



# City Research Online

## City St George's, University of London

**Citation:** Crane, L., Sumner, E. & Hill, E. L. (2017). Emotional and behavioural problems in children with Developmental Coordination Disorder: Exploring parent and teacher reports. *Research In Developmental Disabilities*, 70, pp. 67-74. doi: 10.1016/j.ridd.2017.08.001

This is the published version of the paper.

This version of the publication may differ from the final published version. To cite this item please consult the publisher's version.

**Permanent repository link:** <https://openaccess.city.ac.uk/id/eprint/29060/>

**Link to published version:** <https://doi.org/10.1016/j.ridd.2017.08.001>

**Copyright and Reuse:** Copyright and Moral Rights remain with the author(s) and/or copyright holders. Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge, unless otherwise indicated, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way. For full details of reuse please refer to [City Research Online policy](#).

Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

# Research in Developmental Disabilities

journal homepage: [www.elsevier.com/locate/redevdis](http://www.elsevier.com/locate/redevdis)

## Emotional and behavioural problems in children with Developmental Coordination Disorder: Exploring parent and teacher reports



Laura Crane<sup>a,b</sup>, Emma Sumner<sup>b,\*</sup>, Elisabeth L. Hill<sup>a</sup>

<sup>a</sup> Department of Psychology, Goldsmiths, University of London, United Kingdom

<sup>b</sup> Department of Psychology and Human Development, UCL Institute of Education, United Kingdom

### ARTICLE INFO

Number of reviews completed is 2

#### Keywords:

Developmental Coordination Disorder (DCD)  
Strengths and Difficulties Questionnaire (SDQ)  
Motor impairment  
Hyperactivity  
Emotional symptoms

### ABSTRACT

**Background:** Although characterised by motor impairments, children with Developmental Coordination Disorder (DCD) also show high rates of psychopathology (anxiety, depression, low self-esteem). Such findings have led to calls for the screening of mental health problems in this group.

**Aims:** To investigate patterns and profiles of emotional and behavioural problems in children with and without DCD, using the Strengths and Difficulties Questionnaire (SDQ).

**Methods and procedures:** Teachers and parents completed SDQs for 30 children with DCD (7–10 years). Teacher ratings on the SDQ were also obtained from two typically-developing (TD) groups: 35 children matched for chronological age, and 29 younger children (4–7 years) matched by motor ability.

**Outcomes and results:** Group and individual analyses compared parent and teacher SDQ scores for children with DCD. Teacher reports showed that children with DCD displayed higher rates of emotional and behavioural problems (overall, and on each subscale of the SDQ) relative to their TD peers. No differences were observed between the two TD groups. Inspection of individual data points highlighted variability in the SDQ scores of the DCD group (across both teacher and parent ratings), with suggestions of elevated hyperactivity but comparably lower levels of conduct problems across this sample. Modest agreement was found between teacher and parent ratings of children with DCD on the SDQ.

**Conclusions and implications:** There is a need to monitor levels of emotional and behavioural problems in children with DCD, from multiple informants.

### What this paper adds

In this study, we present a detailed investigation of emotional and behavioural problems in children with Developmental Coordination Disorder (DCD), using parent- and/or teacher-report versions of the Strengths and Difficulties Questionnaire (SDQ). We used both group and individual analysis, which enabled us to compare teacher-ratings of children with DCD to typically developing children (those who were matched for age, as well as younger children matched for motor ability), and to each other. Results demonstrated that there was variability in the SDQ scores of DCD children (across both parents and teacher ratings), but also some

\* Corresponding author at: Department of Psychology and Human Development, UCL Institute of Education, University College London, 25 Woburn Square, London WC1H 0AA, United Kingdom.

E-mail address: [e.sumner@ucl.ac.uk](mailto:e.sumner@ucl.ac.uk) (E. Sumner).

<http://dx.doi.org/10.1016/j.ridd.2017.08.001>

Received 27 February 2017; Received in revised form 28 July 2017; Accepted 1 August 2017

Available online 12 September 2017

0891-4222/ © 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

broad patterns; for example, individually, children with DCD tended to show high levels of hyperactivity, but comparably lower levels of conduct problems. For children with DCD, levels of agreement between parent and teacher ratings on the SDQ were modest. This suggests that information on emotional and behavioural problems in DCD should be collected from multiple informants.

## 1. Introduction

Developmental Coordination Disorder (DCD, sometimes referred to as dyspraxia) affects between 2 and 6% of children (American Psychiatric Association [APA], 2013; Lingam, Hunt, Golding, Jongmans, & Emond, 2009) and is characterised by motor skills that are significantly below age-expected levels, persisting despite opportunities to acquire and develop these skills. These motor impairments must: have a significant impact on activities of daily living and academic achievement; occur early in development; and not be better accounted for by an alternative explanation (e.g., general medical conditions, intellectual disabilities, visual impairments) (APA, 2013).

