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Running Head: Activities of Daily Living in Children With DCD

Research Report

Activities of Daily Living in Children With Developmental Coordination Disorder: Performance, Learning, and Participation

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Abstract

Background. Children with developmental coordination disorder (DCD) face evident motor difficulties in daily functioning. Little is known, however, about their difficulties in specific activities of daily living (ADL).

Objective. To (a) investigate differences between children with DCD and their typically developing peers, for ADL performance, learning, and participation, and (b) explore the predictive values of these aspects.

Design. Cross-sectional study.

Methods: Both in a clinical sample of children diagnosed with DCD (n = 25, age range 5-8 years; 21 males) and typically developing peers (25 matched controls), parents completed the DCDDaily-Q. Differences in scores between the groups were investigated using T-tests for performance and participation, and Pearson's Chi-square for learning. Multiple regression analyses were performed to explore the predictive values of performance, learning, and participation.

Results. Compared to peers, children with DCD showed poor performance of ADL ($p \leq .005$ for all items), delays in learning of ADL $p \leq .002$ for all items), and less frequent participation in some ADL ($p = .001$ for mean total scores, $p \leq .05$ for 7 out of 23 items). Children with DCD demonstrated heterogeneous patterns of performance (poor in 10 - 80% of the items) and learning (delayed in 0 - 100% of the items). In the DCD group, delays in learning of ADL were a predictor for poor performance of ADL ($p = .001$), and poor performance of ADL was a predictor for less frequent participation in ADL compared to peers ($p = .040$).

Limitations. A limited number of children with DCD was addressed in this study.

Conclusions. This study highlights the impact of DCD on children's daily lives and the need for tailored intervention.

Introduction

Developmental Coordination Disorder is associated with impairments in the coordination of voluntary movements, timing, force control and motor learning.[1] These impairments will impact all kinds of motor activities, including activities of daily living (ADL), which are essential for children's daily functioning.[2] Children with developmental coordination disorder (DCD) face difficulties in a broad range of motor-based ADL, e.g. mobility, personal hygiene, feeding, and dressing; handwriting and doing craftwork; ball skills and riding a bike.[3-6] For children with DCD, compared to typically developing peers, poor performance of ADL, delays in learning of ADL, and less frequent participation in ADL are widely suggested in the literature [3-9], and form part of the diagnostic criteria for DCD.[10]

However, evidence is scarce: a recent systematic review concluded that little is known about children's specific difficulties in performance of ADL and participation in ADL.[11] For learning of ADL, no studies were performed at all. It was emphasized in that systematic review that every effort should be made to report the impact of the disorder on children's daily functioning, and improved understanding of the disorder is needed.[11] This requires standardized assessment of ADL for children with DCD.[11-14] For this purpose, the DCDDaily-Q was recently introduced.[15] This parental questionnaire enables investigation of specific ADL difficulties in children with DCD, i.e. how well children perform ADL, whether they have taken longer to learn ADL compared to peers, and how often they perform ADL.[15] The DCDDaily-Q addresses a broad range of 23 crucial ADL known to be difficult for children with DCD,[15] covering the domains of ADL that are relevant for children: "self-care and self-maintenance," "productivity and school" and "leisure and play."[3, 5, 16-20] This comprehensive range of ADL is essential, as full

insight into children's difficulties is needed to support diagnosis, assessment, and intervention.[4, 5, 7, 11, 14, 21, 22]

The current study investigates differences between a clinical sample of children diagnosed with DCD and their typically developing peers for the aspects of performance, learning, and participation. The DCDDaily-Q is thus used to specify the difficulties that children with DCD are faced with in daily functioning, in order to investigate the impact of the disorder on the children's daily lives. In addition, the DCDDaily-Q is the first instrument to assess ADL performance, learning, and participation in parallel. This enables investigation of the predictive values of these aspects. We hypothesized that delayed learning of specific ADL precedes poor performance in these ADL, which in turn may lead to less frequent participation because children avoid these ADL to prevent failure.[23-26] For example, it was recently reported that children with DCD participate less frequently in ADL and play activities, and that a lower level of motor performance was associated with less participation in active physical activities.[24] Further, we hypothesized that less frequent participation in specific ADL may cause performance to fall further behind as children do not practice these ADL as often as peers.[23, 24, 26] This has been proposed in the developmental skill-learning gap hypothesis: low participation will impede skill development, which will in turn lead to avoidance of participation.[22]

Shedding light on children's difficulties in ADL performance, learning, and participation, and the relations between these aspects, the DCDDaily-Q may support diagnosis and intervention for individual children with DCD, and facilitate improved understanding of the disorder.

