



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Starting school

A large-scale start of school assessment within the 'Born in Bradford' longitudinal cohort

Citation for published version:

Shire, K, Andrews, E, Barber, S, Bruce, A, Corkett, J, Hill, LJB, Kelly, B, McEachan, RRC, Mon-Williams, M, Tracey, L, Waterman, AH & Wright, J 2020, 'Starting school: A large-scale start of school assessment within the 'Born in Bradford' longitudinal cohort', *Wellcome Open Research*, vol. 5, 47, pp. 1-16.
<https://doi.org/10.12688/wellcomeopenres.15610.1>

Digital Object Identifier (DOI):

[10.12688/wellcomeopenres.15610.1](https://doi.org/10.12688/wellcomeopenres.15610.1)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

Wellcome Open Research

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy









The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.





DATA NOTE

Starting School: a large-scale start of school assessment within the 'Born in Bradford' longitudinal cohort [version 1; peer review: 1 approved, 1 approved with reservations]

Katy A. Shire ¹⁻³, Elizabeth Andrews^{1,4}, Sally Barber^{1,2}, Alison Bruce ^{1,2}, John Corkett⁵, Liam J. B. Hill ¹⁻³, Brian Kelly ^{1,2}, Rosemary R.C. McEachan ^{1,2}, Mark Mon-Williams ^{1-3,6}, Louise Tracey⁷, Amanda H. Waterman ^{2,3}, John Wright ^{1,2}

¹Bradford Institute for Health Research, Bradford Hospitals National Health Service Trust, Bradford, BD96RJ, UK

²Wolfson Centre for Applied Health Research, Bradford Hospitals National Health Service Trust, Bradford, BD96RJ, UK

³School of Psychology, University of Leeds, Leeds, LS29JT, UK

⁴School of Law, University of Leeds, Leeds, LS15HD, UK

⁵Research and Innovation Centre, Leeds Teaching Hospitals NHS Trust, Leeds, LS97TF, UK

⁶National Centre for Optics, Vision and Eye Care, University of South-Eastern Norway, Kongsberg, Hasbergs vei 36, 3616, Norway

⁷Department of Education, University of York, York, YO105DD, UK

V1 First published: 16 Mar 2020, 5:47
<https://doi.org/10.12688/wellcomeopenres.15610.1>

Latest published: 16 Mar 2020, 5:47
<https://doi.org/10.12688/wellcomeopenres.15610.1>

Abstract

The Born in Bradford (BiB) cohort of 13,776 children born between 2007-2011 and their parents provides a rich data resource for researchers exploring protective and risk factors influencing long-term developmental and health outcomes. Educational attainment is a critical factor related to later health. Literacy and communication, fine motor skills and social and emotional health are key 'early' predictors of educational attainment and can be used to identify children in need of additional support. We describe our BiB 'Starting School' data collection protocol which assessed literacy and communication, fine motor skills and social and emotional health on 3,444 BiB children aged 4-5 years old. These measures supplement the existing dataset, and complement the routine educational, health and social care data available for the cohort.

Keywords

longitudinal cohort, school-readiness, educational attainment





This article is included in the [Born in Bradford gateway](#).

Open Peer Review

Approval Status ? ✓

	1	2
version 1	?	✓
16 Mar 2020	view	view

1. **Nicholas P. Holmes** , University of Nottingham, Nottingham, UK
2. **Rachel F. Barr** , Georgetown University, Washington, USA

Any reports and responses or comments on the article can be found at the end of the article.

Corresponding author: Katy A. Shire (katy.shire@bthft.nhs.uk)

Author roles: **Shire KA:** Investigation, Writing – Original Draft Preparation; **Andrews E:** Investigation, Methodology, Project Administration, Writing – Original Draft Preparation; **Barber S:** Conceptualization, Funding Acquisition, Methodology, Writing – Review & Editing; **Bruce A:** Methodology, Writing – Review & Editing; **Corkett J:** Data Curation, Software, Visualization, Writing – Review & Editing; **Hill LJB:** Data Curation, Methodology, Resources, Software, Writing – Review & Editing; **Kelly B:** Data Curation, Writing – Review & Editing; **McEachan RRC:** Conceptualization, Funding Acquisition, Project Administration, Supervision, Writing – Review & Editing; **Mon-Williams M:** Conceptualization, Funding Acquisition, Methodology, Supervision, Writing – Review & Editing; **Tracey L:** Conceptualization, Data Curation, Funding Acquisition, Methodology, Resources, Supervision, Writing – Review & Editing; **Waterman AH:** Methodology, Writing – Review & Editing; **Wright J:** Conceptualization, Funding Acquisition, Methodology, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: Core support for this Born in Bradford research was provided by the Wellcome Trust (WT101597MA). The Starting School research was funded by the NIHR CLAHRC Yorkshire and Humber (Grant No. KRD/012/001/006) (www.clahrc-yh.nihr.ac.uk). The views expressed are those of the author(s), and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care. Additional funding was also received by the Internal Pump Priming Fund, University of York.

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Copyright: © 2020 Shire KA *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

How to cite this article: Shire KA, Andrews E, Barber S *et al.* **Starting School: a large-scale start of school assessment within the ‘Born in Bradford’ longitudinal cohort [version 1; peer review: 1 approved, 1 approved with reservations]** Wellcome Open Research 2020, 5:47 <https://doi.org/10.12688/wellcomeopenres.15610.1>

First published: 16 Mar 2020, 5:47 <https://doi.org/10.12688/wellcomeopenres.15610.1>

Introduction

The Born in Bradford (BiB) longitudinal cohort study was established in 2007 in response to the high rates of childhood ill-health seen in the City of Bradford (Wright *et al.*, 2013). BiB was set up with the aim of examining the genetic, environmental, behavioural and social factors that influence the health and development of children in the city. All mothers who gave birth at Bradford Royal Infirmary between 2007 and 2011 were invited to take part, which resulted in a cohort of 13,776 children and their families. Mothers recruited into the study provided a rich dataset through detailed questionnaire data, measurements and samples. Mothers also consented to the linkage of routine data (such as primary and secondary care records and local education records) concerning themselves and their child. A full list of all available data provided at baseline recruitment, during pregnancy and at birth can be found on the BiB website (<https://borninbradford.nhs.uk/research/documents-data/>).

Sub-samples of the cohort provided additional measures on growth, physical and mental health, and diet between birth and 3 years of age (Bryant *et al.*, 2013), whilst further measurements relating to physical health (in particular allergies and infections) were collected on sub-cohorts as part of the ‘MeDALL’ (Bousquet *et al.*, 2011) and ‘ALL IN’ studies (Pembrey *et al.*, 2013). Children in the UK typically begin primary school in the September following their 4th birthday and thus an ideal opportunity presented itself to enrich the dataset further with in-school measurements of children during their first year of schooling, on abilities that were directly relevant to their later educational attainment and development.