There are several reasons why children with DCD may present with emotional and behavioural difficulties. Despite being of average or above average intelligence (APA, 2013; Sumner, Pratt, & Hill, 2016), children with DCD often experience problems with school-related tasks (e.g., handwriting, organising their workload, completing tasks on time) (Zwicker, Missiuna, Harris, & Boyd, 2012). DCD also negatively affects leisure participation (Zwicker et al., 2012), meaning that children may become less likely to engage in group activities with peers (Chen & Cohn, 2003), potentially leading to social isolation and loneliness (Missiuna, Moll, King, Stewart, & MacDonald, 2008; Poulsen, Ziviani, Cuskelly, & Smith, 2007). Further, high rates of psychopathology – including anxiety (Pratt & Hill, 2011) as well as depression and low self-esteem (Lingam et al., 2012; Piek et al., 2007) – have been reported in children with DCD. DCD also commonly co-occurs with other conditions, such as attention-deficit-hyperactivity disorder (ADHD), which is often associated with emotional and behavioural problems (Missiuna et al., 2014).

There have been calls for the screening of mental health problems in children with DCD (Rigoli & Piek, 2016), with the Strengths and Difficulties Questionnaire (Goodman, 1997) being suggested as a suitable tool for assessing possible psychosocial problems; both generally (Goodman, Ford, Simmons, Gatward, & Meltzer, 2000) and in the DCD population (Rigoli & Piek, 2016). Using the parent-report version of the SDQ in a sample of 47 children with DCD, Green, Baird, and Sugden (2006) found that 62% of children with DCD showed ‘clinical’ levels of emotional and behavioural difficulties (13% = ‘borderline’, 15% = ‘normal’).<sup>1</sup> Further, 85% of the sample showed ‘significant’ problems in at least one of the five SDQ subscales (Emotional symptoms, Conduct problems, Hyperactivity, Peer problems, Prosocial behaviours). Using the teacher-report version of the SDQ, Van den Heuvel, Jansen, Reijneveld, Flapper, and Smits-Engelsman (2016) reported children with DCD ( $n = 23$ ) to have significantly greater emotional and behavioural problems than typically developing (TD) (chronological age matched) children. However, the proportion of children showing ‘clinical’ levels of the Total difficulties scores (36%) was much lower than the 62% reported by Green et al. (2006). Indeed, mean scores across all subscales of the SDQ were lower in Van den Heuvel et al.’s (2016) sample, relative to Green et al.’s (2006) sample. This could be due to Green et al. (2006) recruiting their sample from a clinic, whereas Van den Heuvel et al. (2016) recruited their sample by screening large numbers of children and identifying those with significant motor impairments (from a community-based school sample). Alternatively, it could be due to the studies differing in their use of parent- versus teacher-report, with teachers potentially rating the children’s difficulties as less severe. This may be because teachers are less familiar with each child’s capabilities (relative to the parents), therefore underestimating the child’s difficulties. Or, it could be because teachers have a greater understanding of what typical performance is (due to working with a large range of children) and are, therefore, less likely to overestimate any difficulties. Indeed, a review of the psychometric properties of the SDQ highlighted only modest agreement between parent- and teacher-reported scores on the SDQ (Stone, Otten, Engels, Vermulst, & Janssens, 2010).

The aim of the current investigation was to explore emotional and behavioural difficulties using the SDQ in a sample of children with a confirmed clinical diagnosis of DCD. First, we sought to confirm previous reports of high levels of emotional and behavioural difficulties amongst children with DCD by comparing teacher SDQ ratings of children with DCD to two groups of TD children: (1) a group matched by chronological age (hereafter ‘CA’ group); and (2) a group matched based on motor ability (motor-match, hereafter ‘MM’ group). The latter group was comparable to the DCD group in terms of performance on a motor task but was, inevitably, younger than the DCD group. Comparisons between these two groups provide an indication of whether the observed profile of children with DCD reflects a level of immaturity, to some extent. The second aim, focusing on the DCD group only, was to investigate levels of agreement between parent- and teacher-report on the SDQ (unfortunately, we were not able to collect parent-reported SDQ data from the TD children, to also explore this comparison in the CA and MM groups). A meta-analysis comprising 14,811 children between the ages of 3–17 years (from a range of typical and clinical populations), reported correlations between parent and teacher SDQ ratings to be between 0.26 and 0.47 (Stone et al., 2010). As such, only “modest” agreement was predicted in the current study. However, adopting group and individual analyses to explore this research question allowed more detailed analyses than has been undertaken in previous research. Further, it enabled us to explore individual profiles of emotional and behavioural problems across the DCD group.

