Comparing Language Profiles: Children with Specific Language Impairment and Developmental Coordination Disorder

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Abstract

Background: Although it is widely recognized that substantial heterogeneity exists in the cognitive profiles of children with Developmental Coordination Disorder (DCD), very little is known about the language skills of children with a relatively pure DCD.

Aims: This study compared the language abilities of children with DCD to a group whose language impairment has been well described, children with Specific Language Impairment.

Methods & Procedures: Eleven children with DCD, and 11 with SLI completed standardized and nonstandardized assessments of vocabulary, grammatical skill, nonword repetition, sentence recall, story retelling, and articulation rate. Performance on the nonstandardized measures was compared to a group of typically developing children of the same age.

Outcomes & Results: Children with DCD were impaired on tasks involving verbal recall and story retelling. Almost half of those in the DCD group performed similarly to the children with SLI over several expressive language measures, while 18% had deficits in nonword repetition and story retelling only. Poor nonword repetition was observed for all members of both the DCD and SLI groups. The articulation rate of the children with SLI was slower than that of the DCD group, which was slower than that of typically developing children.

Conclusions: Language impairment is a common co-occurring condition in DCD. The language profile of children with either DCD or SLI was similar in the majority of, but not all, cases.

Comparing Language Profiles: Children with Specific Language Impairment and Developmental Coordination Disorder

Approximately 6% of children fail to develop coordinated movement skills in a manner similar to other typically developing children (Mandich & Polatajko, 2003). These children have Developmental Coordination Disorder (DCD), characterized by marked motor impairment that affects functioning in daily activities (American Psychiatric Association, 1994) in the absence of intellectual or neurological dysfunction. Although it is widely recognized that substantial heterogeneity exists in the cognitive and language profiles of children with DCD (Kaplan, Wilson, Dewey, & Crawford, 1998; Piek & Dyck, 2004; Visser, 2003; Wilson, 2005), very little is known about the language profiles of children with relatively pure DCD. The purpose of the present study was to describe the language skills of children with relatively pure DCD, and to provide a comparison with a group whose language impairment has been well described, children with Specific Language Impairment (SLI).

Various terms such as developmental dyspraxia, minimal brain dysfunction, perceptual-motor dysfunction, physical awkwardness, and clumsiness have been used to describe children with motor coordination difficulties for decades (Cratty, 1994; Gubbay, 1978; Henderson, 1987). At an International Consensus Conference on Children and Clumsiness (Polatajko, Fox, & Missiuna, 1995), experts from around the world agreed that common nomenclature was essential and recommended that the term Developmental Coordination Disorder (DCD) should be used when referring to children with such motor difficulties. DCD is described in the American Psychiatric Association's Diagnostic and

Statistical Manual (DSM-IV, 1994) as a motor coordination disturbance that significantly hinders activities of daily living and/or school performance and is not the result of another physical disability. Although it was once believed that such clumsiness was due to maturational lag (Gubbay, 1978), it is now recognized that DCD is associated with a life-long disability (Cantell, Smyth, & Ahonen, 1994).

The conceptualization of DCD put forward by the DSM-IV represents the best available classification system for the disorder at present (Henderson & Barnett, 1998; Sugden & Wright, 1998). Geuze, Jongmans, Schoemaker, and Smits-Engelsman (2001) recently reviewed the criteria employed to select children with developmental motor problems in 176 publications and recommended the following criteria for identifying children with DCD for research purposes: (1) a score above 69 on a test of intelligence, and (2) performance below the 15th centile on a standardized test of fine and gross motor performance to detect motor problems although a more stringent criteria of below the 5th centile may be adopted in experimental research designs. These authors report that the Movement Assessment Battery for Children (M-ABC; Henderson & Sugden, 1992) is not only the most widely employed motor test for this purpose, but it is also the most appropriate to assess the DSM-IV criteria for DCD.