In this Reception year of primary school in the UK (a compulsory year of Early Years education before the start of formal education), children are also assessed by their teachers using the EYFSP (Department for Education, 2012, Department for Education, 2013). The current assessment summarises each child’s ability on 17 learning goals, covering the areas: Communications and language development, Physical development, Personal, social and emotional development, Literacy, Understanding of the World, and Expressive arts and design. For each of the learning goals, teachers are asked to judge whether the child is meeting the level of expected development (expected), exceeding it (exceeding), or not yet reaching it (emerging). Since the mothers consented to the collection of routine data on their children, it was possible to link the children’s BiB data to these education records too¹.

The factors that contribute to children’s ‘school readiness’ covers a large range of domains, and so we planned to supplement the information from the EYFSP with some

complementary objective measurements of assessments shown to be important for positive developmental and educational outcomes of the cohort. The United Nations Children’s Fund (UNICEF) describe ‘school readiness’ as encompassing five domains: (i) Physical well-being and motor development; (ii) Social and emotional development; (iii) Approaches to learning; (iv) Language development and cognition; (v) General knowledge (including mathematics) (United Nations Children’s Fund, 2012). Since we only had limited time in which to assess each child, we were not able to run an extensive battery of tests covering all possible fields within these domains. We therefore adopted a pragmatic approach and focused on a limited number of measures that: (a) fit into one of the ‘school readiness’ domains; (b) could be practically completed within a total 20–30-minute assessment timeframe per child; (c) showed good evidence of predicting future development or attainment.

The three school readiness domains chosen for the ‘Starting School’ study were physical well-being and motor development, language development and cognition, and social and emotional development. Within the first domain, we specifically identified fine motor skills as having repeatedly been identified as predictors of later academic attainment in both reading, writing and mathematics (Cameron *et al.*, 2012; Dinehart & Manfra, 2013; Giles *et al.*, 2018; Grissmer *et al.*, 2010; Roebbers *et al.*, 2014). In addition to predicting later academic attainment, motor control difficulties in childhood are also noted to predict certain aspects of physical and mental health later in childhood (Kantomaa *et al.*, 2013; Lingam *et al.*, 2010, Lingam *et al.*, 2012) and into adulthood (Hill & Brown, 2013; Kirby *et al.*, 2013).

Within the language development and cognition domain, the development of early literacy and communication skills is a key area. The British Picture Vocabulary Scale (BPVS) measures receptive vocabulary. It has proven to be highly correlated with later literacy acquisition and is suitable for use with children aged 3 to 16 (Dunn *et al.*, 2009). The Letter Identification (Letter ID) sub-test of the Woodcock Reading Mastery Tests (WRMT-NU/R) was also used as a measure of children’s emerging literacy. Literacy skills are fundamental for success in education, employment and community participation and for higher levels of well-being (Clark, 2011; Dugdale & Clark, 2008; Marmot & Bell, 2012). Vocabulary during pre-school has also been shown to predict future writing ability (Dunsmuir & Blatchford, 2004).

The final domain chosen was social and emotional health. Children with good social skills experience better outcomes, including more positive peer relationships and better mental and physical health (Carneiro *et al.*, 2007), and data from the Avon Longitudinal Study of Parents and Children (ALSPAC) showed that difficulties such as defiant behaviour at 7 years old, were predictive of academic outcomes at 16 years old (Sayal *et al.*, 2015).

To summarise, the Starting Schools project was nested within the larger BiB longitudinal cohort study and aimed

¹It should be noted that a different version of the EYFSP was introduced in September 2012, with the previous incarnation involving 69 learning goals and a 119-point scale. This means that 705 children within the BiB cohort have EYFSP data stemming from the earlier version of the assessment, with the remainder of the cohort being assessed on the newer version.

to collect additional measurements of specific key domains predictive of later attainment and development. This goal was to link to the health and routine educational data already held (as well as data captured in the future) on these children, providing researchers with an enriched resource for examining longitudinal developmental trajectories, and potential avenues for improving educational attainment. We provide a description of the data collection process and the measures used, a brief overview of the process for harmonising these data with the existing BiB database, and a descriptive summary of the data collected.

Methods

Setting

Dates. Data collection for Starting School took place between September and July over two academic years (2012/13 and 2013/14).

Location. At the time of the Starting School study, the Bradford District (West Yorkshire) was the fifth largest metropolitan district in the UK (over half a million people), with nearly a quarter (23.5%) of residents aged under 16 years old (Office for National Statistics, 2013). Just over a quarter of the District's children were classified as living in poverty (Department for Communities and Local Government, 2011; Office for National Statistics, 2011). The largest proportion of Bradford District's population (63.9%) self-identified as White British. However, the District also had the largest proportion of people of Pakistani ethnic origin (20.3%) in England.

Participants

Schools

Eligibility

Starting School aimed to assess children in their Reception year (aged 4–5 years old) in schools where there were ≥ 10 children from the BiB cohort enrolled in reception class that academic year. In the UK, every child has a Unique Pupil Number (UPN) that identifies them at a national level and is allocated on the child's entry into the formal educational system (typically primary school). The number of BiB children in each school was identified via their UPN on the Bradford educational services database, with the UPN used to forge links between participants' cohort data and their routine educational data (e.g. EYFSP profile at the end of reception year). Of the 142 primary schools in Bradford in existence at the time of this study, 94 were identified as eligible for the project.

Method of recruitment

Schools were recruited by BiB researchers via individual letters and emails addressed to Head teachers. If no response was received, then telephone calls and personal visits to schools were made. Non-respondent schools were re-contacted on at least three occasions to maximise recruitment to the study. The Head teachers provided written, informed consent for the school to participate. Once consent was received, a date for the visit was arranged via the school office and/or Reception class teachers.

Children

Eligibility

All children in the identified schools who were in their Reception class of school either in September 2012 or September 2013 were eligible to take part in the fine motor and literacy assessments (not just children who were part of the BiB cohort). This was due to school preference, who as part of their participation in the study received the results from these assessments, therefore enabling them to enhance their identification of areas of support that might be needed by individuals.

