 days, each scored 0-3 and summed to a final score (maximum 30).

Missingness

The proportion of missing data for any given variable ranged from 0.09-26.66% (Table S1). We inspected the structure of missingness alongside multiple auxiliary variables: ethnicity, reading scores, teacher-rated SDQ subscales, and several maternal-reported factors (depression during pregnancy, history of depression, home ownership, home crowding, marriage, age at birth, financial difficulties, smoking during pregnancy). Data met the assumption of missing at random, and we used multiple imputation to address missingness.

We used the *countimp* (Kleinke & Reinecke, 2013) and *mice* (Buuren & Groothuis-Oudshoorn, 2011) packages in R to generate imputed datasets. We started with m=27 imputations (reflecting the highest proportion of missingness in any given analytic variable), and then increased to m = 75 to ensure the loss of precision (Fraction of Missing Information / m) was <1% for all analyses (White et al., 2011; Woods et al., 2021). The preregistered imputation model (incorporating all auxiliary variables) suffered convergence issues. The final imputation model included all analytic variables and interactions, alongside selected auxiliary variables that emerged as frequent predictors of missingness and missing values (maternal age at birth, depression during pregnancy, financial difficulties, home crowding, ethnicity).

Analysis

Data were analysed in R using *lme4* (Bates et al., 2015) and *glmmTMB* (Brooks et al., 2017) packages. For each outcome variable, we used multilevel growth models to estimate the intercept and growth in behaviours for the two reader groups. Given significant skew in symptom counts (Table S1), we examined model fit across linear, Poisson, and negative binomial models. The Poisson regression model was the best fit to the data and was used for the multiple imputation model and main analyses. The negative binomial model was not a good fit; the linear model is presented in Table S2.

We followed a three-step analysis plan to analyse growth in each outcome variable: (1) Base model without covariates (group predictor alongside age); (2) Adjusted model with sex, maternal education, parental occupation, and maternal depression as covariates; (3) Second adjusted model to check whether sex moderates the effect of reader group, given some evidence of gender differences (e.g., Pickren et al., 2024). The reader group contrast was coded such that the intercept reflects the typical reader reference group (0), and children with comprehension

weaknesses coded as 1. The data collection wave was rescaled such that the intercept reflects symptom counts at the first test point (age 9 years for SDQ, 10 years for SMFQ). Maternal education and SES were sum-coded, and maternal depression median-centred for analysis (the centring of covariates was not specified in the preregistration due to an oversight).

Results

Full annotated output files are available at https://osf.io/2wn7k/. We report means and standard deviations in the text, with medians presented in Figure 1. Table 2 summarises model outputs.

Externalising problems

Parents reported a mean of 3.98 externalising problems (SD = 3.12) which remained largely stable over the three time points. There were no differences in reported externalising problems between reader groups overall or in their change over time, and no evidence for moderation by sex (ps >.36).

Internalising problems

Parent-report

Parents reported relatively fewer internalising problems (M = 2.53, SD = 2.69) than externalising, and again these remained relatively stable over time. There were no differences between groups, and no evidence of moderation by sex (ps >.14).

Self-report

Children reported an increasing number of depressive symptoms over time (β = 0.06, SE < 0.01, Z = 15.88, p < .001), rising from 3.93 at age 10 (SD = 3.45) and 12 years (SD = 3.79) to 4.94 (SD = 4.47) at age 13 years. Thus, each additional year is associated with a 6.3% increase in risk for depressive symptoms, 95% CI [5.5%, 7.1%], reduced to 4.2% [3.0%, 5.5%] once controlling for covariates. There was a tendency for children with comprehension weaknesses to report more symptoms (M = 4.39, SD = 4.05) than typically developing readers (M = 4.20, SD = 3.89), but this difference was not statistically significant (p = .056; adjusted p = .140 with socio-demographic factors controlled).

Exploratory analysis: Children with decoding weaknesses

The results provide no evidence that children with comprehension weaknesses have elevated levels of internalising and externalising problems over mid-childhood. As this

contrasts with the risk previously reported for children with poor word reading, we ran exploratory analyses to compare the children with comprehension weaknesses to those with decoding weaknesses (n = 1353; 726 male). This group was also identified in a data-driven way (James et al., 2023) and was excluded from our preregistered analyses. We added this group and repeated the analyses, reversing the group contrast such that children with comprehension weaknesses were the reference group. A second contrast then compared outcomes to those of children with decoding weaknesses.

Children with decoding weaknesses had significantly higher externalising symptoms than those with comprehension weaknesses (β = 0.09, SE = 0.04, Z = 2.58, p =.010), reflecting a 9.5% increase in risk for externalising symptoms, 95% CI [2.2%, 17.3%]. However, this difference did not withstand controlling for covariates (p =.172), with sex, maternal education, and maternal depression each capturing variance in outcomes.

There were no group differences in parent-reported internalising behaviours. Group differences in self-reported depressive symptoms were not statistically significant alone (p =.285), but were in relation to age (β = -0.04, SE = 0.01, Z = -4.01, p < .001). Age-related differences remained significant in the covariate-adjusted model (β = -0.04, SE = 0.01, Z = -3.33, p = .001), and were further moderated by sex (β = -0.04, SE = 0.02, Z = -2.09, p = .036).

