Cognition, Behaviour, and Mental Health in Struggling Learners: A Spotlight on Girls

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Abstract

Objectives: Fewer girls than boys are identified as struggling at school. The objectives of this study were to: i) identify dimensions of cognition, behaviour and mental health in a unique transdiagnostic sample of struggling learners; ii) test whether these constructs were equivalent for boys and girls, and; iii) compare their performance across the dimensions.

Methods: 805 school-aged children, identified by practitioners as experiencing problems in cognition and learning, completed cognitive assessments, and parents/carers rated their behaviour and mental health problems.

Results: Three cognitive, three behavioural, and two mental health dimensions distinguished the sample. Dimensions were structurally comparable between boys and girls, but differences in severity were present: girls had greater cognitive impairments; boys had more severe externalising problems.

Conclusions: Gender biases to stereotypically male behaviours are prevalent among practitioners, even when the focus is on identifying cognitive and learning difficulties. This underscores the need to include cognitive and female-representative criteria in diagnostic systems to identify girls whose difficulties could go easily undetected.

Keywords: sex differences, learning difficulties, cognition, behaviour, mental health, transdiagnostic

Approximately 15% of children have special educational needs (SENs), and the majority of these are boys (Department of Education, 2020). Diagnoses of developmental disorders associated with learning problems, including Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD), are made earlier and more often for boys. Clinical estimates often indicate a higher boy: girl ratio for ADHD and ASD (e.g., Polanczyk & Rohde, 2007; Maenner et al., 2020). However, there is increasing recognition that these sex¹ differences may not reflect the number of girls who are struggling, with lower ratios reported in community and population studies (Gershon, 2002; Loomes et al., 2017). These discrepancies likely reflect both the different manifestations of learning and developmental difficulties between sexes, and the use of diagnostic rubrics used to identify children's difficulties. The primary aim of the current study is to investigate whether dimensions of cognition, behaviour and mental health differ between boys and girls in a large mixed sample of struggling learners with and without diagnoses.

Why more boys than girls?

One possibility for the high male: female sex ratio might relate to a reliance on diagnostic systems that have emerged from descriptions and categorisations of overt behaviours (discussed in Kreiser & White, 2014; Mowlem et al., 2019a). Criteria related to overt and externalising behaviours, such as hyperactivity for ADHD, are likely recognised more easily by practitioners and tolerated less well by parents and teachers (Gaub & Carlson, 1997). Add to that socially constructed gender-biased or stereotypical views of boys as being disruptive, the problem becomes apparent: overt behaviours are more likely to raise concern and expected to be more prevalent in boys. Indeed, studies have shown that boys are rated as more disruptive (e.g., Scitutto et al., 2004).

¹ As defined by the American Psychological Association's Dictionary of Psychology (APA, 2015), sex usually refers to an individual's "biological aspects of maleness or femaleness", whereas gender connotes the "psychological, behavioural, social, and cultural aspects of being male or female". We acknowledge that sex can interact with gender in different ways; while some individuals' identities are informed by both sex and gender, others are not (Lai et al., 2015; Gur and Gur, 2016). However, we use the term "sex" throughout the paper, as the majority of neurodevelopmental studies, and indeed our own, record biological sex at birth.

Another explanation is that symptom manifestations differ between boys and girls. The way in which girls express their difficulties may preclude diagnoses, or make their challenges more difficult to detect. Girls with ADHD often present with predominantly inattentive and internalising symptoms (Biederman et al., 2002; Levy et al., 2005; Rucklidge & Tannock, 2001). In contrast, boys typically present with hyperactive/impulsive symptoms and externalising behaviours (Abikoff et al., 2002; Quinn, 2008). Similarly, some autistic² girls use behavioural camouflaging strategies, appearing less autistic in social interactions (Dean et al., 2017; Hull et al., 2020) and more able from others' perspectives (Hiller et al., 2014), meaning they are less likely to receive a diagnosis. The same is also true in schools, where boys are more likely to manifest externalising behaviours and receive a referral for special education assessment (Dhuey & Lipscomb, 2010).

Sex differences in at-risk developmental populations

Extant research investigating sex differences in cognition, behaviour and mental health in developmental populations has produced mixed results (e.g., Duvall et al., 2020; Gershon, 2002; R. C. Gur & Gur, 2017; R. E. Gur & Gur, 2016; Mandy et al., 2012; Mayes et al., 2020; Rucklidge, 2008), and is dominated by the study of clinical samples of diagnosed children (e.g. discussed in Kreiser & White, 2014; Mowlem et al., 2019a,b). This likely biases our understanding towards a male phenotype, both because clinical samples typically include a greater number of boys, and girls included in such samples are likely to present with overt behaviours more similar to those typically expressed in boys (Mowlem et al., 2019b). Recruiting selective samples based on the presence of a particular diagnosis means that we do not understand sex differences either in children with milder needs, or in those with more complex and co-occurring needs who are often excluded on the basis of comorbidity being treated as a confound.

Developmental problems are increasingly studied using transdiagnostic approaches. These aim to identify dimensions of difficulty that occur across individuals irrespective of diagnostic status

² Identity-first language is sometimes preferred among people on the autism spectrum (e.g., Kenny et al., 2016). We therefore use this terminology throughout the article to respect this preference.