Method of recruitment

Parents received an information sheet via the school that detailed the Starting School study and instructed them to inform their child's teacher if they did not wish their child to take part. A parental 'opt-out' approach to consent was adopted because of the high numbers of pupils targeted for recruitment ($>3,000$), the low risks of participation, and the increased risks of inadvertently excluding groups of children from homes where school-forms are typically not returned. Such homes are over-represented in ethnic minority and lower socio-economic groupings and thus more prevalent within this cohort because of Bradford's demographics (Cruise *et al.*, 2015; Goodman & Gatward, 2008). At the start of each testing day, assessors checked with class teachers for any child whose parent had not given consent to participate. Any child so identified was not included in the assessments. The researchers also obtained the assent of the children, i.e. the child's agreement (expressed verbally and/or behaviourally) to take part in the study before every assessment.

Ethical approval. Ethical approvals for this study were obtained from ethics committees at the University of Leeds (reference number 13-0220) and the University of York (reference number 12/26). Ethical approval for data linkage within the BiB cohort was obtained from the Bradford Leeds Research Ethics Committee (reference 07/H1302/112).

Measurements

Fine motor skills. To assess fine-motor control, an objective computerised assessment (Culmer *et al.*, 2009) was used: the Clinical-Kinematic Assessment Tool (CKAT). The CKAT battery assesses manual visuomotor Tracking, Aiming and Tracing performance and was presented on a tablet computer (Hewlett-Packard EliteBook 2760p tablet PC) that used a digital stylus for input. Flatters *et al.* (2014) provides a detailed description of the three subtests and the specific outcome measures that each test records.

Raw positional (X,Y) movement data were post-processed to produce the outcome measures for each task - providing quantitative measurements of various kinematic features of the participants' movements. For example, the temporal and spatial accuracy of movements, reaction times, movement times and smoothness of movement were all captured during the tracking task under conditions with different difficulty levels (see Flatters *et al.*, 2014 for details of outcome measures

used). At the end of each academic year, individual participant responses to each sub-test were standardised relative to the rest of the recorded response (to-date) using a z-scoring standardisation procedure. A mean average of the three standardised CKAT battery sub-test scores was then calculated to create an overall CKAT battery-score.

Literacy and communication. Two validated assessments, the British Picture Vocabulary Scale – Second Edition (BPVS II; [Dunn et al. \(1997\)](#)) and the Letter Identification (Letter ID) sub-test from the Woodcock Reading Mastery Tests – Revised-Normative Update battery (WMRT-R/NU; [Woodcock \(1998\)](#)), were used to determine the level of children’s language and emerging literacy skills. Letter ID was chosen from this battery as the most appropriate measure for children at 4 to 5 years of age ([Foulin, 2005](#)) due to the anticipated wide response variability in children of this age on this particular (brief) measure. Both assessments were delivered according to standard instructions, and the Letter ID always followed the BPVS. Responses were entered into a purpose-built Microsoft Access database interface on the same laptops used for the motor assessments, developed by researchers at the Institute for Effective Education at the University of York. A pop-up message advised researchers when performance ceilings were reached for each child (i.e. when to terminate assessments).

Social and emotional health. Data were collected on social and emotional health using the Strengths and Difficulties Questionnaire (SDQ). This is a widely used measure for children aged 3–16 years ([Goodman & Goodman, 2011](#); [Goodman et al., 2010](#)), is suitable for multicultural samples ([Goodman et al., 2000](#)), and can be completed by teachers (as in this study) or parents ([Johnson et al., 2014](#)).

Procedure

The Starting School data collection was carried out over two consecutive academic years (2012–13 and 2013–14). Once a school had agreed to participate and prior to the assessment team’s visit, they were asked to provide class lists including: children’s name; date of birth; UPN; home post code; gender; ethnicity; English as an additional language (Yes or No); first language. These data allowed the children to be identified for assessment within classes and were used to link the Starting Schools data collected to the wider BiB cohort database. These multiple data fields helped enable data entry errors to be resolved easily (e.g. if the UPN was missing or mis-entered then linkage could be made using other identifiable information). The data were housed securely and followed the robust data governance rules that protect all of the Born in Bradford studies (following the Bradford Teaching Hospitals Foundation Trust procedures).

The assessment team were trained by senior staff within the Born in Bradford (BiB) cohort study and the Universities of

York and Leeds on administration of the tasks. ‘Refresher’ training at the beginning of the second year of the study was mandatory.

Schools were asked to allocate a quiet room or area within the school to the research team (e.g. library), in which they could then conduct the assessments. Children were taken out of class two at a time, and each sat one-to-one with an assessor. Each assessor administered either the Fine motor or Communication and Literacy tasks, with children swapping between assessors so that both sets were completed by each child during the same session. Assessors explained task requirements to the child at the beginning of each assessment and checked their understanding. Assessments took approximately 20 to 30 minutes per child and each team of two researchers typically assessed between 15 and 20 children per school day.

In addition to this, teachers were asked to complete a Strengths and Difficulties Questionnaire (Teacher-report version) for each participating child in their class who was also part of the BiB cohort study. This was only completed after the child had been attending primary school for at least six months, as it is a requirement of the questionnaire that the adult completing it must know the child for this amount of time. Sufficient paper copies of the questionnaires were delivered in sealed envelopes to schools by the assessment team. Schools were asked to ring or email the researchers when questionnaires were ready for collection. If notification of completion wasn’t received, then schools were contacted via telephone or email. Completed questionnaires were handed back in sealed envelopes.

All data collection and storage procedures were conducted according to the guidelines set out in the Data Protection Act 1998 and followed those of the Bradford Teaching Hospitals Foundation Trusts guidelines. Transfer of data onto the secure central archive at the BiB research office was via encrypted devices (e.g. tablets, memory sticks) or encrypted emails.

Feedback to schools

The results of all the assessments were compiled for each child, and individual reports were delivered back to Reception class teachers, along with a covering four-page document to explain why the skills measured are developmentally important, how the children were assessed, what was measured, what the scores meant, and how they should be interpreted (this is available as *Extended data* ([Shire, 2020](#))). These feedback documents could then be used by schools, in conjunction with their own data, to consider where children might warrant further assessment or testing. Teachers were provided with information on where to find extra information and resources relating to supporting children’s development in these areas.

Dataset description

Recruitment

Schools. A total of 77 schools were recruited from the 94 Bradford primary schools that were approached to take part in the project (See [Table 1](#) for description of their demographics). Two schools declined the invitation and the remainder failed to return a decision about participating.

Children. Although all children in their Reception year of schooling at the recruited schools were eligible to take part, the data presented here only relates to the children who are part of the BiB cohort study. This is due to the focus on data linkage with the wider cohort dataset.

Very few parents chose to opt-out their children from the study (19 over the two years). The vast majority of children also consented to take part, with only 10 choosing not to participate when asked. In total, 3,444 children initially consented to participate.