Methods

The data collected for this study were part of the DCDDaily-Q validation study.[15]

Participants

Twenty five children with DCD were included (age [male: female ratio] 5y [4:0], 6y [5:0], 7y [7:2], 8y [5:2]). All of them were referred to a rehabilitation centre or physical therapy centre in the Netherlands. They were diagnosed by a medical doctor according to the diagnostic criteria for DCD operationalized in the International Clinical Practice Guideline for DCD.[10, 14] A control group of 25 children matched for age and gender was randomly selected from an accessible population of five to eight-year-old school children that served as a reference group for a previous study (see the DCDDaily-Q validation study for additional details).[15] Children were excluded from the control group beforehand when having a known clinical condition such as uncorrected visual problems, or when they were at risk for DCD (a score equal to or lower than the 16th percentile on the Movement Assessment Battery for Children-2 Test (MABC2).[27] The study was approved by the Medical Ethics Committee of the University Medical Center Groningen, the Netherlands.

Test and measures

The development of the DCDDaily-Q was extensively described in an earlier study.[15] The DCDDaily-Q is a parental 23 item questionnaire covering the domains of "self-care and self-maintenance," "fine motor activities," and "gross motor play activities," in correspondence with the relevant ADL domains reported in the literature.[15]

For the aspect of performance of ADL, the DCDDaily-Q was found to be a valid and reliable parental questionnaire to address a comprehensive range of ADL in 5 to 8 year old children with and without DCD.[15] Compared to typically developing peers, children with DCD

demonstrated poor performance of all ADL included. In the current study, data on ADL performance are put into new perspective, as additional data are presented on children's delays in learning of ADL and frequency of participation in ADL, to fully inform professionals about children's daily functioning.

To evaluate any relevant difficulties in motor-based daily functioning, parents rate how well children perform each of the ADL included, whether they are taking or have taken longer to learn these ADL compared to peers, and how often they perform these ADL. An example of the directions given to parents when filling in the questionnaire and an example of one complete item are provided in Appendix 1. An overview of the 23 items included in the DCDDaily-Q is provided in Table 1. For the aspects of performance, learning, and participation, DCDDaily-Q item and total scores are calculated as explained in Table 2. Furthermore, for the aspects of performance, learning, and participation, scores were calculated for the specific domains of "self-care and self-maintenance," "fine motor activities," and "gross motor play activities" (see Table 3).

In order to compare individual children's scores on the three subscales, DCDDaily-Q total scores were converted to percentage scores, ranging from 0% (good performance in all ADL, no delays in learning any of the ADL, and frequent participation in all ADL) to 100% (poor performance and delayed learning in all ADL, and no participation in any of the ADL).

Procedure

The 38-item research version of the DCDDaily-Q was sent to parents, who returned it to the researchers after completion between September 2008 and March 2012. In the current study, data are shown for the 23 items included in the final version of the DCDDaily-Q.[15]

Statistical analyses

Analyses were performed using SPSS (IBM SPSS, version 20.0, Chicago, IL, USA). Alpha was set at .05. The 95% Confidence Intervals (CI) were calculated using the Monte Carlo method.

Missing values were replaced with the mean item score of the child's group (reference or DCD). Per individual questionnaire, a maximum of four out of 23 questions was allowed to remain unanswered; for all questionnaires in total, less than 1% of all answers were missing. When participation was rated 4 (= not yet / never performed), parents could not rate performance and learning for that particular item (4% of all answers in the DCD group; 2% in the control group). Again, for performance and learning, mean scores of the child's group were used for that item to replace the missing value.

For further reliability analyses of the DCDDaily-Q **subscales**, internal consistency was calculated for the three subscales.

To explore whether the data were normally distributed, Kolmogorov-Smirnov Test were performed for the total scores of the three subscales (performance, learning, and participation). The Kolmogorov-Smirnov Test was non-significant for the subscales performance and participation, implying that the distribution of these samples is not statistically different from a normal distribution. For investigation of the differences between children with DCD and their typically developing peers, item scores, domain scores, and total scores were analysed for the three subscales of the DCDDaily-Q. Differences between mean scores in the DCD group and the control group were investigated using T-tests for performance an**d** participation. For learning, Pearson's Chi-square was analysed as this considers nominal data.

Backward stepwise multiple regression analyses were performed to explore the predictive values of performance, learning, and participation. It was hypothesized that (a) learning of ADL would predict performance of ADL; that (b) performance of ADL would predict participation in ADL; and that (c) participation in ADL, in turn, would predict performance of ADL. To analyse hypotheses a and c, *learning* and *participation* were used as predictor variables in Model 1, with *performance* as dependent variable. As a removal criterion for Model 2, to check the predictive value of the separate subscales, the probability of $F \geq .100$ was used. To analyse hypothesis b, the analyses were repeated with *participation* as dependent variable and *performance* and *learning* as predictors. Finally, interaction effects were investigated by calculating standardized values and including the effects of *performance* * *learning* on *participation* and *learning* * *participation* on *performance*. For all models, data are provided for DCDDaily-Q total scores, for the DCD group and the control group separately.