It is widely recognized that the symptoms and severity of DCD vary from child to child (Henderson, 1987; Willoughby & Polatajko, 1995). Indeed, DCD has been associated with articulation problems (e.g., Cermak, Ward, & Ward, 1986), Attention Deficit Disorder (e.g., Kaplan, Crawford, Wilson, & Dewey, 1997), learning disabilities (e.g., Kaplan et al., 1998), dyslexia (e.g., Geuze & Kalverboer, 1994), and developmental language disorder (e.g., Fletcher Flinn, Elmes, & Strugnell, 1997). The substantial heterogeneity that exists in the cognitive profiles of children with DCD has led to the suggestion by some researchers that comorbid deficits in DCD is the norm rather than the exception (Kaplan et al., 1998; Piek & Dyck, 2004; Wilson, 2005). Several studies have attempted to uncover subtypes among children with DCD (e.g., Dewey & Kaplan, 1994; Wright & Sugden, 1996). Although no consensus has been reached, several studies have identified a group of children with DCD with a generalized sensorimotor deficit who have a particularly high rate of additional co-occurring deficits (Visser, 2003). It is of particular interest to examine groups of children with DCD with or without co-occurring deficits in order to improve our understanding of DCD (Visser, 2003).

In the present study, we describe a group of children with DCD without co-occurring receptive language deficits. Although the working memory profiles of this group have been described elsewhere (Alloway & Archibald, in press), the language abilities of this group of children with relatively pure DCD were of particular interest in the current work. Despite the exclusion of children with receptive language deficits from the DCD group in this study, we hypothesized that this group may still present with atypical abilities in some language domains. Two lines of evidence led us to this prediction: First, this group of children with DCD were found to have short-term and working memory deficits in both the verbal and visuospatial domains (Alloway & Archibald, in press). Several studies have demonstrated close and specific associations between verbal short-term memory measures and vocabulary (e.g., Gathercole, Willis, Emslie, & Baddeley, 1992). In addition, links have been found between working memory and other aspects of language such as spoken narrative skills (Adams & Gathercole, 1996), utterance length and range of syntactic constructions used (Adams &

Gathercole, 1995, 2000), sentence repetition (Willis & Gathercole, 2001), and language comprehension (e.g., King & Just, 1991). Even visuospatial short-term memory may support the comprehension of spatial terms in language (Phillips, Jarrold, Baddeley, Grant, & Karmiloff-Smith, 2004), and the early stages of learning to write (Manso, & Ballesteros, 2003) and decode (Meyler, & Breznitz, 1998). Secondly, heterogeneity in language profiles characterizes groups with other developmental pathologies such as children with developmental language impairments who typically have relative strengths in vocabulary and deficits in grammatical skills (Leonard, 1998). Very little is known about the language abilities of children with DCD. Two studies have examined gesture use, a language task that also taps motor skills, and found children with DCD to be impaired (Hill, Bishop, Nimmo-Smith, 1998; Zoia, Pelamatti, Cuttini, Casotto, & Scabar, 2002). Findings of particular difficulty with verbal requests for a gesture (Zoia et al., 2002) suggest that the deficits cannot be entirely accounted for by a motor impairment alone. It may be then, that children with a relatively pure DCD also have deficiencies in one or more aspects of language, and it was the aim of the present study to investigate this.

Of particular interest is whether the language profile of children with DCD is similar to that of children with SLI. A key issue in the field of language disorders is whether the profiles of language deficit among children with different kinds of disorders are similar suggesting a common mechanism, or unique raising the possibility of differential underlying deficits. In a study of children with a variety of neurological abnormalities including fragile X, Sotos syndrome, congenital hydrocephalus, and congenital left hemisphere infact, Levy (2003) reported that grammatical development in the early phases (mean length of utterance 3 or under) was not diagnostic of disorder type. Although these neurological conditions are not directly comparable to the developmental pathologies described in the present work, this finding may suggest that a common language deficit underlies several disorders. In older children, however, differing profiles of morphosyntactic skills have been reported in comparisons of children with SLI and William's Syndrome (Clahsen & Temple, 2003), and children acquiring a second language (Paradis & Crago, 2000).