Data collection

Over the two academic years, 120 school visits were made to assess children in 251 classes. Complete CKAT battery scores were collected successfully on 3,109 BiB children, BPVS and Letter ID were collected successfully on 3,292 and 3,258 children respectively, and SDQ data were collected successfully on 2,335 children. Performance outcomes for each measure, along with demographic information of recruited participants can be seen in [Table 2](#), and [Figure 1–Figure 4](#) show the distribution of scores on each of these outcomes (raw results available as *Extended data* ([Shire, 2020](#))).

Data cleaning and harmonisation

Complete data sets were obtained for 90% of the children who were assessed for fine motor skills, 97% for literacy and communication, and 78% for social and emotional health (SDQ). The reasons for data not being collected for

the fine motor and literacy and communication skills included non-compliance with task instructions, skipping the subtest during testing, or the child being unable to complete the task due to issues relating to SEN. The lower data acquisition rate for SDQ assessment was mainly due to teachers not completing the questionnaires.

Each dataset (CKAT, BPVS, Letter ID and SDQ) was cleaned and cross referenced against the remaining data sets to identify and resolve any inconsistencies before the separate data sets were linked. This raised a few issues with a small number of cases. These mainly resulted from the free text entry fields within the fine motor task, where researchers had to input school name, DOB, and UPN manually. This led to a small number of inaccuracies which were corrected via cross-referencing against class lists, the LEA database, and the main BiB cohort database. Once these issues had been resolved, a consolidated Starting Schools dataset was created by entering the UPN as a unique identifier against each piece of data-capture. This Starting Schools database was then harmonised with the existing BiB database.

Summary

The Starting School study described in this report was a nested study within the wider Born in Bradford project, and aimed to collect data on three specific domains of school readiness hypothesised to be predictive of later attainment and development: fine motor skills, literacy and communication, and social and emotional health.

The percentage of complete data sets for motor and literacy and communication data was high; while the percentage of SDQ data sets was lower due to non-completion by teachers the response rate was still more than tolerable (i.e. > 75%). The outcome measures were clearly defined and it can be seen that the data were reasonably well described by a Gaussian distribution.

Table 1. School characteristics (range of percentages of pupils).

	Single form entry (~30/year group) n=13	2 form entry (~60 per year group) n=48	3 form entry (~90/year group) n=16
SEN / SA+ (%)	0.4 – 14.5	0.8 – 17.0	3.1 – 13.1
English NOT first language (%)	2.8 – 96.2	1.7 – 97.3	6.2 – 95.8
FSM eligible (%)	2.8 – 60.2	6.1 – 61.5	17.6 – 37.4
Overall absences (%)	3.2 – 6.1	3.6 – 7.0	4.3 – 6.6
Expected progress in Reading KS2 (%)	73 – 100	67 – 100	61 – 97
Expected progress in Writing KS2 (%)	88 – 100	80 – 100	81 – 97

SEN, special educational needs; SA+, school action plus; FSM, free school meals; KS2, Key Stage 2.

Table 2. Performance outcomes by gender and ethnicity.

	Literacy and communication (mean (SD))		Fine motor skills (mean (SD))				Social and emotional health (mean (SD))
	BPVS	Letter ID	Tracking	Aiming	Tracing	Overall	SDQ Total Difficulties Score
Total sample (n=3,444)	100.74 (15.66) (n=3,292)	106.45 (12.60) (n=3,258)	31.41(13.66) (n=3,243)	2.81 (1.26) (n=3,235)	1.73 (1.55) (n=3,245)	-.03 (.68) (n=3,109)	5.69 (5.14) (n=2,335)
Gender							
Boys (n=1,763)	100.07 (16.14) (n=1,687)	104.91 (12.57) (n=1,668)	32.6 (13.9) (n=1,658)	2.90 (1.35) (n=1,652)	1.82 (1.61) (n=1,657)	.07 (.71) (n=1,578)	6.63 (5.39) (n=1,141)
Girls (n=1,681)	101.45 (15.10) (n=1,605)	108.07 (12.44) (n=1,590)	30.3 (13.3) (n=1,585)	2.71(1.16) (n=1,583)	1.64 (1.48) (n=1,588)	-.12 (.63) (n=1,531)	4.80 (4.72) (n=1,194)
Ethnicity							
Pakistani origin (n=1,863)	97.02 (14.62) (n=1,795)	105.69 (12.41) (n=1,764)	31.9 (13.7) (n=1,758)	2.94 (1.33) (n=1,753)	1.83 (1.38) (n=1,762)	.04 (.71) (n=1,749)	5.69 (5.26) (n=1,192)
White British (n=988)	107.32 (14.57) (n=933)	107.06 (12.27) (n=936)	30.6 (13.1) (n=932)	2.61(1.11) (n=931)	1.59 (1.25) (n=932)	-.12 (.63) (n=929)	5.77 (5.02) (n=755)
Other (n=581)	101.82 (16.96) (n=552)	107.71 (13.58) (n=547)	31.3 (13.7) (n=542)	2.65(1.22) (n=540)	1.63 (1.38) (n=540)	-.11 (.68) (n=538)	5.58 (5.03) (n=380)

Means and standard deviations (SD) for each outcome measure, for whole sample and split by gender and ethnicity. Only cases where complete data is available are included. Literacy and communication outcomes given are British Picture Vocabulary Scale (BPVS) standardised score, Letter Identification (Letter ID) standardised score. Fine motor skills outcome measures are all absolute values of the median score. Tracking = Root Mean Square Error; Aiming = Movement Time; Tracing = penalised path accuracy (pPA). Details of these measures can be found in [Flatters et al. \(2014\)](#). The Overall Score is an average of these 3 median values and is scaled and centred. The social and emotional health outcome given is the Strengths and Difficulties Questionnaire (SDQ) Total Difficulties Score

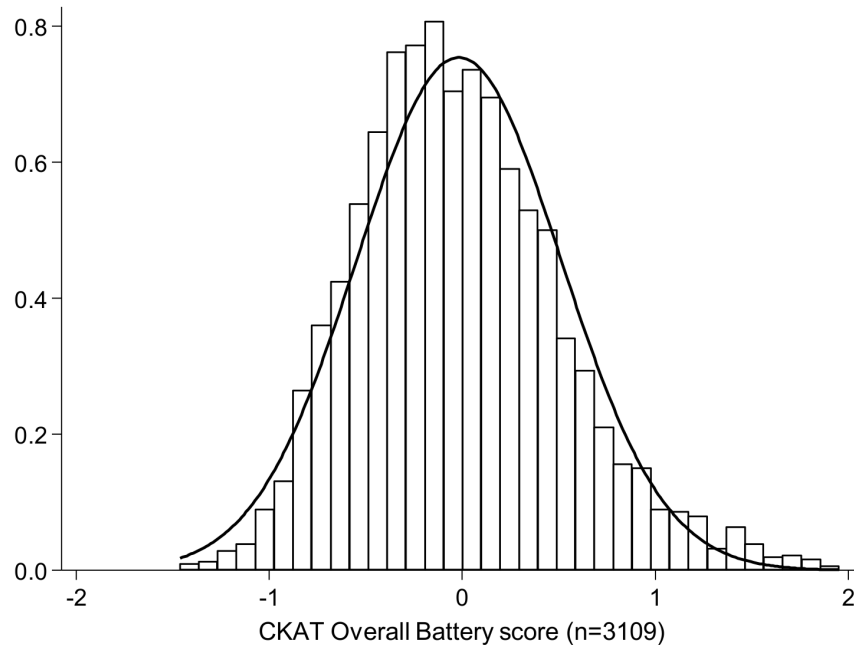


Figure 1. Histogram with normal distribution curve for CKAT Overall Battery Score. Overall CKAT battery score an average of the 3 z-score standardised sub-test performances.