Results

Internal consistency of the performance subscale was found to be good: Cronbach's α = .84 for both the DCD group and the control group.[15] For learning, Cronbach's α = .95 for the DCD group, and .59 for the control group - including items with zero variance. For participation, Cronbach's α = .65 for the DCD group and .77 for the control group.

DCDDaily-Q scores in the DCD group and the control group

According to their parents, children with DCD showed poor performance of ADL compared to their matched controls: Significant differences were found between groups for

DCDDaily-Q total performance scores ($p < .001$), domain scores (all: $p < .001$), and each of the 23 item scores (all: $p \leq .005$; see Table 3 and Figure 1).

Parental rating demonstrated delays in learning of ADL in children with DCD compared to peers: Significant differences were found between groups for DCDDaily-Q total learning scores ($p < .001$), domain scores (all: $p < .001$), and each of the 23 item scores (all: $p \leq .002$; see Table 3 and Figure 1). In more detail, five children with DCD (20%) showed a delay in learning of all ADL included (total learning score = 23; percentage score = 100) and the majority of children in the DCD group (64%) showed a delay in learning more than half of the ADL included (total learning score ≥ 12; percentage score ≥ 50), whereas the maximum total learning score was 4 (percentage score ≤ 17) in the control group (see Table 4 and Figure 2). The majority of children in the control group (76%) showed no delay in learning in any of the ADL, compared to one child in the DCD group (4%; total learning score = 0; percentage score = 0; see Table 4 and Figure 2).

Children with DCD participate in ADL less frequently than their matched controls: Significant differences were found between groups for total participation scores ($p < .001$) as well as for the domain scores of self-care and self-maintenance ($p < .001$) and fine motor activities ($p = .021$), but not for the domain of gross motor play activities ($p = .056$); see Table 3). Considering the specific ADL, parents acknowledged children with DCD to participate less frequently in 7 out of 23 activities: cutting a sandwich with a knife ($p = .002$), pouring a drink ($p = .047$), opening a wrapper or package ($p = .002$), drying after a shower ($p = .035$), constructional play ($p = .030$), moving game pieces on a board game ($p = .020$), and kicking a football ($p = .018$; see Figure 1).

Performance, learning, and participation

Percentage scores on performance, learning, and participation were below the 40th percentile for all children in the control group, indicating good performance in most ADL, no delays in learning in most of the ADL, and frequent participation in most of the ADL; for the majority of children in the DCD group, percentile scores were above the 40th percentile for performance and learning of ADL (see Figures 1 and 2).

For children with DCD, percentage scores on performance, learning, and participation ranged from 0% to 100%, reflecting heterogeneous patterns in their scores on the three subscales (see Figure 2). Heterogeneity in performance and learning were demonstrated in Figures 1 and 2: Difficulties are seen in each of the ADL included and of the individual children with DCD, some showed difficulties in only some ADL and others in all ADL.

Relations between performance, learning, and participation

In the DCD group, regression analyses of the DCDDaily-Q total scores demonstrated (a) delays in learning to predict poor performance, and (b) poor performance to predict less frequent participation, but (c) less frequent participation did not predict poor performance (see Table 5). In the control group, regression analyses of DCDDaily-Q total scores did not demonstrated (a) delays in learning to predict poor performance, but (b) performance to predict participation, and (c) participation to predict performance (see Table 5).

No interaction effects were found (DCD group: $p = .713$ for learning * participation on performance, $p = .899$ for performance * learning on participation; Control group: $p = .468$ for learning * participation on performance, $p = .170$ for performance * learning on participation).

Discussion

The first aim of this study was to investigate difficulties in daily functioning for children with DCD. The DCDDaily-Q was used to assess children's performance, learning, and participation in a broad range of crucial ADL, in order to elucidate the consequences of DCD for the individual child. This study is the first to quantify what has been suggested in the literature: Children with DCD show poor performance of ADL, delays in learning of ADL, and less frequent participation in some ADL compared to their typically developing peers.[3-7, 10, 25, 28]