<sup>1</sup> Note: these figures only add up to 90%, as reported in the Green et al. (2006) paper.

**Table 1**  
Demographics of the DCD, CA and MM groups.

	Group			Group differences
	DCD (n = 30)	CA (n = 35)	MM (n = 29)	
Age in years	8.61 (1.16)	9.12 (.96)	6.19 (.65)	$H(2) = 61.29, p < 0.001$ DCD = CA > MM
FSIQ standard score	96.43 (13.14)	110.23 (10.13)	109.34 (11.82)	$F(2,91) = 13.48, p < 0.001$ MM = CA > DCD
MABC-2 percentile	3.48 (4.82)	64.80 (22.08)	45.21 (19.73)	$H(2) = 66.41, p < 0.001$ DCD < MM < CA
Maternal education	5.14 (1.19) <sup>a</sup>	4.86 (1.46)	4.86 (1.36) <sup>a</sup>	$F(2,90) = 0.77, p = 0.65$
Paternal education	4.86 (1.55) <sup>a</sup>	5.18 (1.31) <sup>b</sup>	4.86 (1.46)	$F(2,88) = 1.08, p = 0.60$

Note: Parental education was scored based on the education system on a scale from 1 (no qualifications) to 7 (qualified to doctoral level). Scores of 4 and 5 represent further education and degree level status, respectively.

<sup>a</sup> = one missing data point.

<sup>b</sup> = two missing data points.

## 2. Method

### 2.1. Participants

As part of a broader study exploring the cognitive and behavioural profiles of children with DCD (see Sumner, Hutton, Kuhn, & Hill, 2016; Sumner, Leonard, & Hill, 2016), 30 children with a diagnosis of DCD (21 boys, 9 girls, all aged 7–10 years) were recruited through primary schools, as well as advertisements via a charitable organization (the Dyspraxia Foundation, UK). Prior to taking part in the study (and independent of the research study itself), children had received a diagnosis of DCD from a multi-disciplinary team of clinicians who were external to the research team. The second edition of the Movement Assessment Battery for Children (MABC-2; Henderson, Sugden, & Barnett, 2007) was used to confirm a DCD diagnosis, and all children scored at or below the 16th percentile on this measure. Additionally, on an initially screening questionnaire, parents confirmed that there was no history of additional diagnoses or medical conditions that might explain the child's motor difficulties.

The CA group comprised 35 children (26 boys, 9 girls, aged 7–10 years), whilst the MM group comprised 29 children (19 boys, 10 girls, aged 4–7 years), all recruited from primary schools in South London. In a screening questionnaire, their parents reported no identified diagnosis of a neurodevelopmental condition, including DCD. The MM group were screened based on the time taken to complete a peg placing task as part of the MABC-2 (in which they had to place 12 pegs into a board as quickly and accurately as possible, using both their preferred and non-preferred hands); as reported in Sumner, Hutton et al. (2016) and Sinani, Sugden, & Hill (2011), who have adopted similar approaches to matching. Raw scores were used for the motor matching process (i.e., number of seconds taken) of children in the MM and DCD groups. After screening peg placing time, all children in the MM group completed a standardised assessment of their fine and gross motor skills to determine age-appropriate motor skills (at or above the 25th percentile on the MABC-2), detailed below. Similarly, all children in the CA group had to score at or above the 25th percentile on the MABC-2. Background characteristics of the groups are presented in Table 1. This included a measure of parental education, which has been used as a measure of socio-economic status in similar studies (Fernald, Marchman, & Weisleder, 2013; LeBarton & Iverson, 2013), and was found to be comparable across the groups.

### 2.2. Materials

#### 2.2.1. Wechsler intelligence scale for children (WISC-IV) and wechsler preschool and primary scale of intelligence (WPPSI-IV)

The WISC-IV (Wechsler, 2003) and WPPSI-IV (Wechsler, 2012) were used to determine inclusion in the study, which required a Full-Scale IQ (FSIQ) > 70 for all groups. FSIQ calculated from the WISC-IV comprises four indices and ten subtests (items per index shown in brackets): verbal comprehension (3 items), perceptual reasoning (3 items), working memory (2 items), and processing speed (2 items). From the WPPSI-IV, FSIQ is calculated from five indices and 6 subtests: verbal comprehension (2 items), visual spatial (1 item), fluid reasoning (1 item), working memory (1 item) and processing speed (1 item). Participants completed all subtests. The DCD and CA groups completed the WISC-IV, while the younger MM group completed the WPPSI-IV. The psychometric properties of these tests have been established from large, representative samples which confirm good reliability (including internal consistency above 0.88 for the four indices of the WISC-IV, and above 0.89 for the WPPSI-IV indices; and test-retest stability above 0.86 for the WISC-IV, and above 0.84 for the WPPSI-IV).