When probing age trends further, boys showed stable or declining self-reported depressive symptoms which did not differ between any reader group. Girls in all reader groups showed an increase in depressive symptoms over time, but this increase was weaker in the group with decoding weaknesses versus both comprehension weaknesses and typical readers (Figure 2). Model-predicted outcomes at age 10 indicated that girls with decoding weaknesses reported higher symptoms than typical readers, and higher but not statistically different than those with comprehension weaknesses. At age 13, the confidence intervals of all three groups overlapped substantially (Figure S1).

General discussion

We asked whether children with comprehension weaknesses were at risk for behavioural and emotional problems, akin to those observed for children with reading impairments defined by decoding. We considered this a likely hypothesis, yet children with comprehension weaknesses appeared relatively spared of adverse behavioural and emotional outcomes. In contrast, exploratory analyses showed that children with decoding weaknesses

had higher levels of externalising problems, and of self-reported internalising symptoms for females only in mid-late childhood (but not early adolescence).

One reason for this null result concerns the way comprehension weaknesses were identified in this project. Our data-driven approach to identifying reading difficulties found no support for profiles of isolated decoding and comprehension impairments (James et al., 2023; see also Psyridou et al., 2021). Instead, the best fitting model—and the one used to identify groups here—captured *relative* comprehension weaknesses across the spectrum of overall reading ability. This conceptualisation has been supported by other studies (e.g., Wagner et al., 2021). Sample size is unlikely to be an issue, and a registered report with the same group of children found increased risk for poorer education and employment outcomes that was comparable to that of children with decoding weaknesses (James et al., 2024). Thus, it is not the case that the group classification is insensitive. Similarly, a different registered report found risk factors in language and other domains related to group membership (James et al., 2025). Nevertheless, our sample had milder weaknesses than much of the prior research on behavioural and emotional difficulties in reading and language disorders, meaning that perhaps their difficulties do not pose as great a risk for mental health outcomes.

While the characterisation of this group is a likely contributing factor, the increased risk observed for children with decoding weaknesses—who were identified using the same methodological approach—suggests it may not be the whole picture. Moreover, meta-analyses on reading and language disorders do not support the severity of disorder as a moderating factor for internalising and externalising outcomes (Donolato et al., 2022). An alternative account considers the relatively "hidden" nature of even categorically identified comprehension impairments (Nation et al., 2004), which could plausibly spare this group from the adverse social and peer experiences found to partially mediate mental health outcomes (Menting et al., 2011; Petersen & LeBeau, 2021; Toseeb et al., 2020; Yew & O'Kearney, 2015). The other side of this coin may be that the *absence* of emotional and behavioural symptoms contributes to the low rates of identifying comprehension difficulties in the classroom, providing fewer signals that a child is struggling in some capacity. These suggestions are wholly speculative, but understanding the different school experiences of children with decoding versus comprehension weaknesses may contribute to ongoing efforts to identify risk pathways in these respective groups. More generally, efforts to fully understand potential causal pathways that link language, literacy and psychosocial outcomes are much needed and welcomed (e.g., McArthur, 2022).

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Table 1

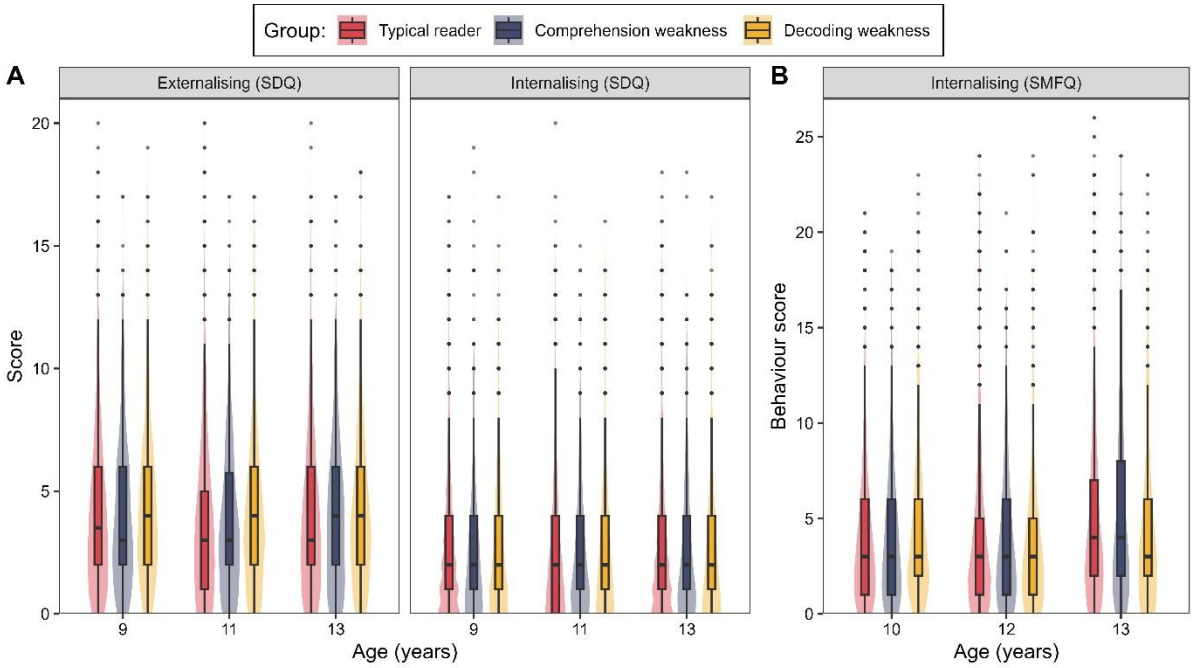
Sample-standardised descriptive statistics for the reading and language profiles of each group