Interestingly, for the majority of the specific ADL included in the DCDDaily-Q (16 out of 23), parents rated children with DCD to participate as often as peers. Children with DCD were found to participate less frequently in those ADL that can be avoided, e.g. the domain of gross motor play activities and, at item level, kicking a ball, constructional play, and moving game pieces on a board game; or ADL that can be "taken over" by parents, such as cutting bread, pouring a drink, unwrapping packages, and drying after a shower. The moderate reliability of this subscale for the DCD group must be taken into account when interpreting these findings. However, it was demonstrated earlier that children with DCD avoid certain ADL when their poor performance disturbs other children, e.g. in playing games.[7-9, 26] Further, as the poor performance in children with DCD puts pressure on the entire family, parents may "take over" activities such as preparing food, in order to prevent the mess of spilled juice or dangerous situations involving the knife, or purchase supportive materials such as Velcro shoes to prevent endless attempts of getting dressed during the morning rush to get to school.[7-9] For all other ADL included in the DCDDaily-Q, parents rated children with DCD to participate as often as peers. Apparently, avoidance or adaptations are uncommon for these ADL, e.g. children have to wash their own

hands and participate in school activities such as writing and tinkering, and children participate as often as peers in play activities such as catching balls and hopping in squares. Given their poor performance in these ADL, this must be a frustrating experience.

A second important result of this study considers the heterogeneity of DCD. It is well-known that children with DCD show heterogeneous performance.[6] Some children face difficulties in handwriting only, others lack specific skills such as ball skills, and others may experience severe "clumsiness" in multiple motor domains.[3, 10] The current study is the first to assess children's difficulties in a broad range of crucial ADL with a valid and reliable instrument. The heterogeneity in ADL performance and learning in children with DCD as revealed with the DCDDaily-Q stresses the range of differences between individual children with DCD and, with that, the need for tailored intervention. Moreover, the DCDDaily-Q may support the investigation of possible subtypes of DCD.[29] When future studies would demonstrate comparable patterns of difficulties in ADL performance, learning, or participation in larger groups of children with DCD, the specific impairments of children in these subgroups may be explored.

Thirdly, the relation between the aspects of performance, learning, and participation was explored: (a) Delays in learning of ADL were hypothesized to predict poor performance of ADL. In children with DCD, delays in learning were indeed found a predictor for poor performance. This is an excellent starting point for assessment, as early recognition of delays in learning may support intervention to prevent performance difficulties. This is important, as children's further motor development is challenged when their performance stays behind because of delays in learning of ADL.[4, 23] In the control group, learning was not found to predict performance, likely due to the small variation in total learning scores; (b) Participation was hypothesized to predict

performance, because performance may fall behind when children do not practice certain ADL as often as peers.[23, 24, 26] In the control group, more frequent participation was associated with better performance of ADL. In the DCD group, however, this was not the case. As it appears, the relatively poor performance of children with DCD was not due to less frequent participation in these ADL compared to peers. Indeed, for 17 out of the 23 ADL included, parents rated their children to participate as often as peers. For these children, a lack of practice does not explain their poor ADL performance. Thus, in order to improve their ADL performance, more is needed than practice alone, i.e. task-specific interventions, which were found effective to improve children's performance;[6, 30] During task specific interventions, poor muscle strength, coordination and balance are trained as part of the daily tasks that children experience problems with; (c) Performance of ADL was hypothesized to predict participation in ADL, as poor performance in specific ADL might lead to avoidance or adaptations as described above.[4, 23, 24, 26] This hypothesis was confirmed in both children with DCD and their typically developing peers. This suggests that intervention aimed to improve performance of ADL also reinforces children's participation in ADL. It is worthwhile to evaluate this in future research as more frequent participation may support prevention or limitation of secondary consequences such as low self-esteem and social exclusion.[4, 23, 26]

A final interesting difference was found between the DCD and the control group in the performance difficulty per item. For example, compared to children in the control group, children with DCD showed a relatively good performance on pouring a drink and putting on socks, and a relatively poor performance on handling a key or cutting a paper with scissors. Further investigation of these differences in item difficulty is recommended to gain more insight into the impact of DCD on children's daily functioning.

Limitations

A first limitation of this study is the use of a questionnaire, which is a subjective form of assessment. However, parental questionnaires do provide a valuable source of information[31] as they provide a long-term perspective instead of results of specific moments of testing. Second, although the clinical sample used in the study is promising, it must be noted that this study comprises data on performance, learning, and participation of only 25 children with DCD. Further, only 4 girls were included, but this represents the male: female ratio in the DCD population.[32] In future studies it is recommended to assess a larger sample, in order to investigate possible differences between groups of age and gender. Finally, considering this small sample size, no Bonferroni–correction was applied to the large number of comparisons of the DCDDaily-Q mean item scores, i.e. 3 subscales x 23 questions.

Conclusions

Children with DCD in this study demonstrated poor performance of ADL, delays in learning of ADL, and less frequent participation in some ADL, compared to typically developing peers. These difficulties in daily functioning clearly indicate the impact of the disorder on these children's daily lives. Further, heterogeneous patterns were found in children with DCD for performance and learning of ADL, which stresses the need for tailored intervention. Finally, in children with DCD, learning was found to predict performance of ADL, and performance was found to predict participation in ADL. It is of worth to evaluate these finding in future research, as the findings suggest that early recognition of delays in learning might support clinicians to prevent or limit performance difficulties in children with DCD.