SLI is a relatively common developmental condition in which a child fails to develop language at the typical rate despite normal general intellectual abilities, adequate exposure to language, and in the absence of hearing impairments. There has been some consensus in recent years regarding the criteria for identifying research participants with SLI after an influential study by Records and Tomblin (1994) indicating that Speech-Language Pathologists agreed on the diagnosis of SLI for individuals scoring at least 1.25 standard deviations below the mean on composite language measures. Exclusion criteria include performance below age level on tests of nonverbal abilities or articulation, or the presence of hearing impairment, Autism Spectrum Disorder, or other developmental pathology that could account for the language learning disability. As well, many research groups include only those individuals with deficits in both expressive and receptive language abilities (e.g., Stark & Tallal, 1988; Rice & Oetting, 1993).

Even with fairly stringent criteria, however, considerable heterogeneity exists in the profiles of children with SLI both within the realm of language and across other domains. Lexical, grammatic, and syntactic skills may all be impaired to some degree, although the extent of the deficit in any area varies across individuals. As well, SLI deficits have been reported in nonlinguistic tasks such as problem solving (e.g., Ellis Weismer, 1991) and attention (e.g., Niemi, Gundersen, Leppasaari, & Hugdahl, 2003). Even motor impairments have been found to be more common amongst children with SLI (e.g., Hill, 2001), although the motor impairments tend to occur in children with SLI who also have speech production deficits (Bishop, 2002). Despite the heterogeneity, a number of tasks do differentiate children with SLI. For example, story retelling has been found to be the best predictor of overall prognosis in both preschool and school age children with SLI (Bishop & Edmundson, 1987; Botting, Faragher, Simkin, Knox, & Conti-Ramsden, 2001). Two measures have been proposed as clinical markers of the disorder: verb tense and agreement (Leonard, Miller & Gerber, 1999; Rice & Wexler, 1996), and nonword repetition (Bishop, North, & Donlan, 1996; Dollaghan & Campbell, 1998; Gathercole & Baddeley, 1990). It remains unclear whether these tasks are sensitive to a specific impairment as reflected by relatively greater deficits in children with SLI than children with other developmental conditions affecting language, or to a general language delay with impairments present across disorder types. In the case of poor nonword repetition, decrements have been reported for a variety of groups including individuals with specific reading disabilities (e.g., Snowling, 1983; Swanson & Berninger, 1995), and Down's syndrome (e.g., Laws, 2004).

The present study compared groups of school-age children with either SLI or DCD on a battery of language measures. One aim was to describe the language profile of children with a relatively pure DCD, who had age-appropriate receptive language skills. Intact linguistic abilities across several measures would be consistent with a specific impairment in motor coordination, whereas a mixed language profile would suggest that a more general deficit is characteristic of the disorder. A second goal was to compare the language profiles of DCD and SLI. Similar strengths and weaknesses across language domains would highlight commonalities in the language skills of the two groups, whereas areas of difference would point to unique underlying mechanisms.

Method

Participants

Twenty-two children participated in the specifically-impaired groups in the present study, 11 children with SLI (7 males; 4 females), and 11 children (8 males, 3 females) with DCD. Because three of the measures included in the present study were not standardized for this age range, data from an age-matched typically developing group (7 males; 4 females) was selected from a database available in our lab for these measures and provided a comparison with the impaired groups. The mean ages of the groups were as follows: SLI, 8 years; 10 months (*SD*=1.41, *R*=6;9-10;10); DCD, 8;11 (*SD*=1.43, *R*=6;11-11;0); age-match, 9 years; 3 months (*SD*=1.36, *R*=7;0-11;1). All participants achieved a standard score of 85 or greater on a test of nonverbal reasoning (*Raven's Colored Matrices*; Raven, Court & Raven, 1986), and all were native English speakers. None of the children were diagnosed with ADD/ADHD, Autism Spectrum Disorder, or hearing impairment. All of the children with recruited from schools in the northeast region of England, all were white and from a similar lower-middle class socioeconomic grouping.