(Cuthbert & Insel, 2013). Such approaches offer an alternative way to understand sex differences in struggling learners. Rather than focussing on diagnoses informed by diagnostic criteria, which may be biased towards stereotypically male behaviours, transdiagnostic sampling provides the opportunity to recruit children with a broader range of developmental and learning difficulties (e.g., Casey et al., 2014): they provide a way to explore sex differences in the common struggling learner.

The current study

The current study adopts a transdiagnostic approach to characterise male and female phenotypes in a large mixed sample of children identified as experiencing problems in attention, learning and / or memory by education and health professionals. Using this sample, we explored the prevalence of male and female struggling learners. A latent variable approach was used to identify dimensions of difficulty in the whole sample, and then to test whether these dimensions differed in structure and severity between boys and girls. We broadly classified multiple individual tasks into three domains, cognition, behaviour and mental health, based on their common use in clinical and educational practice. Our analyses were data-driven and exploratory, so we had no specific predictions about whether the factor compositions would be similar for male and female struggling learners, or whether the severity of impairments would differ between boys and girls on specific dimensions.

Method

Procedure and Measures

The cognitive, behavioural and mental health data from the Centre for Attention, Learning and Memory (CALM) cohort were used (see Table S1 for a description of the tasks). Recruitment details and testing procedures are described in the study protocol (Holmes et al., 2019). Ethical approval was granted by the National Health Service (REC: 13/EE/0157). Parents/caregivers provided written consent and child verbal assent was obtained.

Raw scores were used in all analyses as some measures factor sex into their age standardization (Mayes et al., 2020). To control for age, raw scores were regressed on age and the residuals were used. Higher raw scores were associated with better performance for the cognitive tasks, but greater severity for the behavioural and mental health questionnaires. Residuals for Rapid Naming, Simple Reaction Time (SRT; TEA-Ch2; Manly et al., 2016) and Prosocial Behaviour (SDQ; Goodman, 1997) were reverse coded to streamline the interpretation of respective cognitive and mental health measures. Missing data were imputed with a full information maximum likelihood estimator for all models (Rosseel, 2012).

Participants

The sample included 805 children, whose average age was $M = 9.48$ years, $SD = 2.38$ (552 boys $M_{age} = 9.41$, $SD = 2.35$; 253 girls $M_{age} = 9.63$, $SD = 2.46$, $t(468.6) = -1.21$, $p = .23$). Characteristics, including diagnostic status and referral route, are presented in Table S2.

Performance was close to age-appropriate levels for Mr X and Cancellation (see Table 1). All other cognitive scores were approximately one standard deviation below age-normed population means. Behavioural problems were elevated for the whole sample (see Table 1), with the exception of Organisational problems (BRIEF; Gioia et al., 2000). The majority of mental health ratings on the RCADS-P (Chorpita et al., 2000) were elevated, but still within age-typical and subclinical bounds (i.e. RCADS-P T score less than 65).

Insert Table 1

Analysis Plan

Analyses were conducted in four steps: exploratory factor analysis (EFA), confirmatory factor analysis (CFA), multigroup CFA with measurement invariance (Steenkamp & Baumgartner, 1998; van de Schoot et al., 2013), and comparisons of latent means (intercepts). A detailed description of this approach is provided in the Supporting Information. All analyses were conducted using R version

4.0.3 using the Psych (2.0.12; Revelle, 2020), Lavaan (0.6-7; Rosseel, 2012) and semTools packages (0.5-4, Jorgensen et al., 2020).

Results

Descriptive Statistics

Descriptive statistics for boys and girls are presented in Table 2. Correlations between the measures are provided in Tables S3-S5.

Insert Table 2

Considerably more boys than girls were referred: 552 boys and 253 girls. Comparisons between boys and girls revealed girls performed more poorly than boys on the majority of cognitive measures (see Table 2). Boys were rated higher than girls on most of the behaviour rating scales, except WM (BRIEF; $p = .05$), Organisation (Conners Parent Short Form (CPSF); Conners, 2008; $p = .83$), and Peer Relations (CPSF; $p = .07$; see Table 2). Boys also had elevated ratings on mental health subscales measuring conduct problems, hyperactivity, and prosocial behaviours (all SDQ; all $ps < .05$; see Table 2).

Dimensions of Cognition, Behaviour and Mental Health

Cognition

Parallel analysis followed by an EFA with an oblimin rotation suggested a four-factor model was a good fit to the cognitive data, $\chi^2 (32) = 63.47$, $p < .001$, RMSEA = 0.035 (90% confidence interval [CI] = 0.022, 0.048), CFI = 0.986, RMSR = 0.02; see Schermelleh-Engel et al., 2003). This model included factors corresponding to executive function (Matrix Reasoning, Following Instructions, Mr X), verbal short-term (STM) and working memory (WM, Digit Recall, Nonword Repetition, Backward Digit Recall), phonological processing and attention (Alliteration, Rapid Naming, Cancellation, SRT, Vigil), and visual STM (Dot Matrix; see Table S6). Despite the good fit, this model was difficult to interpret because the fourth factor representing visual STM had only one indicator and the factor

reflecting phonological processing and attention had loadings from measures with little in common. For these reasons, a three-factor model was tested.