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Table 1. Items included in the DCDDaily-Q.

Self-care and self-maintenance	Fine motor activities	Gross motor play activities
1. Buttering a sandwich	11. Writing	18. Hopping in squares
2. Cutting a sandwich with a knife	12. Gluing paper using a glue stick	19. Jumping rope
3. Pouring a drink	13. Folding a Jacobs ladder†	20. Throwing a tennis ball
4. Opening a wrapper or package	14. Colouring a picture	21. Catching a ball
5. Eating soup with a spoon	15. Cutting paper with scissors	22. Kicking a football
6. Washing hands	16. Lego© building	23. Playing marbles
7. Drying after a shower	17. Moving game pieces on a board game	
8. Brushing teeth		
9. Handling a key		
10. Putting on socks		

†: Craftwork project, folding two long pieces of paper over each other to create a 3D ladder.

Table 2. DCDDaily-Q scorings for performance, learning, and participation.

Performance of ADL	Learning of ADL	Participation in ADL
1 = well	0 = is not taking or has not taken longer to learn the activity than peers	1 = regularly
2 = sometimes well and at other times less well	1 = is taking or has taken longer to learn the activity than peers	2 = sometimes
3 = not very well (or badly) most of the time		3 = seldom
		4 = not yet / never

Notes: *Total performance scores* may range from 23 (performs all items well) to 69 (performs all items not very well); *total learning scores* may range from 0 (is not taking or has not taken longer than peers to learn any activity) to 23 (is taking or has taken longer than peers to learn all activities); *total participation scores* may range from 23 (regularly performs all items) to 92 (never performed one of the items). *Percentage scores* for performance, learning and participation range from 0% (good performance, no delays in learning, and frequent participation) to 100% (poor performance and delayed learning in all ADL, and no participation in any of the ADL), calculated as: performance percentage score = ([total performance score - 23] / [69 - 23]) * 100; learning percentage score = (total learning score / 23) * 100; participation percentage score = ([total participation score - 23] / [92 - 23]) * 100.

Table 3. DCDDaily-Q domain and total scores for performance, learning, and participation

	DCD group Mean (SD)	Control group Mean (SD)	T (95% CI), *p*-value	**X^2 (df), *p*-value**
Performance				
Total score	45.8 (6.9)	30.0 (5.2)	-9.16 (-19.37 to -12.39), $p <$ .001	
Self-care and self-maintenance	19.4 (3.4)	12.5 (2.5)	-8.19 (-8.62 to -5.22), $p <$ .001	
Fine motor activities	13.5 (3.2)	9.0 (2.2)	-5.93 (-6.11 to -3.01), $p <$ .001	
Gross motor play activities	13.0 (2.5)	8.6 (2.2)	-6.67 (-5.73 to -3.07), $p <$ .001	
Learning				
Total score	13.6 (7.6)	0.5 (1.1)		**38.53 (13), $p < .001$**
Self-care and self-maintenance	6.0 (3.5)	0.3 (0.9)		**36.00 (8), $p < .001$**
Fine motor activities	3.8 (2.8)	0.1 (0.3)		**28.30 (7), $p < .001$**
Gross motor play activities	3.8 (2.3)	0.1 (0.6)		**39.33 (6), $p < .001$**
Participation				
Total score	40.6 (5.5)	34.0 (6.1)	-4.08 (-9.91 to -3.37), $p <$ .001	
Self-care and self-maintenance	16.7 (3.6)	13.2 (2.8)	-3.82 (-5.373 to -1.67), $p <$ .001	
Fine motor activities	10.9 (2.2)	9.4 (2.2)	-2.38 (-2.73 to -.23), $p =$ .021	
Gross motor play activities	13.0 (2.8)	11.3 (3.2)	-1.96 (-3.33 to 0.47), $p =$ .056	

Notes: DCD = developmental coordination disorder. For *performance*, s*elf-care and self-maintenance scores* may range from 10 (performs all items well) to 30 (performs all items not very well), *fine motor activities scores* may range from 7 to 21, *gross motor play activities scores* may range from 6 to 18; for *learning,* s*elf-care and self-maintenance scores* may range from 0 (is not taking or has not taken longer than peers to learn any activity) to 10 (is taking or has taken longer than peers to learn all activities), *fine motor activities scores* may range from 0 to 7, *gross motor play activities scores* may range from 0 to 6; for *participation*, s*elf-care and self-maintenance scores* may range from 10 (regularly performs all items) to 40 (never performed one of the items), *fine motor activities*

scores may range from 7 to 28, *gross motor play activities scores* may range from 6 to 24 (see also Table 2 and Figure 1 for a further specification of the DCDDaily-Q total scores and the specific items per domain)