SLI group. The children in the SLI group met identification criteria for SLI consistent with those described by Records and Tomblin (1994). They performed at least 1.25 *SD* below the mean on two of the following (including at least one receptive measure): *British Picture Vocabulary Scales, 2nd ed.* (Dunn, Dunn, Whetton & Burley, 1997); *Test for Reception of Grammar* (Bishop, 1982), or *Recalling Sentences* subtest of *Clinical Evaluation of Language Fundamentals – UK3* (CELF-UK3, Semel, Wiig, & Secord, 1995). Two measures were used to rule out motor impairment in this group: (1) all of the children in the SLI group received a standard score greater than 85 on the *Goldman Fristoe Test of Articulation 2* (Goldman & Fristoe, 2000), and (2) none were identified as having motor difficulties on the *Movement Assessment Battery for Children* teacher checklist (M-ABC, Henderson & Sugden, 1992).

DCD group. All of the children in the DCD group were identified by a qualified occupational therapist as having motor difficulties consistent with the DSM IV-R criteria for DCD, and performed below the 15th centile on the M-ABC (Henderson & Sugden, 1992). Children in the DCD group achieved a standard score of 85 or greater on the BPVS-II (Dunn et al., 1997) and TROG (Bishop, 1982), and were individually age-matched to the children in the SLI group.

Age-match group. None of the children in the control group had any history of speech, language, or motor coordination problems, or any type of exceptional educational needs. All of the children scored within 1 *SD* of the mean for their age on all four of the language measures described below.

Speech and Language Measures

A standard battery of language tests was administered individually to the children, measuring their articulation, lexical, and higher order semantic and grammatical language abilities. Testing took place in one or two sessions, in a quiet room in the child's school with breaks provided as necessary for the individual child. The 5 standardized and 3 nonstandardized measures (*nonword repetition*, *story retelling* and *articulation rate*) administered including those used for identification purposes as outlined above are as described below.

British Picture Vocabulary Scales, 2nd ed. (BPVS-II; Dunn et al., 1997). The BPVS-II tests lexical comprehension by presenting an auditory word and asking the child to pick the correct pictures from an array of four pictures.

Test for Reception of Grammar (TROG, Bishop, 1982). The TROG is a multiple choice comprehension test in which the task is to select a picture to match a sentence spoken by the tester. All items use a simple vocabulary; grammatical complexity increases as the test proceeds, and understanding of 20 sentence types is tested.

Word Structure subtest of *Clinical Evaluation of Language Fundamentals – UK3* (CELF-UK3, Semel et al., 1995). The word structure subtest tests expressive grammatical skills by asking the child to complete a sentence about a picture that is designed to elicit particular grammatical structures. This subtest is normed up to 8;11; scaled scores for children 8 or older were based on the 8;11 scores. Groups were also compared on raw score on this measure.

Recalling Sentences subtest of *Clinical Evaluation of Language Fundamentals – UK3* (CELF-UK3, Semel et al., 1995). The recalling sentences subtest assesses expressive language skills by having the child repeat auditorally presented sentences of increasing grammatical complexity.

Goldman Fristoe Test of Articulation 2 (GFTA-2, Goldman & Fristoe, 2000). The GFTA-2 measures the accuracy of productive phonology for the consonant sounds of English. The child is presented with a series of pictures to name, such that all the consonant sounds of English are tested in word initial, medial, and final position, where applicable.

Children's Test of Nonword Repetition (CNRep; Gathercole & Baddeley, 1996). The child is asked to repeat 40 non-words, divided equally into two-, three-, four- and five-syllable items. The non-words are presented in a fixed random order by audiotape recording with typical English stress patterns. The test provides norms up to age 8;11 and thus were not suitable for the present participant groups. Thus, the CNRep was treated as a nonstandardized measure in this study.

Story retelling. Story retelling was included as a measure of narrative skill. The child listened to a short story read aloud, and was asked to retell it. The number of story events retold was recorded, and a percentage score calculated.

Articulation rate. Rate of articulation was measured by asking children to repeat each of the following words individually, as fast as possible, five times: *elephant, newspaper, telephone, banana*, and *bicycle*. Following Hulme, Thomson, Muir, and Lawrence (1984) and Hulme and Tordoff (1989), these words were selected because they are highly familiar, require rapid alternating movements, and use labial, alveolar, and velar sounds. The digital recordings of each trial were measured on an acoustic waveform with visual and auditory control using the software program, Goldwave (2003). Each run was measured from onset to offset of voicing. A run was defined as at least two repetitions of a target word without pauses of more than 150 msec. Number of syllables per second was calculated for each run, and the mean of all runs was taken as the articulation rate.