Fit statistics for a three-factor solution indicated that this model was a good fit, $\chi^2(42) = 105.5$, $p < .001$, RMSEA = 0.044 (90% confidence interval [CI] = 0.033, 0.054), CFI = 0.947, RMSR = 0.030, see Table S6). The first factor was most strongly associated with measures that draw on executive resources (Dot Matrix, Backward Digit Recall, Mr X and Matrix Reasoning). The second factor was linked mostly to speeded tasks or tasks that were completed under time constraints (SRT, Rapid Naming, Cancellation, and Vigil). This factor was also linked to tasks that were not speeded (Alliteration, Delayed Recall, and Following Instructions), but that might be performed better if they are performed quickly (e.g., due to less forgetting time). The third factor was associated with measures involving the storage of phonological material (Digit Recall and Nonword Repetition). These factors were labelled Executive, Speed, and Phonological Processing, respectively. The labelling of Factor 2 as Speed does not necessarily reflect that all tasks were speeded, but that the majority of tasks with a speeded component loaded on this factor. A confirmatory factor analysis revealed the three-factor model was an acceptable fit to the data, $\chi^2(62) = 203.12$, $p < .001$, RMSEA = 0.053 (90% confidence interval [CI] = 0.045, 0.061), CFI = 0.930, SRMR = 0.039, so it was selected for further analyses exploring sex differences (see Figure 1).

Insert Figure 1

Behaviour

Parallel and EFA analyses identified a three-factor solution as an acceptable fit to the behavioural data (see Table S7), $\chi^2(42) = 417.75$, $p < .001$, RMSEA = 0.105 (90% confidence interval [CI] = 0.096, 0.115), CFI = 0.947, RMSR = 0.03). The Monitor subscale loaded on all three factors in this model, and excluding it yielded a marginally better fit, $\chi^2(33) = 311.50$, $p < .001$, RMSEA = 0.102 (90% confidence interval [CI] = 0.092, 0.113), CFI = 0.956, RMSR = 0.03). This latter model, excluding the Monitor subscale, was selected for further analysis in the interests of parsimony, $\Delta\chi^2(9) =$

106.24, $p < .001$. Symptoms related to everyday difficulties with cognitive control loaded most highly on Factor 1. These included WM, planning, executive functions, inattention, initiation, and organization. Problems with emotional control, shifting, aggression, and peer relationships loaded most highly on Factor 2. Subscales measuring behavioural control, including hyperactivity and inhibition, loaded on Factor 3. The factors were labelled Cognitive Control (Factor 1), Emotion Regulation (Factor 2) and Behaviour Regulation (Factor 3). These labels were given based on the hypothesized dimension underlying differences in performance based on the constellation of tasks with the highest loadings. It is important to note that they do not represent a rigid mapping of tasks on factors and could be labelled differently depending on the sample (e.g., Simpson-Kent et al., 2020).

A CFA testing the fit of the three-factor model indicated it was a poor fit to the data, $\chi^2(51) = 676.21$, $p < .001$, RMSEA = 0.124 (90% confidence interval [CI] = 0.115, 0.132), CFI = 0.900, SRMR = 0.054. Modification indices revealed that scores for the Initiation subscale loaded highly on two factors: Emotion Regulation and Cognitive Control. Allowing this measure to cross-load on both factors significantly improved the goodness of fit, $\Delta\chi^2(1) = 52.43$, $p < .001$, but the overall model remained an inadequate fit, $\chi^2(50) = 615.08$, $p < .001$, RMSEA = 0.119 (90% confidence interval [CI] = 0.110–0.127), SRMR = 0.047, CFI = 0.909. Further inspection of the modification indices suggested that allowing hyperactivity and inattention, symptoms that co-occur in ADHD, to co-vary might improve the model. Adding this covariance significantly improved the model, $\Delta\chi^2(1) = 113.36$, $p < .001$, and produced a model with adequate fit to use in subsequent analyses exploring sex differences, $\chi^2(49) = 488.98$, $p < .001$, RMSEA = 0.106 (90% confidence interval [CI] = 0.097, 0.114), SRMR = 0.043, CFI = 0.929 (Figure 1).

Mental Health

A parallel analysis indicated a two-factor solution would be a good fit, which was confirmed by an EFA, $\chi^2(26) = 59.4$, $p < .001$, RMSEA = 0.056 (90% confidence interval [CI] = 0.038, 0.076), CFI =

0.981, RMSR = 0.02; see Table S8). Factor 1 was associated with symptoms of generalised, social and separation anxiety, panic and obsessive-compulsive disorders, and depression. Factor 2 was linked to conduct and peer relationship problems, low prosocial behaviour, and hyperactivity. These factors were labelled Internalising (Factor 1) and Externalising (Factor 2), respectively. CFA fit indices revealed that this two-factor model was an acceptable fit to the data, $\chi^2(34) = 179.44$, $p < .001$, RMSEA = 0.103 (90% confidence interval [CI] = 0.088–0.118), SRMR = 0.069, CFI = 0.918, with the exception of the RMSEA statistic (e.g. > 0.08). Modification indices suggested that allowing depression to cross-load on both factors would improve the model. The model was re-estimated with this cross-loading, and the fit was improved significantly, $\Delta\chi^2(1) = 75.49$, $p < .001$, yielding fit statistics within an acceptable range, $\chi^2(33) = 111.72$, $p < .001$, RMSEA = 0.077 (90% confidence interval [CI] = 0.062–0.093), SRMR = 0.054, CFI = 0.956. This model was used in all subsequent analyses (see Figure 1).