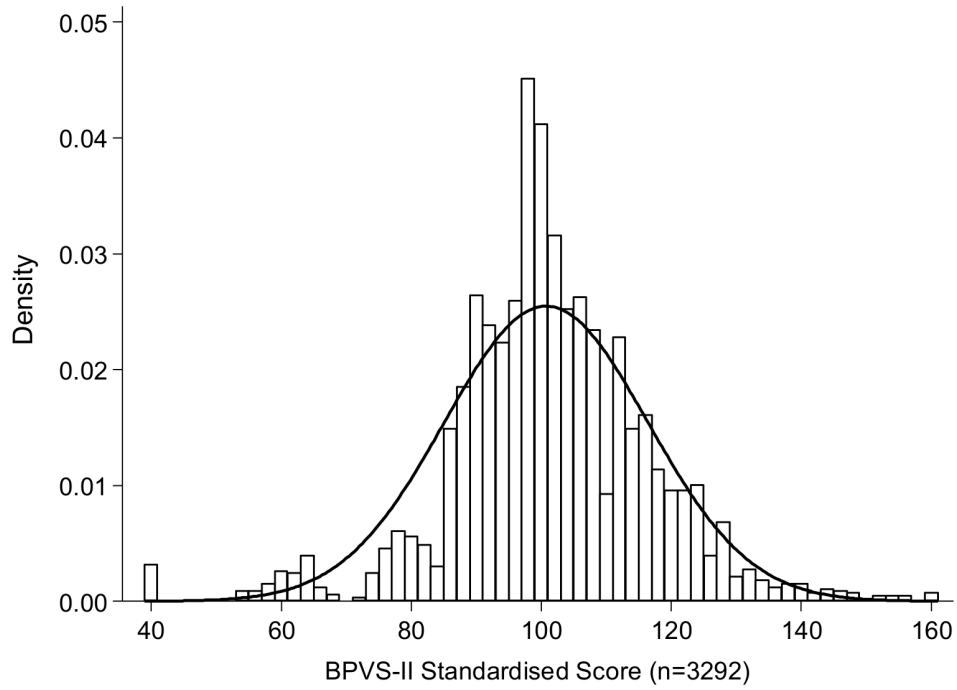


Figure 2. Histogram with normal distribution curve for BPVS-II standardised score. Standardised score is normed for age with a mean of 100 and range of (39 to 161).

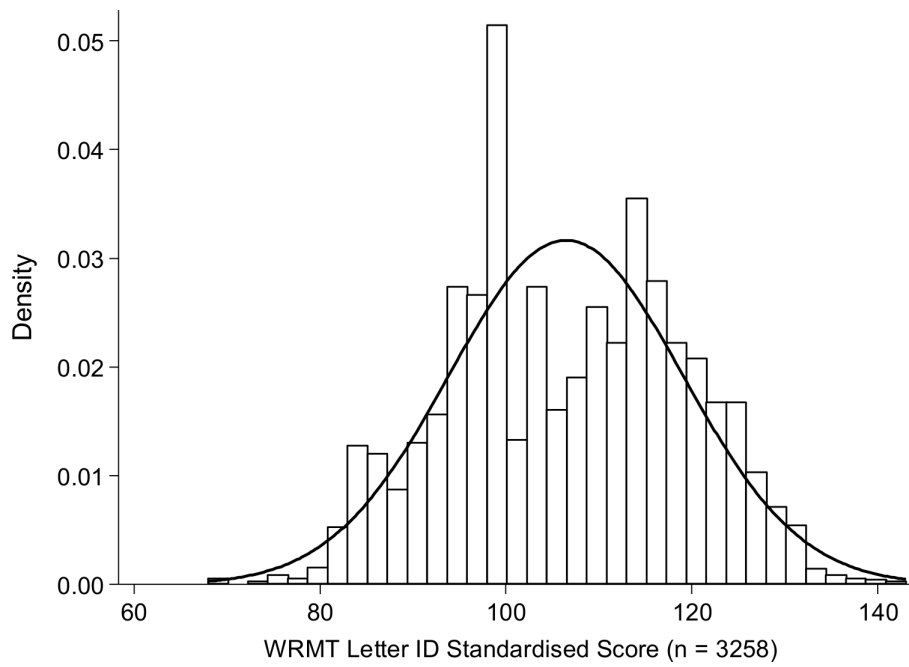


Figure 3. Histogram with normal distribution curve for Letter ID subtest standardised score. Standardised score is normed for age with a mean of 100 and range of (68 to 143).

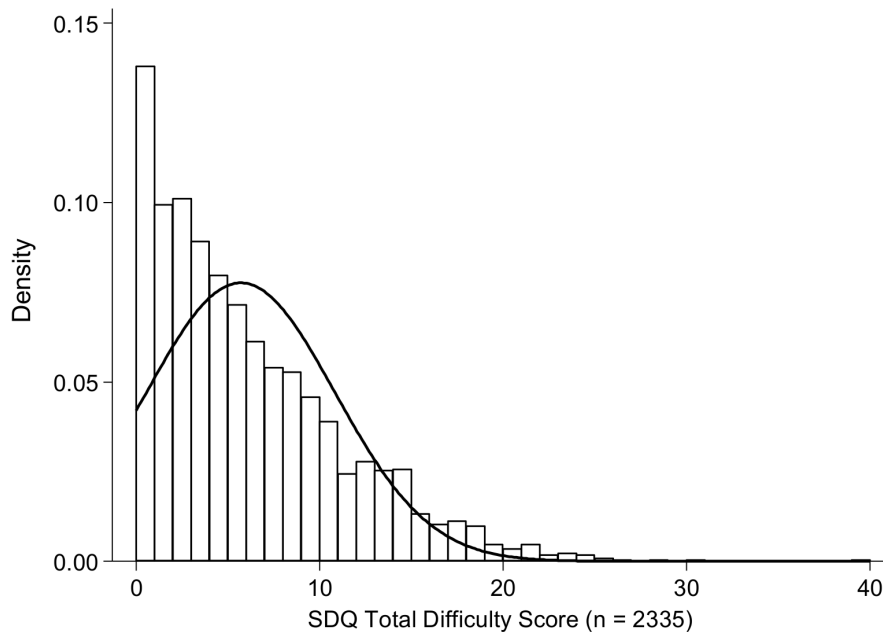


Figure 4. Histogram with normal distribution curve for SDQ Total Difficulty Score. Score can range from 0 to 40.