Table 4. Total of DCDDaily-Q item scores on learning for children in the DCD group and the control group

	Learning		Self-care and self-maintenance		Fine motor activities		Gross motor play activities	
	DCD group	Control group	DCD group	Control group	DCD group	Control group	DCD group	Control group
0	1	19	2	22	6	23	3	24
1	1	3	1	1	1	2	4	-
2	-	1	1	1	2	-	1	-
3	2	1	3	-	2	-	-	1
4	1	1	2	1	2	-	4	-
5	-	-	3	-	3	-	5	-
6	-	-	-	-	3	-	8	-
7	2	-	4	-	6	-	-	-
8	-	-	-	-	-	-	-	-
9	-	-	2	-	-	-	-	-
10	2	-	7	-	-	-	-	-
11	-	-	-	-	-	-	-	-
12	2	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-
14	1	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-
16	3	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-
18	3	-	-	-	-	-	-	-
19	1	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-
21	1	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-
23	5	-	-	-	-	-	-	-

Notes: DCD = developmental coordination disorder. The total number of learning scores per child may range from 0 to 23; *self-care and self-maintenance scores* may range from 0 (is not taking or has not taken longer than peers to learn any activity) to 10 (is taking or has taken longer than peers to learn all activities), *fine motor activities scores* may range from 0 to 7, *gross motor play activities scores* may range from 0 to 6.

Table 5A. Backward regression analyses for mean DCDDaily-Q total performance scores.

	DCD group				Control group			
	B (SE)	*β* (95% CI)	*p*-value	R^2	*B* (SE)	*β* (95% CI)	*p*-value	R^2
Total score								
Model 1				.42				.30
Learning	0.48 (0.16)	.53 (0.16 to 0.81)	.005*		0.83 (0.96)	.16 (-1.16 to 2.81)	.396	
Participation	0.32 (0.22)	.25 (-0.13 to 0.77)	.158		0.40 (0.17)	.47 (0.06 to 0.75)	.024*	
Model 2				.37				.28
Learning	0.55 (0.15)	.61 (0.24 to 0.87)	.001*					
Participation					0.45 (0.15)	.53 (0.14 to 0.77)	.007*	

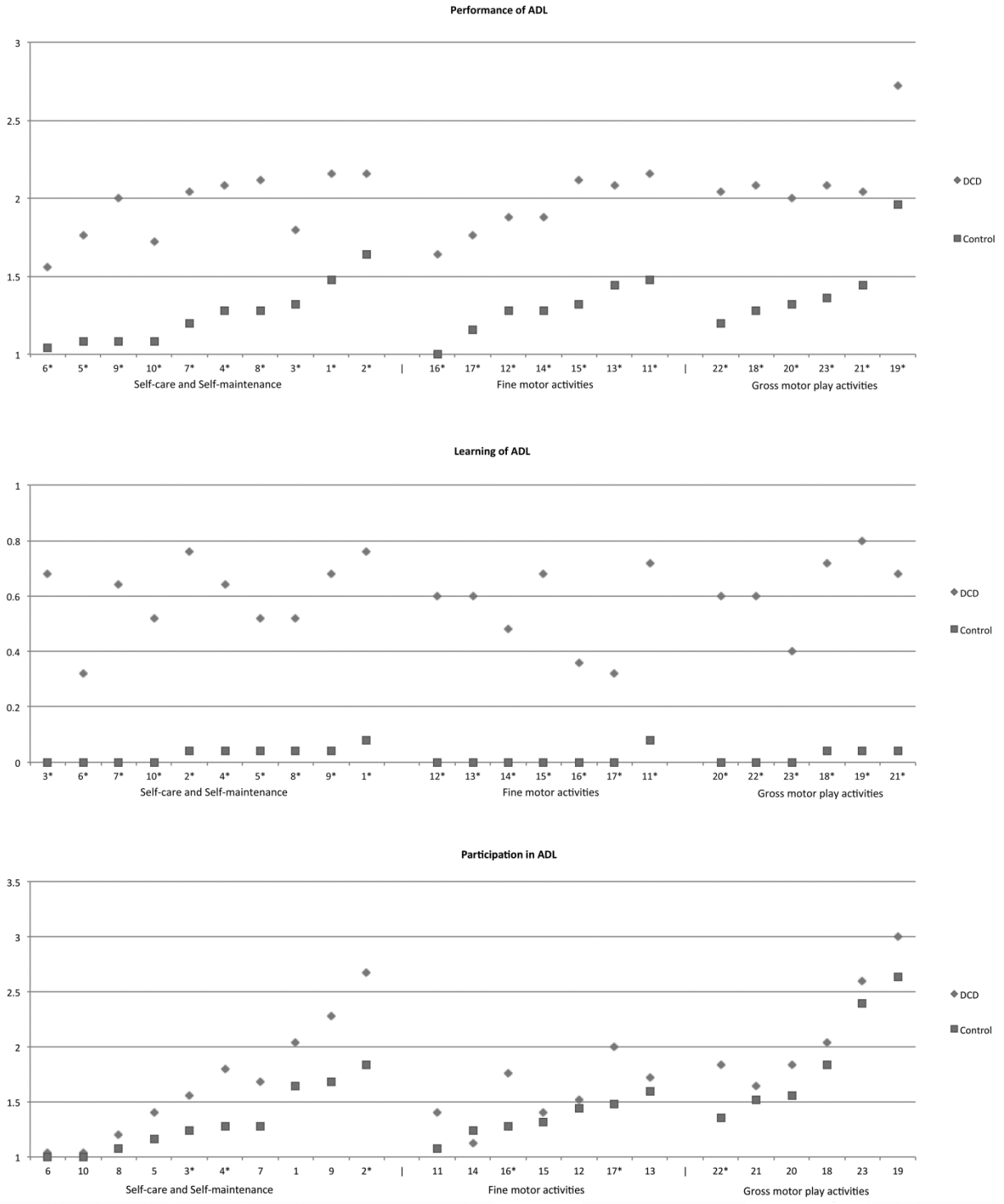
Table 5B. Backward regression analyses for mean DCDDaily-Q total participation scores.