Comparing Boys and Girls

Cognition

Tests of configural invariance revealed that the three factor model captured the data well for both boys and girls, $\chi^2(124) = 280.70$, $p < .001$, RMSEA = 0.056 (90% confidence interval [CI] = 0.047–0.065), SRMR = 0.046, CFI = 0.922. Tests of metric invariance showed no significant deterioration of model fit when loadings were constrained to be equal across groups, $\Delta\chi^2(10) = 11.48$, $p = .321$. However, tests of scalar invariance indicated that the intercepts differed between boys and girls, $\Delta\chi^2(10) = 18.86$, $p = .04$. Inspection of the modification indices revealed a large discrepancy for the MrX test. Releasing the equality constraint on these intercepts improved the model fit to the data, $\Delta\chi^2(9) = 7.85$, $p = .550$, and partial scalar invariance was supported (see Table S9).

Group differences in latent means were explored by comparing the freely estimated and constrained models (see Figure 2). The freely estimated model fit better than the constrained model,

suggesting that latent intercepts (i.e. means) differed between boys and girls. Applying individual constraints on the latent intercepts revealed a significant difference between groups on the Executive factor alone, $\Delta\chi^2(1) = 11.62$, $p < .001$, with girls performing significantly worse than boys (girls $M = -0.49$, $SD = 2.87$, boys $M = 0.44$, $SD = 2.44$). Intercepts for Speed and Phonological Processing did not differ significantly between groups, (Speed $\Delta\chi^2(1) = 3.46$, $p = .06$, Phonological Processing $\Delta\chi^2(1) = 3.48$, $p = .06$; see Figure 5).

Insert Figure 2

Behaviour

The behavioural model met conditions for configural and metric invariance but not for scalar invariance (see Table S9). Modification indices for subtest mean scores revealed discrepancies for Organisation, Planning and WM. Allowing these intercepts to vary freely between groups improved the model fit and partial scalar invariance was achieved, $\Delta\chi^2(5) = 11.69$, $p = .07$ (see Figure 3).

Insert Figure 3

The freely estimated model fit better than the constrained model, indicating that latent intercepts were significantly different between boys and girls. Boys had significantly more difficulties on all three factors, Cognitive Control ($\Delta\chi^2(1) = 17.56$, $p < .001$, boys $M = 0.11$, $SD = 0.95$, girls $M = -0.24$, $SD = 1.06$), Emotion Regulation ($\Delta\chi^2(1) = 10.39$, $p = .001$, boys $M = 0.09$, $SD = 0.97$, girls $M = -0.20$, $SD = 1.03$), and Behaviour Regulation ($\Delta\chi^2(1) = 37.34$, $p < .001$, boys $M = 0.16$, $SD = 0.98$; girls $M = -0.34$, $SD = 0.97$; see Figure 5).

Mental Health

For mental health, there was no significant deterioration of model fit with increasing constraints. The conditions of configural, metric and scalar invariance were met indicating that the overall structure, loadings and intercepts were similar across groups (see Table S9 and Figure 4).

Insert Figure 4

Comparisons between boys and girls revealed that constraining intercepts for the Externalising factor significantly degraded the fit, $\Delta\chi^2(1) = 18.56, p < .001$. Boys exhibited significantly more externalising problems than girls (boys $M=0.10$, $SD = 0.95$; girls $M = -0.23$, $SD = 1.07$). No significant group differences were found for internalising problems, $\Delta\chi^2(1) = 0.03, p = .871$ (see Figure 5).

Insert Figure 5

Discussion

This is the first study, to our knowledge, to adopt a transdiagnostic dimensional approach to understanding sex differences in children with developmental difficulties. The key findings were that more boys than girls were referred, and while dimensions of cognition, behaviour and mental health were invariant across boys and girls, cognitive problems were more severe in girls and behavioural difficulties and externalising problems greater in boys.

Prevalence of boys and girls

Prevalence estimates indicating a high boy:girl ratio for developmental difficulties are drawn predominantly from studies of clinical populations (e.g. autistic children or those with ADHD, discussed in Kreiser & White, 2014; Mowlem et al., 2019a,b). Using a novel sampling frame, which aimed to represent the full spectrum of children with learning-related difficulties, including those with relatively mild problems in addition to those with diagnosed conditions, we also found a high boy:girl ratio, with twice as many boys than girls referred. This might reflect implicit gender biases and stereotyping (e.g., discussed in Anderson, 1997), or different manifestations, drivers and expressions of difficulties in boys and girls (e.g. Dhuey & Lipscomb, 2010; Hiller et al., 2014), but we suspect it is also related to practitioners using heuristics for diagnostic criteria that emphasize overt behaviours.