#### 2.2.2. Movement Assessment Battery for Children (MABC-2)

Children completed the age-appropriate assessments (age band 1: 4–6 years; age band 2: 7–10 years) of the second edition of the MABC-2 (UK norms; Henderson et al., 2007). Each age band comprises three components: manual dexterity (3 items), aiming and catching (2 items), and static and dynamic balance (3 items). Scores from the eight items are summed to provide a total standard score (Mean = 10, SD = 3) and percentile rank. The MABC-2 was used to confirm the diagnostic status of the DCD (i.e., at or below the 16th percentile) and to confirm age-appropriate abilities in both TD (i.e., at or above the 25th percentile) groups. Across studies that have addressed the psychometric properties of the MABC-2, reliability is considered good. Intra class correlations (ICCs) for test-

retest reliability are reported between 0.77 and 0.95, and for inter-rater reliability ICCs have been reported at 0.95 and above (see Henderson et al., 2007, for details).

### 2.2.3. Strengths and Difficulties Questionnaire (SDQ)

The SDQ (Goodman, 1997) is a 25-item questionnaire that can be completed by parents or teachers (note: the questions asked are the same in both formats but the opening statement differs very slightly from ‘your child’ to ‘the child’, respectively). It comprises five scales (of five items each): Emotional symptoms (e.g., “Often unhappy, down-hearted or tearful”); Conduct problems (e.g., “Often has temper tantrums or hot tempers”); Hyperactivity (e.g., “Constantly fidgeting or squirming”); Peer problems (e.g., “Rather solitary, tends to play alone”); and Prosocial behaviours (e.g., “Considerate of other people’s feelings”). Ten of the questions are designed to tap the child’s strengths; 14 represent difficulties; and 1 item is neutral. Parents or teachers (depending on the informant) rate each question on a three-point scale (“Certainly True”, “Somewhat True”, “Not True”) and scores of 0, 1 or 2 are assigned (depending on whether the items are positively or negatively phrased). A ‘Total Difficulties’ score (ranging from 0 to 40) is generated by summing scores from all of the scales except the Prosocial behaviours scale (as this reflects positive behaviours). As well as using SDQ scores as continuous variables, scores can be classified into ‘normal’, ‘borderline’ and ‘clinical’<sup>2</sup> categories, and risk factors can be determined regarding Emotional disorders, Behavioural disorders and Hyperactive disorders (‘low risk’, ‘medium risk’, and ‘high risk’) (see [www.sdqinfo.org](http://www.sdqinfo.org)). Data from a large, representative sample has confirmed satisfactory reliability (mean Cronbach  $\alpha$  = 0.73; mean cross-informant correlation = 0.34; mean retest stability after 4–6 months = 0.62) and validity (as assessed by comparing SDQ scores against independent psychiatric diagnoses) (Goodman, 2001).

### 2.3. Procedure

Ethical approval was obtained from Goldsmiths, University of London. Written informed consent was provided by all schools and parents/carers, while verbal assent was obtained from the children that took part in the study. Children completed the cognitive and motor assessments in two separate sessions either in their school (for the TD groups) or during a visit to the research lab (for the DCD group). They were seen individually in a quiet room. Parents of children with DCD completed the questionnaire during the visit to the research lab, while teachers of children with DCD were sent a copy of the questionnaire and asked to post the completed copy back to the research team. Teachers of the TD groups completed the questionnaires during school time and returned them to a member of the research team.

### 2.4. Statistical analyses

Tests of normality and homogeneity were conducted prior to test selection. Parametric (paired samples *t*-test, ANOVA) and non-parametric equivalents (Kruskall-Wallis) were used to investigate differences at the group level and when comparing teacher and parent responses. Intra class correlations (ICCs) were also used, when comparing agreement between teacher and parent ratings on the SDQ.

## 3. Results

Relating to the inclusion criteria for the study, Table 1 presents the background characteristics of the three groups. The DCD and CA groups were significantly older than the MM group. No significant differences were found between the CA and MM groups on FSIQ, but the DCD were shown to have slightly lower FSIQ scores (although still scoring within the average range for this test). FSIQ was not found to be correlated with any of the SDQ measures ( $ps > 0.18$ ) and, therefore, is not included in subsequent analyses. Finally, the inclusion criteria for motor abilities were met for all three groups. Of note, 2 (7%) children with DCD scored on the 16th percentile, while the remaining DCD participants scored on the 9th ( $n = 6$ , 20%) or at or below the 5th percentile ( $n = 22$ , 73%).