	Comprehension weakness (*n* = 931)		Typical reader (*n* = 4422)		Decoding weakness[#] (*n* = 1353)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Item accuracy[a*]	99.90	15.46	103.92	12.38	87.87	15.33
NARA[b] Passage accuracy*	106.08	14.05	100.21	13.92	95.88	17.15
NARA[b] Passage comprehension*	92.67	12.34	102.64	14.39	97.18	16.06
WOLD[c] Listening comprehension*	95.02	14.09	100.56	15.08	101.93	14.61
WISC[d] Vocabulary	95.84	13.90	101.16	15.13	99.11	14.82

Note. Scores reflect performance age-standardised on the sample entered into the latent profile analysis (n = 6,846; James et al., 2023). (a) The item accuracy measure comprises real word and nonword reading scores (Nunes et al., 2003); (b) Neale Analysis for Reading Ability II (Neale, 1997) ; (c) Wechsler Objective Language Dimensions (Rust, 1996); (d) Weschler Intelligence Scale for Children III (Wechsler et al., 1992); * reflect measures used in group identification; # the decoding weakness group was not the focus of our initial investigation but was included in exploratory analyses.

Figure 1

Summary statistics for externalising and internalising problems as measured by (A) the SDQ, and (B) the SMFQ



Note. Boxplots depict medians and first and third quartiles, with whiskers extending up to 1.5* the interquartile range. Outliers beyond this range are plotted separately. Density plots depict the distribution of data points. Only typical readers and children with comprehension weaknesses were included in the main preregistered analysis.

Table 2

Poisson model outputs for the main analysis comparing children with comprehension weaknesses to typically developing readers

Outcome	Base model						Adjusted model					
Predictor	*β*	*SE*	*Z*	*p*	*RR [95% CI]*		*β*	*SE*	*Z*	*p*	*RR [95% CI]*	
Externalising (SDQ)												
(Intercept)	1.19	0.01	92.76	<.001	3.28	[3.20, 3.36]	1.23	0.03	47.59	<.001	3.43	[3.26, 3.61]
Age	-0.00	0.00	-0.29	.769	1.00	[0.99, 1.01]	0.00	0.00	-0.19	.848	1.00	[0.99, 1.01]
Group	0.01	0.03	0.47	.638	1.01	[0.96, 1.08]	-0.02	0.05	-0.49	.623	0.98	[0.89, 1.07]
Age*Group	0.00	0.01	0.08	.939	1.00	[0.99, 1.02]	0.00	0.01	0.12	.904	1.00	[0.99, 1.02]
Internalising (SDQ)												
(Intercept)	0.62	0.02	36.40	<.001	1.85	[1.79, 1.91]	0.64	0.04	17.55	<.001	1.89	[1.76, 2.03]
Age	-0.01	0.00	-1.64	.102	0.99	[0.99, 1.00]	-0.01	0.01	-1.15	.249	0.99	[0.98, 1.01]
Group	0.02	0.04	0.45	.650	1.02	[0.94, 1.10]	-0.07	0.07	-1.01	.313	0.94	[0.83, 1.06]
Age*Group	0.01	0.01	0.77	.439	1.01	[0.99, 1.02]	0.01	0.01	0.82	.415	1.01	[0.99, 1.03]
Internalising (SMFQ)												
(Intercept)	1.13	0.01	88.35	<.001	3.11	[3.03, 3.19]	1.15	0.02	58.00	<.001	3.17	[3.05, 3.30]
Age	0.06	0.00	15.89	<.001	1.06	[1.06, 1.07]	0.04	0.01	7.02	<.001	1.04	[1.03, 1.06]
Group	0.06	0.03	1.91	.056	1.06	[1.00, 1.13]	0.06	0.04	1.48	.140	1.06	[0.98, 1.15]
Age*Group	-0.01	0.01	-1.18	.239	0.99	[0.97, 1.01]	-0.01	0.01	-1.12	.261	0.99	[0.97, 1.01]

Note. Each dependent variable was analysed using a Poisson regression model. RR = Risk Ratio; SDQ = Strengths and Difficulties Questionnaire (Goodman, 1997); SMFQ = Short Moods and Feelings Questionnaire (Angold et al., 1995); Adjusted model includes sex, maternal education, parental social class, and maternal depression as covariates. Sex did not moderate any group effects.

Figure 2

Model-predicted associations between age, sex, and reader group in predicting self-reported internalising problems