Referrers to this study identified children based on observations of cognitive and learning problems. Despite this, health and education practitioners referred more children with behavioural difficulties than cognitive problems, suggesting they were spotting and raising concern for overt behaviours more easily than cognitive problems. This bias towards male-focussed diagnostic criteria makes it less likely for a girl to be diagnosed with conditions such as ASD (Lai et al., 2015), and here we see it extends to the broader population of children struggling at school. Moving forward it will be important to decrease these biases towards diagnostic criteria, and increase knowledge of the female phenotype among professionals involved in referrals, to ensure we meet the needs of girls who are struggling.

Differences between boys and girls

The broad dimensions underpinning the cognitive abilities of the whole sample included Executive Function, Speed and Phonological Processing factors. These factors correspond to those previously identified in a study investigating the cognitive dimensions of learning in the same children from the CALM cohort (Holmes et al., 2020), showing again that the key constructs that distinguish cognitive abilities in typically developing children and adults also differentiate cognitive function in struggling learners.

The cognitive dimensions were invariant across boys and girls, indicating that the overall latent structure of cognitive skills does not differ between sexes. There were no differences in scores on the phonological or speed dimensions, but girls were more impaired on the executive function dimension. These data support the notion that girls must show greater cognitive deficits for educational or health practitioners to notice their struggles (e.g., Dworzynski et al., 2012; Gaub & Carlson, 1997). They also suggest the biggest driver of problems for girls in our sample is executive function difficulties. Executive functions are associated with learning outcomes in typical and neurodiverse groups (e.g., Peng et al., 2018; Swanson & Ashbaker, 2000). However, there is evidence that girls may draw more on these resources than boys: girls take a more effortful, mastery-based

approach to learning that draws on general higher-order cognitive skills, while boys draw more on domain-specific knowledge and skills during learning (Brunner et al., 2008; Kenney-Benson et al., 2006). If this is the case, then impairments in executive function problems might be expected to have a more significant impact on girls' school progress, and this might explain why the girls referred to the CALM cohort were characterised by more severe executive function problems than the boys.

Parent/carer ratings of the children's behaviour and mental health captured three dimensions of behaviour and two of mental health. For behaviour, factors corresponding to Cognitive Control, Emotion Regulation and Behaviour Regulation emerged. Two of these factors, Behaviour Regulation and Cognitive Control, map on to dimensions of impairment proposed by multiple pathway models of ADHD (e.g., Castellanos et al., 2006). According these models, ADHD symptoms arise as consequence of impairments in two neurobiological pathways: one serves cool cognitive functions such as working memory, planning and switching, and the other hot executive functions that contribute to hyperactivity/ impulsivity and emotional-reward dysregulation (Zelazo & Müller, 2002). The third dimension, Emotional Regulation, resembles part of a broader self-regulation concept, which is also linked to increased risks for ADHD (Walcott & Landau, 2004) and other psychopathologies (e.g., McLaughlin et al., 2011; Röhl et al., 2012). For mental health, two dimensions emerged, internalising and externalising. These align with models of child psychopathology (Achenbach, 1966; McElroy, et al., 2018; Patalay et al., 2015).

Dimensions of behaviour and mental health were the same for boys and girls, but the severity of their impairments differed on specific dimensions. There were no differences on the internalising symptoms dimension, but girls had fewer externalising problems and fewer difficulties across all three dimensions of behaviour than boys. This could mean that externalising symptoms and overt behaviours commonly associated with ADHD are genuinely more prevalent and manifest in boys (e.g., Abikoff et al., 2002). Alternatively, elevated problem behaviours in boys could reflect socially constructed gender-biased or stereotypical views of boys as being disruptive, and the

application and use of diagnostic criteria that emphasise overt behaviours (Hiller et al., 2014; Mowlem et al., 2019a). Both boys and girls had elevated symptoms of internalising problems. Internalising problems have been linked to stressful and negative life events (Kim et al., 2003; March-Llanes et al., 2017), which are likely common among our sample, and may explain why symptoms were elevated for both sexes.

Conclusion

This study shows that when health and education professionals identify children with cognitive and learning problems, they recognise more boys than girls. Despite this, the girls referred showed greater cognitive difficulties, with significantly more impairments on executive functions. They also exhibited fewer externalising problems. These results underscore the need to include cognitive and female-representative criteria in diagnostic systems. Including these criteria, and / or routinely administering cognitive assessments in schools may help to identify girls whose difficulties could easily go undetected. By raising awareness of the profile of struggling girls, and drawing attention to the systemic and implicit bias present in the fields of both healthcare and education, we have the potential to increase the likelihood that girls' difficulties will be recognised.

Key Points

- Our understanding of sex differences in at-risk developmental populations is dominated by studies of clinical samples, likely biasing knowledge towards a male phenotype.
- Male and female phenotypes were characterised in a large transdiagnostic sample of children identified by practitioners as experiencing problems in cognition and learning, irrespective of diagnostic status.
- Practitioners recognised more boys than girls as struggling.

- Dimensions of cognition, behaviour and mental health were structurally invariant between boys and girls, but cognitive problems were more severe in girls, and behavioural difficulties and externalising problems greater in boys.
- These findings illustrate the profile of struggling girls, and highlight systemic and implicit biases in the fields of healthcare and education that need to be addressed to provide appropriate support.