### 3.1. Teacher ratings of emotional and behavioural difficulties in children with and without DCD

Data screening highlighted that SDQ Total Difficulties scores, as well as three SDQ subtest scores (Emotional symptoms, Conduct problems, and Peer problems), were not normally distributed (skewness values  $> 1$ ). Applying transformations to these data did not result in the assumptions of normality being met, so non-parametric (Kruskall-Wallis) tests were used. For the normally distributed variables (Hyperactivity, and Prosocial behaviour), one way ANOVAs were used. Results demonstrated that teachers rated the DCD group as showing greater levels of emotional and behavioural problems than their TD peers (CA and MM matched) on all subscales of the SDQ, and in their overall scores (see Table 2).

As can be seen in Table 2, the TD average scores were low in each subtest, except for in the Prosocial behavior ratings where a higher score reflects more positive, prosocial behaviour. Notably, none of the children in the two TD groups (CA or MM) scored in the ‘borderline’ or ‘clinical’ ranges on the SDQ Total Difficulties component (all scoring in the ‘normal range’). Further, in relation to the subtest scores, teacher ratings demonstrated only one ‘borderline’ case from the CA group in each of the following categories: Emotional symptoms, Hyperactivity and Prosocial behaviour; in addition to, two ‘clinical’ scores on the Hyperactivity scale, three

<sup>2</sup> Referred to as ‘abnormal’ by Goodman (1997).

**Table 2**  
Teacher reported SDQ scores in children with DCD and TD children (CA/MM).

SDQ measure	Group			Group differences
	DCD (n = 30) <sup>a</sup>	CA (n = 35)	MM (n = 29)	
Emotional symptoms	4.65 (2.69)	1.08 (1.70)	0.90 (1.45)	$H(2) = 37.01, p < 0.001$ DCD > CA = MM
Conduct problems	1.62 (1.66)	0.14 (0.35)	0.34 (0.86)	$H(2) = 26.14, p < 0.001$ DCD > CA = MM
Hyperactivity	6.21 (2.78)	1.46 (1.75)	2.14 (2.25)	$F(2,90) = 38.98, p < 0.001$ DCD > CA = MM
Peer problems	3.76 (2.57)	0.28 (0.67)	0.48 (0.91)	$H(2) = 41.74, p < 0.001$ DCD > CA = MM
Prosocial behaviour	6.14 (1.90)	8.68 (1.69)	8.48 (1.72)	$F(2,90) = 19.29, p < 0.001$ DCD < CA = MM
Total difficulties	16.21 (6.65)	2.97 (2.65)	3.86 (3.17)	$H(2) = 51.88, p < 0.001$ DCD > CA = MM

<sup>a</sup> Note. One missing data point. Higher scores indicate that more symptoms are endorsed in the respective SDQ measures.

‘borderline’ scores on the Prosocial behaviour and one on the Peer problems scale from the MM group. Analyses of borderline and clinical cases in the DCD group are discussed below.

### 3.2. Comparing parent and teachers SDQ scores in children with DCD

Focusing on the DCD group only, group analyses compared parent and teacher reports on the SDQ before examination of individual data points allowed us to: (a) look more closely at concordance between parent and teacher ratings on the SDQ; and (b) determine whether children with DCD presented with a specific profile of emotional and behavioural difficulties on the SDQ.

As seen in Table 3, a paired samples *t*-test revealed no significant difference between parent and teacher scores when considering the Total difficulties scores of children with DCD on the SDQ. However, paired samples *t*-tests exploring SDQ subscale scores indicated two key differences between parent and teacher ratings of the children with DCD. First, parents reported their DCD children’s hyperactivity to be more problematic than teachers did. Second, parents rated the prosocial behaviours of their children with DCD more highly (i.e., less problematic) than teachers did. There was also a non-significant trend towards parents rating their DCD children’s conduct problems to be more severe than teachers did. Across the other subtests, there was general agreement between parent and teacher ratings. Significant correlations between parent and teacher ratings were found for three of the five subscales (Emotional symptoms, Conduct problems and Peer problems), with correlations approaching significance for the Total difficulties score (see Table 3).