The Total Difficulties Score for the SDQ (social and emotional health) did not exhibit a normal distribution, but the range of scores was in line with previous distributions on this measure. The majority of the BiB children with available data appeared to have adequate social and emotional development at the time of testing (a total difficulty score of 14 to 16 indicates only slightly raised levels of difficulty). Nevertheless, a number of children were doing less well (Total Difficulty Score between 17 and 19 suggests a high level of difficulty, and a score above 19 indicates serious difficulties).

The data collected as part of Starting School is linked with the wider BiB database, and thus it provides a key set of information about approximately 3000 children in the cohort (N dependent on specific measure) at a particularly important stage of their lives. It is hoped that this information will be used to identify ways of better screening for difficulties early on in a child's education, promoting more effective provision of intervention and support earlier - given the importance of early intervention for any developmental and learning difficulties experienced by children. For example, this dataset has been utilised to examine the impact of visual acuity on developing literacy (Bruce *et al.*, 2016).

Full details of this dataset, along with instructions for how to access this data (along with other data kept on the BiB cohort) can be found at <https://borninbradford.nhs.uk/research/documents-data/>.

Data availability

Underlying data

Scientists are encouraged and able to use BiB data, which are available through a system of managed open access.

The steps below describe how to apply for access to BiB data.

- Before you contact BiB, please make sure you have read our [Guidance for Collaborators](#). Our BiB executive review proposals on a monthly basis and we will endeavour to respond to your request as soon as possible. You can find out about the different datasets which are available [here](#) (the datasets described in this article can be found in [the Born in Bradford Data Dictionary](#)). If you are unsure if we have the data that you need please contact a member of the BiB team (borninbradford@bthft.nhs.uk).
- Once you have formulated your request please complete the 'Expression of Interest' form available [here](#) and send to the BiB Programme Director (rosie.mceachan@bthft.nhs.uk).
- If your request is approved we will ask you to sign a [collaboration agreement](#); if your request involves biological samples we will ask you to complete a [material transfer agreement](#).

Extended data

Open Science Framework: Starting School: a large-scale start of school assessment within the 'Born in Bradford' longitudinal cohort. <https://doi.org/10.17605/OSF.IO/JEY5H> (Shire, 2020).

This project contains the following extended data:

- Starting School data for histograms (data used to generate histograms in [Figure 1–Figure 4](#)).
- Starting School Feedback document for teachers.

Extended data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

Acknowledgements

Our thanks to all the children (and parents), teachers and school staff who were involved in the research. Thanks also to the

Born in Bradford (BiB) Research Assistants for data collection and to Louise Elliott, at the York Trials Unit, University of York for developing the Microsoft Access database interface for collecting and calculating receptive vocabulary assessment scores. Born in Bradford is only possible because of the enthusiasm and commitment of the Children and Parents in BiB. We are grateful to all the participants, teachers, school staff, health professionals and researchers who have made Born in Bradford happen.