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Table 1

Descriptive Statistics for Whole Sample (N=805) on Cognitive, Behavioural and Mental Health Measures with Raw (left) Standardized (right) Scores

Measures	Raw Scores					Standardized Scores					Above Cutoff
	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max	
Cognition											
Alliteration	788	7.93	2.50	0	10	788	91.31	10.12	69	107	-
Rapid Naming	786	121.53	43.03	55	377	787	88.68	15.13	0	131	-
Nonword Repetition	481	25.58	6.87	2	38	481	82.41	20.62	45	125	-
Digit Recall	801	24.58	5.38	7	47	801	92.63	15.41	60	149	-
Dot Matrix	799	18.03	5.69	2	43	799	90.63	14.98	47	141.20	-
Backward Digit Recall	780	9.69	4.42	0	25	780	91.53	12.62	58	137	-
MrX	795	9.34	5.14	0	32	795	97.38	15.35	61	148	-
Following Instructions	750	11.20	4.04	1	33	750	0	3.64	-9.60	18.58	-
Delayed Recall	775	28.77	16.16	0	71	775	7.88	3.30	1	19	-
Cancellation	771	14.96	3.70	4.67	27	771	10.17	3.31	1	19	-
SRT	739	726.54	314.23	233.51	2,276.36	739	7.80	4.06	1	19	-
Vigil/Barking	748	7.10	2.42	0	10	748	8.01	3.29	3	19	-
Matrix Reasoning	804	11.20	5.56	0	28	803	43.04	9.57	20	80	-
Behaviour											
BRIEF:Inhibit	800	21.59	6.17	10	30	800	65.74	14.65	36	98	45.5
BRIEF:Shift	801	17.08	4.24	8	24	801	68.15	14.82	36	99	50.56
BRIEF:Emotion Control	800	22.18	5.57	10	30	800	64.70	13.35	35	91	41.88
BRIEF:Initiate	800	17.70	3.32	8	24	800	66.49	10.74	35	95	40.62
BRIEF:WM	800	25.74	4.05	11	30	800	73.84	9.71	38	93	72.5
BRIEF:Planning	789	29.02	5.00	13	36	789	71.40	10.46	35	100	62.74

BRIEF:Organisation	801	14.63	3.23	6	18	801	60.22	10.02	33	73	17.48
BRIEF:Monitor	799	19.04	3.52	9	24	799	66.14	11.24	31	91	42.68
CPSF:Inattention	795	11.67	3.44	0	15	793	80.80	11.14	40	90	83.35
CPSF:Hyperactivity/Impulsivity	797	10.89	5.58	0	18	796	75	15.66	40	90	64.57
CPSF:Executive Function	794	10.19	3.62	0	15	793	74.75	12.46	40	90	69.74
CPSF:Aggression	794	3.56	3.99	0	15	793	64.65	17.53	44	91	37.33
CPSF:Peer Relations	788	5.52	4.46	0	15	787	73.46	17.53	44	90	60.1
Mental Health											
RCADS:Generalised Anxiety	398	5.98	3.97	0	18	399	56.54	12.47	36	81	19.05
RCADS:Panic Disorder	396	3.91	4.12	0	27	397	57.44	13.64	40	81	23.93
RCADS:Social Phobia	400	12.44	6.34	0	27	401	59.55	14.18	29	81	26.18
RCADS:Separation Anxiety	402	6.86	5.05	0	21	403	59.45	14.94	36	81	28.29
RCADS:Obsessive-Compulsive Disorder	399	3.01	3.09	0	15	400	53.74	11.16	41	81	11.25
RCADS:Major Depression	401	9.10	5.21	0	27	402	65.18	12.87	37	81	43.53
SDQ:Conduct Problems	797	3.51	2.53	0	10						45.09
SDQ:Prosocial Behaviour	797	6.81	2.38	0	10						41.49
SDQ:Peer Relationships Problem	797	3.43	2.62	0	10						45.22
SDQ:Hyperactivity/Inattention	796	7.64	2.43	0	10						60.12

Note. Descriptive statistics are based on raw scores (left) and standardized scores (right) to ease interpretability. For the cognitive tasks, lower raw, standard and scaled scores indicate greater difficulties. However, RAN and SRT are speeded tasks in which higher raw values reflect a slower, and thereby, poorer performance. For all behavioural and mental health tasks, higher raw scores and T-scores reflect greater difficulties. The Prosocial Behaviour Subscale of the SDQ is an exception; higher scores reflect greater strengths. The percentage of participants with scores within the abnormal or clinical levels were calculated using the following criteria: T-scores of 70 or above for all BRIEF, CPSF, RCADS subscales; raw scores equal or higher than 4 for SDQ Conduct

problems and Peer relationships problems; raw scores equal or higher than 7 for SDQ Hyperactivity/Inattention; and raw scores equal or lower than 5 for SDQ Prosocial behaviour. Following Instructions is an experimental task that is not age-standardized. To control for age, raw scores were regressed on age and residual scores were used. BRIEF = The Behaviour Rating Inventory of Executive Function; CPSF = Conners-3 Parent Rating Scale Short Form; RCADS = Revised Child and Anxiety and Depression Scale (Parent Version); SDQ = Strengths and Difficulties Questionnaire.