Classifying DCD children’s scores (overall, and for each subtest) into ‘normal’, ‘borderline’ or ‘clinical’ categories, we explored individual children’s scores on the SDQ for those who had both parent and teacher reported scores ( $n = 26$ ; one teacher and three parents did not return the SDQs). Table 4 presents the classification for each individual child, on each subtest and overall, as rated by both their parent and teacher: unshaded cells reflect ‘normal’ scores, grey cells reflect ‘borderline’ scores, and black cells reflect ‘clinical’ scores. For Total difficulties scores, as well as scores on each subtest, a tick after the parent and teacher ratings reflects agreement between the informants’ classifications (with ‘agreement’ being classed as both parent and teacher reporting the child’s behaviour to be either ‘normal’ or in the ‘borderline/clinical’ range) and a cross denotes disagreement (i.e., a parent rating the child’s behaviour in the ‘normal’ range and the teacher reporting the child’s behaviour to be in the ‘borderline/clinical’ range, or vice versa). A tally at the end of each row or column indicates the number of parent-teacher classification agreements for each child or across the subscales (including the overall total).

Inspection of Table 4 serves to further demonstrate the modest level of agreement between parent and teacher ratings of children with DCD on the SDQ. For example, on the Total difficulties SDQ scores, parents and teachers classified children similarly in 15 out of 26 cases (57.7%). Likewise, classification agreements across the other subtests ranged from 15 to 20 out of 26 (57.7%–76.9%), and classifications for risk of Emotional, Behavioural or Hyperactive disorders ranged from 15 to 19 out of 26 (57.7%–73.1%).

A further feature of Table 4 is that it illustrates the variability in the scores of children with DCD across the different subscales of the SDQ. Visual inspection of Table highlights that no discernable pattern emerges amongst the group, aside from fairly severe levels of hyperactivity across the sample (with only 2/26 DCD children showing ‘normal’ levels of hyperactivity, as rated by both parents and teachers), as well as a relative lack of children with the presence of conduct problems (16/26 DCD children showed ‘normal’ levels of conduct problems, as rated by both parents and teachers). DCD children were also rated as having a slightly raised profile of

**Table 3**  
Mean (SD) SDQ scores for children with DCD ( $n = 30$ ), as reported by parents and teachers.

	Parent report	Teacher report	Intra-class correlation	Paired samples <i>t</i> -tests
Emotional symptoms	4.72 (2.42)	4.68 (2.59)	0.39 ( $p = 0.025$ )	$t(24) = 0.07, p = 0.94$
Conduct problems	2.56 (1.76)	1.80 (1.71)	0.39 ( $p = 0.03$ )	$t(24) = 1.98, p = 0.06$
Hyperactivity	7.64 (2.21)	6.28 (2.86)	0.15 ( $p = 0.23$ )	$t(24) = 2.04, p < 0.05$
Peer problems	3.88 (2.62)	3.68 (2.66)	0.50 ( $p = 0.005$ )	$t(24) = 0.38, p = 0.71$
Prosocial behaviour	7.76 (1.83)	6.00 (1.87)	0.06 ( $p = 0.38$ )	$t(24) = 3.47, p < 0.005$
Total difficulties	18.80 (5.59)	16.40 (6.95)	0.33 ( $p = 0.05$ )	$t(24) = 1.65, p = 0.11$



which is consistent with previous research (Gustafsson et al., 2014). Yet, it should be noted that conduct problems were reported in just over a third of this group. Finally, the slightly raised profile of emotional difficulties and peer problems in the children with DCD also confirms previous findings (e.g., King-Dowling, Missiuna, Rodriguez, Greenway, & Cairney, 2015; Wagner, Bós, Jascenoka, Jekauc, & Petermann, 2012).

Group and individual analyses demonstrated modest agreement between parent and teacher scores on the SDQ for children with DCD. Whilst previous studies have reported high levels of emotional and behavioural problems in children with DCD, findings from SDQ studies using parent or teacher reports have not yielded equivalent results; for example, teacher-reported SDQ scores of children with DCD (Van den Heuvel et al., 2016) have been reported to be lower than those reported by parents (Green et al., 2006). These previous studies have each used parent or teacher reports in isolation, whereas the present research compared parent and teacher ratings across the same group of children. Adopting this approach provides further, more solid evidence for subtle disparities between parent and teacher ratings on the SDQ. They also confirm previous studies (outside the field of DCD) showing only modest agreement between parent- and teacher-reported scores on this measure (Stone et al., 2010).

Analysis of parent and teacher reports also revealed that parents often rated their children with DCD to be more hyperactive than teachers did; however, the opposite was true for prosocial behaviours (with parents often reporting higher levels of prosocial behaviour than teachers). This could be accounted for by children behaving differently in school and at home, or could be related to teachers having a broader (and potentially more accurate) benchmark against which to compare the children. Irrespective of the reasons underlying these differences, it illustrates the importance of professionals obtaining reports from both teachers and parents when using the SDQ with children with DCD. In doing so, any bias ought to be removed, as well as ensuring no information is missing. This, in turn, will lead to a more comprehensive picture of the child's difficulties.