References

- Bousquet J, Anto J, Auffray C, *et al.*: **MeDALL (Mechanisms of the Development of ALLergy): an integrated approach from phenotypes to systems medicine.** *Allergy*. 2011; **66**(5): 596–604.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Bruce A, Fairley L, Chambers B, *et al.*: **Impact of visual acuity on developing literacy at age 4-5 years: a cohort-nested cross-sectional study.** *BMJ Open*. 2016; **6**(2): e010434.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Bryant M, Santorelli G, Fairley L, *et al.*: **Design and characteristics of a new birth cohort, to study the early origins and ethnic variation of childhood obesity: the BiB1000 study.** *Longit Life Course Stud*. 2013; **4**(2): 119–135.
[Publisher Full Text](#)
- Cameron CE, Brock LL, Murrah WM, *et al.*: **Fine motor skills and executive function both contribute to kindergarten achievement.** *Child Dev*. 2012; **83**(4): 1229–1244.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Carneiro P, Crawford C, Goodman A: **The Impact of Early Cognitive and Non-Cognitive Skills on Later Outcomes.** 2007.
[Reference Source](#)
- Clark C: **Setting the Baseline: The National Literacy Trust’s first annual survey into reading - 2010.** London. 2011.
[Reference Source](#)
- Cruise SM, Patterson L, Cardwell CR, *et al.*: **Large panel-survey data demonstrated country-level and ethnic minority variation in consent for health record linkage.** *J Clin Epidemiol*. 2015; **68**(6): 684–692.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Culmer PR, Levesley MC, Mon-Williams M, *et al.*: **A new tool for assessing human movement: the Kinematic Assessment Tool.** *J Neurosci Methods*. 2009; **184**(1): 184–192.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Department for Communities and Local Government: **English indices of deprivation 2010.** 2011.
[Reference Source](#)
- Department for Education: **Early Years Foundation Stage Profile 2013 Handbook.** London, UK. 2012.
[Reference Source](#)
- Department for Education: **Early Years Foundation Stage Profile 2014 Handbook.** London, UK. 2013.
[Reference Source](#)
- Dinehart LH, Manfra L: **Associations Between Low-Income Children’s Fine Motor Skills in Preschool and Academic Performance in Second Grade.** *Early Education & Development*. 2013; **24**(2): 138–161.
[Publisher Full Text](#)
- Dugdale G, Clark C: **Literacy changes lives: An advocacy resource.** London. 2008.
[Reference Source](#)
- Dunn LM, Dunn DM, Styles B: **British Picture Vocabulary Scale (3rd ed.).** London: GS Assessment. 2009.
[Reference Source](#)
- Dunn LM, Dunn LM, Whetton C, *et al.*: **The British Picture Vocabulary Scale, Second Edition.** Windsor: NFER-Nelson. 1997.
[Reference Source](#)
- Dunsmuir S, Blatchford P: **Predictors of writing competence in 4- to 7-year-old children.** *Br J Educ Psychol*. 2004; **74**(Pt 3): 461–483.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Flatters I, Mushtaq F, Hill LJ, *et al.*: **Children’s head movements and postural stability as a function of task.** *Exp Brain Res*. 2014; **232**(6): 1953–1970.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Foulin JN: **Why is letter-name knowledge such a good predictor of learning to read?** *Reading and Writing*. 2005; **18**(2): 129–155.
[Publisher Full Text](#)
- Giles OT, Shire KA, Hill LJB, *et al.*: **Hitting the Target: Mathematical Attainment in Children Is Related to Interceptive-Timing Ability.** *Psychol Sci*. 2018; **29**(8): 1334–1345.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Goodman A, Gatward R: **Who are we missing? Area deprivation and survey participation.** *Eur J Epidemiol*. 2008; **23**(6): 379–387.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Goodman A, Goodman R: **Population mean scores predict child mental disorder rates: validating SDQ prevalence estimators in Britain.** *J Child Psychol Psychiatry*. 2011; **52**(1): 100–108.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Goodman A, Lamping DL, Ploubidis GB: **When to use broader internalising and externalising subscales instead of the hypothesised five subscales on the Strengths and Difficulties Questionnaire (SDQ): data from British parents, teachers and children.** *J Abnorm Child Psychol*. 2010; **38**(8): 1179–1191.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Goodman R, Ford T, Simmons H, *et al.*: **Using the Strengths and Difficulties Questionnaire (SDQ) to screen for child psychiatric disorders in a community sample.** *Br J Psychiatry*. 2000; **177**(6): 534–539.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Grissmer D, Grimm KJ, Aiyer SM, *et al.*: **Fine motor skills and early comprehension of the world: two new school readiness indicators.** *Dev Psychol*. 2010; **46**(5): 1008–1017.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Hill EL, Brown D: **Mood impairments in adults previously diagnosed with developmental coordination disorder.** *J Ment Health*. 2013; **22**(4): 334–340.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Johnson S, Hollis C, Marlow N, *et al.*: **Screening for childhood mental health disorders using the Strengths and Difficulties Questionnaire: the validity of multi-informant reports.** *Dev Med Child Neurol*. 2014; **56**(5): 453–459.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Kantomaa MT, Stamatakis E, Kankaanpää A, *et al.*: **Physical activity and obesity mediate the association between childhood motor function and adolescents’ academic achievement.** *Proc Natl Acad Sci U S A*. 2013; **110**(5): 1917–1922.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Kirby A, Williams N, Thomas M, *et al.*: **Self-reported mood, general health, wellbeing and employment status in adults with suspected DCD.** *Res Dev Disabil*. 2013; **34**(4): 1357–1364.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Lingam R, Golding J, Jongmans MJ, *et al.*: **The association between developmental coordination disorder and other developmental traits.** *Pediatrics*. 2010; **126**(5): e1109–e1118.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Lingam R, Jongmans MJ, Ellis M, *et al.*: **Mental health difficulties in children with developmental coordination disorder.** *Pediatrics*. 2012; **129**(4): e882–e891.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Marmot M, Bell R: **Fair society, healthy lives.** *Public Health*. 2012; **126**(Suppl 1): S4–S10.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Office for National Statistics: **Index of Multiple Deprivation 2010.** 2011; Newport.
- Office for National Statistics: **2011 Census: Key Statistics and Quick Statistics for Local Authorities in the United Kingdom.** 2013.
[Reference Source](#)
- Pembrey L, Raynor P, Griffiths P, *et al.*: **Seroprevalence of cytomegalovirus, Epstein Barr virus and varicella zoster virus among pregnant women in Bradford: a cohort study.** *PLoS One*. 2013; **8**(11): e81881.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Roebbers CM, Röthlisberger M, Neuwenschwander R, *et al.*: **The relation between cognitive and motor performance and their relevance for children’s transition to school: a latent variable approach.** *Hum Mov Sci*. 2014; **33**: 284–297.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Sayal K, Washbrook E, Propper C: **Childhood behavior problems and academic**

outcomes in adolescence: longitudinal population-based study. *J Am Acad Child Adolesc Psychiatry.* 2015; 54(5): 360–368.e2.

[PubMed Abstract](#) | [Publisher Full Text](#)

Shire K: **Starting School: a large-scale start of school assessment within the 'Born in Bradford' longitudinal cohort.** 2020.

[Publisher Full Text](#)

United Nations Children's Fund: **School Readiness: A Conceptual Framework.**

2012; New York, USA.

[Reference Source](#)

Woodcock RW: **Letter Identification from the Woodcock Reading Mastery Tests – Revised (WMRT-R).** 1998.

Wright J, Small N, Raynor P, *et al.*: **Cohort Profile: the Born in Bradford multi-ethnic family cohort study.** *Int J Epidemiol.* 2013; 42(4): 978–991.

[PubMed Abstract](#) | [Publisher Full Text](#)

Open Peer Review

Current Peer Review Status: ? ✓


Version 1

Reviewer Report 15 May 2020

<https://doi.org/10.21956/wellcomeopenres.17100.r38183>

© 2020 Barr R. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



Rachel F. Barr 

Department of Psychology, Georgetown University, Washington, DC, USA

The report presents data from a subset of Born in Bradford sample of children collected at the time of school entry. The authors report measures of motor behavior, communication and socio-emotional development. The datasets for the first two domains are quite complete but the socio-emotional dataset is less complete. It was also a teacher report while the other two domains were direct child measures.

There are a number of very positive aspects to this report. This is a rich dataset that has been organized to optimize widespread sharing which will be important for the field. In addition the sample is diverse. Both the language and fine motor skills are fairly normally distributed which is another important feature meaning that these data are likely to provide good predictions of future child outcomes. But the socio-emotional dataset is skewed and based on teacher report.

The fine motor skills tasks are innovative and the creation of the composite score for fine motor skills fills a gap in the literature. Prior large scale longitudinal studies have included quite coarse measures of fine motor skills. These coarse measures nonetheless were predictive of later outcomes. The more fine grained measure here is therefore likely to be a useful tool for examining the role of fine motor skills and child outcomes.

There were a few elements that were unclear to me. Table 1 was very confusing and it was unclear to me how well special education populations were represented in the dataset and if these data could be subsetted for children with special needs. Given that the authors argued that these data would serve as important predictors of future outcomes, it would be useful to know if there was concurrent predictive validity in the dataset. In addition more information describing Table 1 should be provided in the text.

I think limitations of the strengths and difficulties teachers report data should also be mentioned in the discussion. Although there was a 75% response rate it is unclear where the most difficult cases were not completed due to the skew or whether the sample actually was an accurate depiction of the socio-emotional health of children in the reception classes.

I also read the other review and the other reviewer's points seem relevant but to avoid redundancy I will not repeat here.