Table 2

Descriptive Statistics for Boys and Girls on Cognitive, Behavioural and Mental Health Measures with Residual Scores

Measures	Group												
	N	M	Boys			N	M	Girls			Group Comparisons		
			SD	Min	Max			SD	Min	Max	t	p	d
Cognition													
Alliteration	539	0.07	2.26	-9.24	3.94	249	-0.16	2.17	-6.81	3.44	1.40	.16	-0.11
Rapid Naming	538	2.36	33.14	-163.69	83.33	248	-5.13	37.71	-221.02	50.59	2.69	.01*	-0.22
Nonword Repetition	339	0.20	6.22	-18.21	12.78	142	-0.47	5.82	-15.46	11.79	1.13	.26	-0.11
Digit Recall	550	0.19	4.92	-16.70	17.93	251	-0.41	4.95	-18.99	15.77	1.59	.11	-0.12
Dot Matrix	547	0.35	4.89	-19.95	20.81	252	-0.76	4.41	-15.28	11.39	3.18	<.001***	-0.23
Backward Digit Recall	534	0.21	3.62	-11.09	14.56	246	-0.45	3.62	-12.18	10.16	2.33	.02*	-0.18
MrX	544	0.55	4.35	-13.54	18.23	251	-1.19	4.28	-13.38	13.71	5.31	<.001***	-0.40
Following Instructions	516	0.07	3.84	-9.60	18.58	234	-0.16	3.16	-9.11	9.10	0.87	.38	-0.06
Delayed Recall	530	0.48	14.82	-39.08	36.50	245	-1.03	15.25	-47.49	34.58	1.30	.20	-0.10
Cancellation	525	0.10	3.28	-9.89	10.12	246	-0.21	3.47	-10.10	9.04	1.16	.25	-0.09
SRT	501	0.19	274.20	-1,373.14	465.06	238	-0.40	253.58	-1,047.39	451.09	0.03	.98	0
Vigil/Barking	514	0.01	2.37	-7.01	3.35	234	-0.03	2.45	-7.32	3.35	0.22	.82	-0.02
Matrix Reasoning	551	0.29	4.58	-14.24	13.00	253	-0.64	4.46	-12.24	14.56	2.73	.01*	-0.21
Behaviour													
BRIEF:Inhibit	548	0.77	6.01	-12.14	9.37	252	-1.68	6.11	-11.98	9.88	5.30	<.001***	-0.41
BRIEF:Shift	549	0.35	4.17	-9.22	7.32	252	-0.76	4.27	-9.27	7.37	3.43	<.001***	-0.26
BRIEF:Emotion Control	548	0.37	5.44	-12.23	7.91	252	-0.80	5.76	-12.13	7.90	2.70	.01*	-0.21
BRIEF:Initiate	548	0.16	3.14	-10.29	6.74	252	-0.36	3.51	-8.92	6.36	2.02	.04*	-0.16
BRIEF:WM	548	0.19	3.93	-14.72	4.51	252	-0.42	4.26	-14.63	4.65	1.94	.05	-0.15
BRIEF:Planning	539	0.55	4.80	-16.14	7.91	250	-1.19	5.07	-14.71	8.23	4.55	<.001***	-0.36

BRIEF:Organisation	549	0.02	3.22	-9.01	3.63	252	-0.04	3.25	-8.99	3.62	0.22	.83	-0.02
BRIEF:Monitor	547	0.37	3.37	-10.08	5.40	252	-0.81	3.69	-9.95	5.39	4.33	<.001***	-0.34
CPSF:Inattention	544	0.31	3.20	-11.66	3.51	251	-0.67	3.83	-11.72	3.56	3.50	<.001***	-0.29
CPSF:Hyperactivity/Impulsivity	546	0.79	5.28	-11.78	8.71	251	-1.73	5.57	-11.68	10.58	6.03	<.001***	-0.47
CPSF:Executive Function	544	0.37	3.50	-10.64	5.27	250	-0.80	3.70	-11.00	5.27	4.17	<.001***	-0.33
CPSF: Aggression	544	0.29	4.04	-3.78	11.52	250	-0.63	3.80	-3.71	11.36	3.10	<.001***	-0.23
CPSF:Peer Relations	539	0.20	4.37	-7.73	9.92	249	-0.43	4.50	-7.04	10.51	1.83	.07	-0.14
Mental Health													
RCADS:Generalised Anxiety	274	0.04	4.04	-6.34	12.18	124	-0.09	3.81	-6.55	10.11	0.29	.77	-0.03
RCADS:Panic Disorder	273	-0.11	3.99	-4.83	22.24	123	0.25	4.30	-4.95	18.86	-0.78	.43	0.09
RCADS:Social Phobia	276	-0.32	6.19	-14.13	14.62	124	0.71	6.39	-12.11	14.42	-1.51	.13	0.17
RCADS:Separation Anxiety	277	0.02	4.85	-7.99	13.41	125	-0.05	5.31	-7.62	13.04	0.14	.89	-0.02
RCADS:Obsessive-Compulsive	275	0.06	3.10	-3.02	11.99	124	-0.14	3.05	-3.02	11.99	0.62	.54	-0.07
RCADS:Major Depression	276	0.16	5.17	-9.89	14.97	125	-0.34	4.89	-9.04	17.38	0.93	.35	-0.10
SDQ:Conduct Problems	546	0.19	2.51	-3.68	6.67	251	-0.41	2.54	-3.85	6.60	3.10	<.001***	-0.24
SDQ:Prosocial Behaviour	546	0.26	2.31	-3.37	6.98	251	-0.56	2.41	-3.60	5.98	4.52	<.001***	-0.35
SDQ:Peer Relationships Problem	546	0.09	2.55	-5.20	6.97	251	-0.19	2.63	-4.65	6.82	1.37	.17	-0.11
SDQ:Hyperactivity/Inattention	545	0.32	2.30	-7.59	3.12	251	-0.69	2.52	-7.84	2.93	5.37	<.001***	-0.42