Results

Table 1 about here

Standardized Measures

Table 1 presents descriptive statistics for all of the standardized measures for the SLI and DCD groups. Data was available for the age-match group for all of the measures except the Word Structure subtest. These data are summarized in Table 1 for comparison purposes. Consider first the scores of the DCD group. Mean scores were within age range for the Raven's Matrices and BPVS-II, as expected given the inclusion criteria. The group also scored within 1 *SD* of the standardized mean on the TROG, Word structure subtest, and GFTA-2. The mean score for the Recalling sentences subtest was 3.4 *SD* below the mean. Individual profiles conformed closely to the group pattern with all members of the DCD group achieving age appropriate scores on the tests used for participant selection (Raven's Matrices, BPVS-II, TROG). Only one child scored below 85 on the GFTA-2, and this child scored in the average range on all of the remaining tests. Performance on the expressive language measures was more variable: Four of the children in the DCD group scored below 7 on each of the Word structure and Recalling sentences subtests, three (27%) of whom were the same children in both cases. Thus, 54% of the DCD group showed no impairment on any of the standardized language tests, and an additional 27% were impaired on two tests of expressive language.

The children with SLI were impaired on all of the standardized measures except those for which age-appropriate performance was selected, the Raven's Matrices and GFTA-2. Group means were approximately 2 *SD* below the standardized mean for all of the language measures. Individual profiles conformed closely to this group pattern. Eighty-two percent of the group scored below 85 on both the BPVS-II and TROG. The group was uniformly impaired on the Recalling sentences and CNRep tests while 3 individuals scored 7 (just at 1 *SD* below the scaled mean) on the remaining expressive test, the Word structure subtest.

The scores on the standardized measures of the DCD group were consistently higher than those of the SLI group with the exception of the Raven's Matrices. The performance of the DCD and SLI groups was compared for all standardized measures in independent t-tests. The DCD group achieved significantly higher scores on the BPVS-II, TROG, Word structure raw score and scaled score, and Recalling sentences subtest, $t(20)=6.036, 5.138, 3.404, 3.475, 4.235$, respectively, $p<.006$, all cases. The groups did not differ on Raven's Matrices, or GFTA-2, $t(20)=.000, 1.348$, respectively, $p>.10$, both cases. It should be noted that a Bonferroni correction to the alpha-level was adopted for these comparisons such that the standard .05 level was divided by the number of comparisons (7) for a critical value of .007, however this manipulation did not change the conclusions for any of the comparisons.

Nonstandardized measures

Figures 1, 2, and 3 about here

Figures 1, 2, and 3 present side-by-side boxplots comparing the DCD, SLI, and age-match groups for the three nonstandardized measures, CNRep, percent story events retold and articulation rate, respectively. Boxplots have the advantage of representing the entire distribution of the data set for each group with the median represented by the thick black line, the middle 50% of the data depicted by the box, the data range reflected by the whiskers, and outliers marked above or below the whiskers where applicable. Given the small sample size employed in the present study and the asymmetrical (non normal) distributions for some of the variables as evident in the boxplots, groups were compared on these measures using the Kruskal-Wallis nonparametric test for multiple comparisons. Chi-square was used to compare proportions. Mann-Whitney U tests were employed for *post hoc* pairwise comparisons.