Although a strength of this study is the inclusion of a younger MM comparison group, it is noted that the procedure of matching on a single measure of fine motor skill has its limitations. Future research may consider extending this approach to a larger sample of participants and to consider matching on fine and gross motor skill. In selecting samples, care was taken to exclude children with known co-occurring difficulties (based on parent and clinical reports) so that conclusions related to the core motor difficulty could be made. However, it is recognised that further screening of possible co-occurring difficulties would help further categorise the profiles seen here. In taking this research forward, direct comparison of both parent and teacher SDQ ratings in the TD (CA and MM) groups would be fruitful, to align to the present findings. Interestingly, our data show that teachers do not rate the TD children particularly highly on any aspect of the SDQ; nevertheless, parent perspectives would be valuable here.

Overall, the current findings highlight that a large proportion of children with DCD present with problems with attention (hyperactivity). In addition, albeit to a lesser extent, a number of DCD children had a raised profile of emotional difficulties and peer problems. As the sample did not have any confirmed co-occurring diagnoses (e.g., ADHD), it highlights the importance of exploring emotional and behavioural problems in a DCD population, to fully support these individuals. The findings also flag inconsistencies across parent and teacher ratings, stressing the importance of considering both perspectives. Moreover, the variability in SDQ scores across the DCD sample suggests that a tailored approach to intervention is necessary to support the emotional and behavioural needs of this group.

## Acknowledgments

This work was supported by a grant from The Leverhulme Trust (RPG-2012-742) to E. Hill at Goldsmiths, University of London. We would like to thank all of the children, parents and teachers that participated in this study.

## References

- American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. Arlington, VA: American Psychiatric Association.
- Biotteau, M., Chaix, Y., Blais, M., Tallet, J., Peran, P., & Albaret, J.-M. (2016). Neural signature of DCD: A critical review of MRI neuroimaging studies. *Frontiers in Neurology*, 7, 227. <http://dx.doi.org/10.3389/fneur.2016.00227>.
- Chen, H. F., & Cohn, E. S. (2003). Social participation for children with developmental coordination disorder: Conceptual, evaluation and intervention considerations. *Physical & Occupational Therapy in Pediatrics*, 23(4), 61–78. [http://dx.doi.org/10.1080/j006v23n04\\_05](http://dx.doi.org/10.1080/j006v23n04_05).
- Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science*, 16, 234–248. <http://dx.doi.org/10.1111/desc.12019>.
- Goodman, R., Ford, T., Simmons, H., Gatward, R., & Meltzer, H. (2000). Using the strengths and difficulties questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *British Journal of Psychiatry*, 177, 534–539.
- Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, 38(5), 581–586. <http://dx.doi.org/10.1111/j.1469-7610.1997.tb01545.x>.
- Goodman, R. (2001). Psychometric properties of the strengths and difficulties questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40(11), 1337–1345. <http://dx.doi.org/10.1097/00004583-200111000-00015>.
- Green, D., Baird, G., & Sugden, D. (2006). A pilot study of psychopathology in developmental coordination disorder. *Child: Care, Health and Development*, 33, 741–750.
- Gustafsson, P., Kerekes, N., Anckarsäter, H., Lichtenstein, P., Gillberg, C., & Råstam, M. (2014). Motor function and perception in children with neuropsychiatric and conduct problems: Results from a population based twin study. *Journal of Neurodevelopmental Disorders*, 6, 11. <http://dx.doi.org/10.1186/1866-1955-6-11>.
- Henderson, S. E., Sugden, D. A., & Barnett, A. L. (2007). *Movement assessment battery for children* (2nd ed.). London: The Psychological Corporation.
- Kadesjo, B., & Gillberg, C. (1998). Attention deficit and clumsiness in Swedish 7-year-old children. *Developmental Medicine and Child Neurology*, 40, 796–804. <http://dx.doi.org/10.1111/j.1469-8749.1998.tb12356.x>.
- King-Dowling, S., Missiuna, Rodriguex, M. C., Greenway, M., & Cairney, J. (2015). Co-occurring motor, language and emotional-behavioral problems in children 3–6 years of age. *Human Movement Science*, 39, 101–108. <http://dx.doi.org/10.1016/j.humov.2014.10.010>.
- LeBarton, E. S., & Iverson, J. M. (2013). Fine motor skill predicts expressive language in infant siblings of children with autism. *Developmental Science*, 16, 1–23. <http://dx.doi.org/10.1111/desc.12069>.
- Lingam, R., Hunt, L., Golding, J., Jongmans, M., & Emond, A. (2009). Prevalence of developmental coordination disorder using the DSM-IV at 7 years of age: A UK