Note. Descriptive statistics are based on age regressed residuals on raw scores. For the cognitive tasks, lower scores indicate greater difficulties. For all

behavioural and mental health tasks, higher ratings reflect greater difficulties. Residuals for Rapid Naming, Simple Reaction Time (SRT; TEA-Ch2) and

Prosocial Behaviour (SDQ) were reverse coded to streamline the interpretation of respective cognitive and mental health measures. BRIEF = The Behaviour

Rating Inventory of Executive Function; CPSF = Conners-3 Parent Rating Scale Short Form; RCADS = Revised Child and Anxiety and Depression Scale (Parent

Version); SDQ = Strengths and Difficulties Questionnaire.

Figure 1

Confirmatory Factor Models for Cognitive (Top), Behavioural (Middle) and Mental Health (Bottom) Dimensions

Note. For ease of interpretation, schematic representations are presented. Cognitive Dimensions: Executive = Executive Functions; Speed = Processing Speed; Phonological = Phonological Processing; DotMat = Dot Matrix; MrX = Mister X, Matrix = Matrix Reasoning; BackDR = Backward Digit Recall; Allit = Alliteration; SRT = Simple Reaction Time, RAN = Rapid Automatic Naming; CMS = Delayed Recall; Cancel = Cancellation; FI = Following Instructions; DigRec = Digit Recall; CNRep = Nonword Repetition. Behavioural Dimensions: WM = Working Memory; Plan = Planning; Exec = Executive Functions; Inatt = Inattention; Org = Organisation; Emo = Emotion Control; Shift = Shifting; Agg = Aggression; PeerRel = Peer Relations; Hyper = Hyperactivity/impulsivity; Inhibit = Inhibition. Mental Health Dimensions: GAD = Generalized Anxiety Disorder; Panic = Panic Disorder; SocPhob = Social Phobia; SepAnx = Separation Anxiety; OCD = Obsessive Compulsive Disorder; Dep = Depression; Conduct = Conduct Problems; ProSoc = Prosocial Behaviour; Hyper = Hyperactivity/inattention; PeerProb = Peer Relationship Problems.

Figure 2

Multigroup Measurement Model of Cognitive Dimensions

Note. Standardized values are derived from the model that achieved partial scalar invariance across boys and girls. For ease of interpretation, only intercepts that differed significantly across groups are shown. These intercepts were estimated freely across groups. Executive = Executive Functions; Speed = Processing Speed; Phonological = Phonological Processing; DotMat = Dot Matrix; MrX = Mister X, Matrix = Matrix Reasoning; BackDR = Backward Digit Recall; Allit = Alliteration; SRT = Simple Reaction Time, RAN = Rapid Automatic Naming; CMS = Delayed Recall; Cancel = Cancellation; FI = Following Instructions; DigRec = Digit Recall; CNRep = Nonword Repetition.

Figure 3

Multigroup Measurement Model of Behaviour Dimensions

Note. Standardized values are derived from the model that achieved partial scalar invariance across boys and girls. For ease of interpretation, only intercepts that differed significantly across groups are shown. These intercepts were estimated freely across groups. Executive = Executive Functions; WM = Working Memory; Plan = Planning; Exec = Executive Functions; Inatt = Inattention; Org = Organisation; Emo = Emotion Control; Shift = Shifting; Agg = Aggression; Peer = Peer Relations; Hyper = Hyperactivity; Inhibit = Inhibition.

Figure 4

Multigroup Measurement Model of Mental Health Dimensions

Note. Standardized values are derived from the model that achieved scalar invariance across boys and girls. For ease of interpretation, intercepts are not shown. GAD = Generalized Anxiety Disorder; Panic = Panic Disorder; SocAnx = Social Anxiety; SepAnx = Separation Anxiety; OCD = Obsessive Compulsive Disorder; Dep = Depression; Conduct = Conduct Problems; ProSoc = Prosocial Behaviour; Hyper = Hyperactivity/Inattention; Peer = Peer Relationship Problems.

Figure 5

Mean Cognitive, Behavioural and Mental Health Factor Scores for Boys and Girls

Note. Factor scores were converted to Z scores for visualization. Error bars represent the standard error of the mean. Executive = Executive Functions; Speed = Processing Speed; Phonological = Phonological Processing.