	DCD group				Control group			
	B (SE)	*β* (95% CI)	*p*-value	R^2	*B* (SE)	*β* (95% CI)	*p*-value	R^2
Total score								
Model 1				.18				.32
Performance	0.28 (0.19)	.36 (-0.12 to 0.68)	.158		0.53 (0.22)	.45 (0.08 to 0.98)	.024*	
Learning	0.07 (0.18)	.10 (-0.29 to 0.43)	.698		1.23 (1.08)	.21 (-1.01 to 3.48)	.267	
Model 2				.17				.28
Performance	0.33 (0.15)	.41 (0.02 to 0.64)	.040*		0.61 (0.21)	.53 (0.18 to 1.03)	.007*	

Notes: * = Significant with alpha < .05. Table 5A, Model 1: Predictor variables are learning and participation, dependent variable is performance; Model 2: same variables but F set to >.100; Table 5B Model 1: Predictor variables are performance and learning, dependent variable is participation; Model 2: same variables but F set to >.100.

Figure 1.

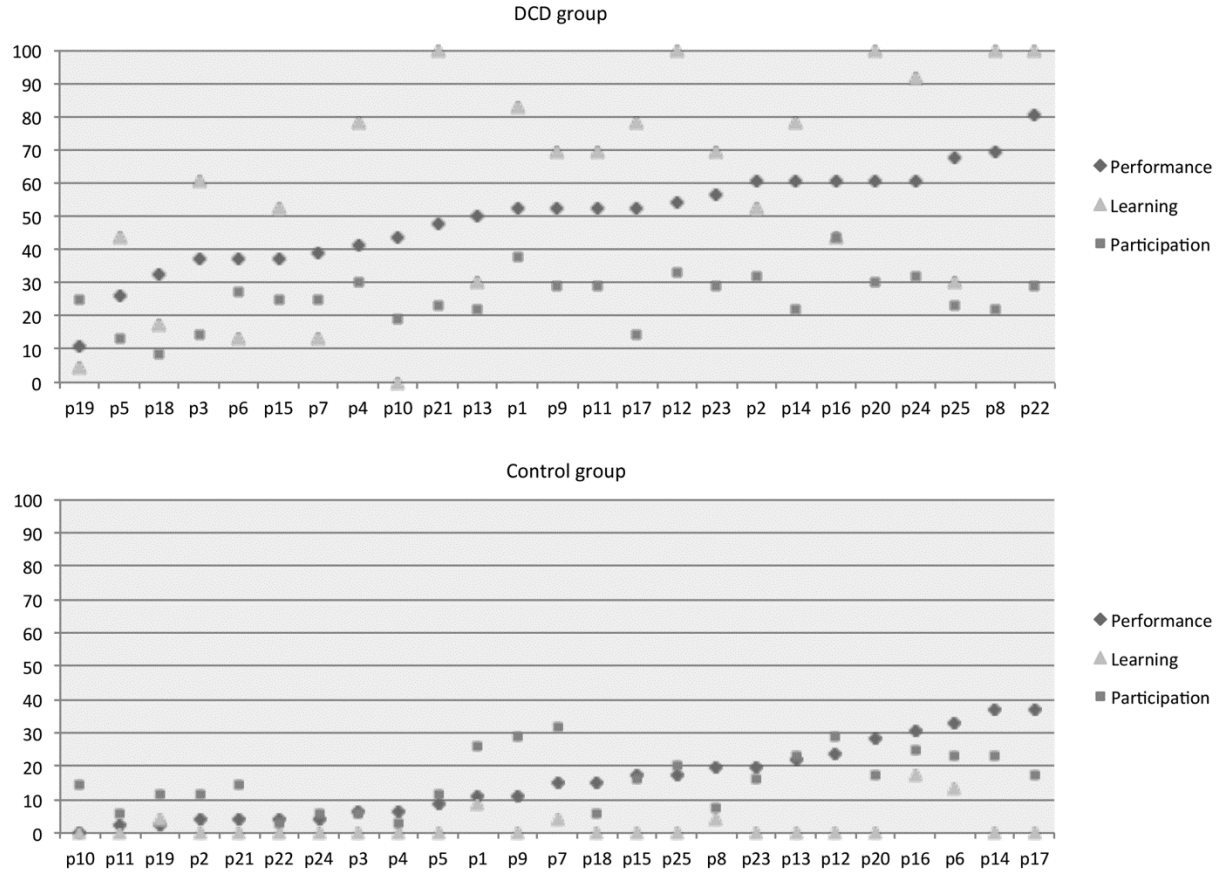
DCDDaily-Q mean item scores on ADL performance, learning, and participation in children with and without DCD