Is the rationale for creating the dataset(s) clearly described?

Yes

Are the protocols appropriate and is the work technically sound?

Yes

Are sufficient details of methods and materials provided to allow replication by others?

Yes

Are the datasets clearly presented in a useable and accessible format?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Developmental psychology: learning and memory during early childhood.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 15 April 2020

<https://doi.org/10.21956/wellcomeopenres.17100.r38218>

© 2020 Holmes N. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



Nicholas P. Holmes 

School of Psychology, University of Nottingham, Nottingham, UK

Shire and colleagues describe the 'Starting School' study of several thousand children, which builds on the large 'Born in Bradford' cohort study of nearly 14 thousand children. This is a protocol report describing the methods and available datasets. It refers to additional reports for details on specific methods, which it is not possible to do here.

I have no major concerns with the article. I have not reviewed this form of article before, and am a little unsure whether it is meant to serve as some form of 'pre-registration' for use by the authors or their collaborators, or is entirely for the purpose of data-sharing with the wider community. Either or both purposes are good, but I would ask the authors to state the purpose of the report more explicitly. The last sentence of introduction and last two of the abstract are clear about what the report does, but I think we need something to say what the longer-term purpose is.

The only substantive comment (i.e., consideration of which is required to make the article

'technically sound') I have about the data is/are in the assessment of the 'normality' of the datasets, as shown in Figures 1-4. The authors have not reported any particular tests, but do conclude that only Figure 4 shows non-normally-distributed data. Now, the authors have such large datasets, that any 'statistical' test of normality is very likely to show 'significant' departure from normality (e.g., Kolmogorov-Smirnov, K-S, tests), even when the deviations are only small - as in Figure 1.

My colleague Blandine French and I tackled this sort of issue for developmental assessments recently (French *et al.* 2018)¹. In that article, we used three methods to assess 'normality': 1) K-S (or Shapiro-Wilk for small samples <50), 2) skew (values around 0 are good, values above |1| are bad), and 3) Chi-Square goodness-of-fit, which used discretised (binned) expected counts under the normal distribution to match the possible bins actually in the dataset.

I would suggest the authors use at least one (ideally all 3, for completeness and comparison) measure to assess whether the data are normal or not. Again: given the sample size, even very small deviations will be 'statistically significant' in tests 1 and 3 - but the skew value should help the authors to interpret these. We interpreted skew > 1 to be non-normal. The SE of the skew value depends only on sample size, so provides no additional information to that reported.

The authors could/should also perform or suggest to readers or users of the data how to transform or further normalise the data, if that is required. I would suggest, e.g., that the data in Fig 4 should be log-transformed before use. That may be against the SDQ instructions(!), but at least the authors could point out the problems found in their large dataset.

Signed: Nick Holmes (I sign all my reviews).

Minor

The following are all either further details on the above comments, or very minor typos/language suggestions.

General

- Probably too many Capitalised Words - try to reduce where they are not proper nouns, (e.g., for published or commercial test names is OK, but not for, e.g., 'Reception')

Introduction

P3 (of 11)

- 'factors ... covers' - plurals?
- 'having repeatedly being identified' - awkward.
- same sentence as above - remove 'both'?
- 'aged 3 to 16' - add 'years'.
- 'education, employment and community participation and' - not clear if 'employment' is to be read as 'employment participation' - need more commas?

Methods

P4

- 'This was due to school preference...' - this sentence is long and complex, perhaps rewrite.

- 'whose parent had not given consent' - more accurate to say: 'had not opted-out' or 'had not withdrawn their consent'.
- 'visuomotor Tracking, Aiming and Tracing' - why the capitals?
- 'Flatters *et al.* (2014) provides' - 'provide'.

P5

- (procedure) 'BiB... Born in Bradford' - once an acronym has been defined, use it consistently (see, e.g., next paragraph), OK to re-use full words in Summaries.
- 'Fine motor or Communication and Literacy' - a previous paragraph was 'Literacy and communication' - use key terms consistently (and ideally without Capitals).
- 'ring or email' - 'telephone or email' - 'ring' is ambiguous in the context of paper questionnaires!

P6

- 'See Table 1' - 'see'.
- 'children also consented' - 'assented' - again later in paragraph.
- 'due to issues relating to SEN' - not clear. SEN has also not been defined. What are implications of some children with SEN being less-likely to have data included?
- 'Each dataset... was cleaned' - what does this mean? 'Cleaning' could hide a multitude of data sins - does it cover just what is described in this paragraph? Please describe briefly. Has the cleaning process been published/reviewed?
- 'more than tolerable (i.e. > 75%)' - better to just say 'over 75%' - the reader can decide whether the (very large) remaining datasets are tolerable or not.
- 'it can be seen that the data were reasonably well described by a Gaussian distribution.' - where? Figs 1-3? Please be more explicit. How was normality assessed? (I do not mind if the 'normality' tests like K-S are significant here, at least for Figs 1-3 - they are not very powerful tests and are likely to show significant results with very large samples, like all stats tests). Figs 2-4 would probably not pass a K-S test, I am quite sure, and even Fig 1 may not (very minor deviations with very large sample size = 'significantly non-normal')

P7-9

- Table 2: numbers and percentages are all given to 2 decimal places, which is not ideal. 3 significant (i.e. important) figures may be better, e.g., not 100.74% but 101%, not 31.41 but 31.4, not -.03, but -0.03 [in the last case, the two leading zeros are 'significant' because the expected value here is 0.00. By switching from 2 d.p. to 3 s.f. the authors will provide similar precision across different measures on different scales.
- Fig 1: y-axis label missing - 'Proportion of sample' might be better than 'Density'.
- Fig1-4 x-axis labels: add comma as thousands separator to match rest of text (and check rest of text, e.g. '3000' on p9).

- Fig 4 - do these data need log-transforming before fitting a normal curve? This will greatly reduce the skew, but the data will still show these floor/ceiling effects (see, e.g., French *et al.* 2018).

P9

- 'utilised' - change to 'used'.

References

1. French B, Sycamore NJ, McGlashan HL, Blanchard CCV, et al.: Ceiling effects in the Movement Assessment Battery for Children-2 (MABC-2) suggest that non-parametric scoring methods are required. *PLoS One*. 2018; **13** (6): e0198426 [PubMed Abstract](#) | [Publisher Full Text](#)

Is the rationale for creating the dataset(s) clearly described?

Yes

Are the protocols appropriate and is the work technically sound?

Partly

Are sufficient details of methods and materials provided to allow replication by others?

Yes

Are the datasets clearly presented in a useable and accessible format?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Motor control, touch perception, developmental (childhood and ageing) research on movement and touch, brain stimulation (TMS).

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