- population-based study. *Pediatrics*, 123, 693–700.
- Missiuna, C., Moll, S., King, G., Stewart, D., & MacDonald, K. (2008). Life experiences of young adults who have coordination difficulties. *Canadian Journal of Occupational Therapy*, 75(3), 157–166. <http://dx.doi.org/10.1177/000841740807500307>.
- Missiuna, C., Cairney, J., Pollock, N., Campbell, W., Russell, D. J., Macdonald, K., et al. (2014). Psychological distress in children with developmental coordination disorder and attention-deficit hyperactivity disorder. *Research in Developmental Disabilities*, 35(5), 1198–1207. <http://dx.doi.org/10.1016/j.ridd.2014.01.007>.
- Piek, J. P., Rigoli, D., Pearsall-Jones, J. G., Martin, N. C., Hay, D. A., Bennett, K. S., et al. (2007). Depressive symptomatology in child and adolescent twins with attention-deficit hyperactivity disorder and/or developmental coordination disorder. *Twin Research and Human Genetics*, 10(4), 587–596. <http://dx.doi.org/10.1375/twin.10.4.587>.
- Poulsen, A. A., Ziviani, J. M., Cuskelly, M., & Smith, R. (2007). Boys with developmental coordination disorder: Loneliness and team sports participation. *American Journal of Occupational Therapy*, 61, 451–462. <http://dx.doi.org/10.5014/ajot.61.4.451>.
- Pratt, M. L., & Hill, E. L. (2011). Anxiety profiles in children with and without developmental coordination disorder. *Research in Developmental Disabilities*, 32, 1253–1259.
- Rigoli, D., & Piek, J. (2016). Motor problems as a risk factor for poorer mental health in children and adolescents. What do we know and should we be screening for psychological difficulties in those with poor motor skills? *Current Developmental Disorders Report*, 3, 190–194. <http://dx.doi.org/10.1007/s40474-106-0091-9>.
- Sinani, C., Sugden, D. A., & Hill, E. L. (2011). Gesture production in school vs clinical samples of children with developmental coordination disorder (DCD) and typically developing children. *Research in Developmental Disabilities*, 32, 1270–1282.
- Stone, L. L., Otten, R., Engels, R. C. M. E., Vermulst, A. A., & Janssens, J. M. A. M. (2010). Psychometric properties of the parent and teacher versions of the strengths and difficulties questionnaire for 4- to 12-year-olds: A review. *Clinical Child and Family Psychology Review*, 13(3), 254–274. <http://dx.doi.org/10.1007/s10567-010-0071-2>.
- Sumner, E., Hutton, S. B., Kuhn, G., & Hill, E. L. (2016). Oculomotor atypicalities in developmental coordination disorder. *Developmental Science*. <http://dx.doi.org/10.1111/desc.12501>.
- Sumner, E., Leonard, H. C., & Hill, E. L. (2016). Overlapping phenotypes in autism spectrum disorder and developmental coordination disorder: A cross-syndrome comparison of motor and social skills. *Journal of Autism and Developmental Disorders*, 46, 2609–2620.
- Sumner, E., Pratt, M. L., & Hill, E. L. (2016). Examining the cognitive profile of children with developmental coordination disorder. *Research in Developmental Disabilities*, 56, 10–17.
- Van den Heuvel, M., Jansen, D. E. M. C., Reijneveld, S. A., Flapper, B. C. T., & Smits-Engelsman, B. C. M. (2016). Identification of emotional and behavioural problems by teachers in children with developmental coordination disorder in the school community. *Research in Developmental Disabilities*, 51, 40–48.
- Wagner, M. O., Bös, K., Jascenoka, J., Jekauc, D., & Petermann, F. (2012). Peer problems mediate the relationship between developmental coordination disorder and behavioral problems in school-aged children. *Research in Developmental Disabilities*, 33(6), 2072–2079. <http://dx.doi.org/10.1016/j.ridd.2012.05.012>.
- Wechsler, D. (2003). *Wechsler intelligence scale for children – Fourth edition (WISC-IV)*. San Antonio, TX: The Psychological Corporation.
- Wechsler, D. (2012). *Wechsler preschool and primary scale of intelligence (4th ed.)*. London: Pearson Assessment.
- Zwicker, J. G., Missiuna, C., Harris, S. R., & Boyd, L. A. (2012). Developmental coordination disorder: A review and update. *European Journal of Paediatric Neurology*, 16(6), 573–581. <http://dx.doi.org/10.1016/j.ejpn.2012.05.005>.