Notes: The items are organized per domain and sequenced from good to poor, for the mean DCDDaily-Q **item** scores in the control group (performance scores range from 1 [good] to 3 [poor]; learning scores range from 0 [did not take long to learn compared to peers] or 1 [took long to learn the ADL compared to peers]; and participation scores range from 1 [often performed] to 4 [never performed]). DCD = developmental coordination disorder; ADL = activities of daily living. An explanation of the item numbers is provided in Table 1. *= $p < .05$, marked at the item numbers.

Figure 2.

Percentage scores for ADL performance, learning, and participation, for all children in the DCD and the control group.



Notes: Children's scores are sequenced according to their performance scores, from good to poor. Percentage scores range from 0% (good performance, no delays in learning, and frequent participation) to 100% (poor performance and delayed learning in all ADL, and no participation in any of the ADL). DCD = developmental coordination disorder.

Appendix 1

Example and general explanation for the questions in the DCDDaily-Q (the complete DCDDaily-Q [in Dutch or English] is available on request from the authors)

<table>
<tr><td colspan="3">a. Activity
Catching a ball</td><td colspan="3">c. Correct performance
Confident, accurate catch of a ball thrown by an age peer from about 2 meters</td></tr>
<tr><td colspan="3">b. Participation
My child does this…

□ 1. regularly

□ 2. sometimes

□ 3. seldom

□ 4. not yet / never</td><td colspan="2">d. Quality
My child can do this…

□ 1. well

□ 2. sometimes well and at other times less well

□ 3. not very well (or badly) most of the time</td><td>e. Acquisition
My child …

□ is taking or has taken longer to learn this skill than his/her age peers</td></tr>
</table>

Step 1: In the first text box **a. Activity**, the motor action is described, *catching a ball* in our example.

Step 2: In the column below, **b. Participation**, we ask you to indicate how often your child performs this activity. You tick the box

1. *regularly*, when your child catches a ball, or tries to catch a ball often, for instance every day;
2. *sometimes*, when your catches a ball, or tries to catch a ball every now and then;
3. *seldom,* when your child only rarely catches a ball, or tries to catch a ball. He/She may, for instance, have tried but was unable to or does not feel like doing it and hardly ever tries;
4. *not yet / never*, when your child has never caught a ball, or has never tried to catch a ball, possibly because you think it is too difficult or too dangerous for your child. > You can skip columns d. and e.

Step 3: In text box **c. Correct performance**, we describe what we consider to be the right way to perform the activity. In our example: *Confident, accurate catch of a ball thrown by an age peer from about 2 meters.* **We urge you** to read these 'correct performance' definitions carefully and to use this definition to judge the way your child performs the activity.

Step 4: In column **d. Quality**, you are asked to choose the option that best describes the way your child performs the activity described. You tick

1. *well* when your child generally performs the activity *as described* in c.;
2. *sometimes well and at other times less well* when your child does not always perform the activity as described in c. Your child occasionally gets butter on his/her fingers or on the table, for instance;

3. ***not very well (or badly) most of the time*** when your child as a rule does not perform the activity as described in c. Your child tends to be messy or has more difficulty buttering his/her sandwich or takes longer than other children of his/her age.

Step 5: You tick the box in column **e. Acquisition** when you think it took or is taking your child longer than other children of about the same age to learn to master the activity as described in c.

Activities of Daily Living in Children With Developmental Coordination Disorder: Performance, Learning, and Participation

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