Consider first the CNRep. It can be seen in Figure 1 that there is considerable differentiation in performance of the groups on the nonword repetition task with the age-match group achieving the highest scores (*M*=27.09, *SD*=5.338), followed by the DCD (*M*=22.36, *SD*=3.64) and then SLI groups (*M*=15.27, *SD*=4.25). The proportion of children in each of the DCD and SLI groups who scored more than 1 and 1.65 *SD* below the mean for typical children of the same age was determined by calculating a cutoff point based on the performance of the age-match group. In a normal distribution these levels correspond to the 16th and 5th centiles respectively, with the 5th clearly providing a reasonable threshold of deviance (Ramus, Rosen, Dain, Day, Castellote, White, et al., 2003). Thus, scores below 22 (i.e., 27.09 - 5.338 = 21.75) and 19 corresponded to 1 or 1.65 *SD* below the age-match mean. Forty-five percent (5/11) of the children in the DCD group and 91% (10/11) of those in the SLI group repeated fewer than 22 nonwords correctly. Similarly, two in the DCD group and seven in the SLI group accurately recalled fewer than 19 nonwords. The DCD group data was inspected to determine whether the five individuals who repeated fewer than 22 nonwords correctly also obtained low scores on other language measures. Three of the individuals had standard scores below 85 on both the Word structure and Recalling sentences subtests and an additional individual performed below age level on the Word Structure subtest only. The remaining child scored in the average range on all of the standardized measures. Thus, 83% of those in the DCD group who scored poorly on the CNRep also had deficits on at least one of the other expressive language measures. In the Kruskal-Wallis test performed on the CNRep data, there was a significant effect of group, $\chi^2(2)=17.389$, $p<.001$. *Post hoc* comparisons revealed that the age-match group achieved significantly higher CNRep scores than either the DCD, $U=28.00$, $p=.03$, or SLI groups, $U=5.50$, $p<.001$, and the SLI group recalled significantly fewer nonwords than the DCD group, $U=15.50$, $p=.003$.

It can be seen in Figure 2 that there was a large degree of overlap in the performance of the DCD and SLI groups on the story retelling measure, although a higher proportion of the DCD group achieved scores within the range of those of the age-match group. Cut offs of 52 and 41 percent story events retold corresponding to the 16^{th} and 5^{th} centile of the age-match group data were calculated as described above for the CNRep. Fifty-five percent (6/11) of the children in the DCD group and 64% (7/11) of those in the SLI group retold fewer than 41% of the story events, and the remaining individuals in both groups retold greater than 52%. The DCD group data was inspected to determine whether the six individuals who retold fewer than 41% of the story events also obtained low scores on other language measures. Two individuals had scored within the average range on all of the standardized measures, and three had standard scores below 85 on both the Word structure and Recalling sentences subtests, while the remaining child performed below age level on one the Word Structure subtest only. Thus, the low scores of 33% of those in the DCD group who scored poorly on the story retelling task were not associated with any other deficits on the standardized language measures included in this study. In the Kruskal-Wallis test performed on the data from story retelling, there was a significant effect of group, $\chi^2(2)=8.008$, $p=.018$. *Post hoc* comparisons revealed that the age-match group retold significantly more story events than either the DCD, $U=29.5$, $p=.04$, or SLI groups, $U=20.5$, $p=.008$, whereas the DCD and SLI groups did not differ, $U=47.5$, $p=.39$.

The results displayed in Figure 3 for articulation rate indicate that there was little overlap between groups on this measure with the SLI rate in syllables per second (s/sec) being slowest ($M=4.91$, $SD=0.64$), followed by the DCD group ($M=5.62$, $SD=0.79$), and the age-match group, the fastest ($M=6.17$, $SD=0.79$). Cut offs of 5.37 and 4.87 s/sec corresponding to the 16th and 5th centile were calculated based on the age-match group data as described above. Three children in the DCD and nine in the SLI group obtained rates slower than 5.37 s/sec. Rates lower than 4.87 s/sec were obtained by two and six children in the DCD and SLI groups, respectively. There was no clear relationship between those from the DCD group who had slow articulation rates and their language scores: two individuals scored below 85 on both the Word structure and Recalling sentences subtests, and one scored in the average range on both of these tests. In the Kruskal-Wallis test performed on articulation rate, the effect of group was significant, $\chi^2(2)=12.600$, $p=.002$. *Post hoc* comparisons indicated that the articulation rate of the age-match group was faster than either the DCD, $U=30.0$, $p=.047$, or SLI groups, *U*=11.00, *p*=.001. As well, the DCD group rate was faster than that of the SLI group, *U*=29.00, *p*=.039.

Discussion

This study examined the language profiles of children with either Developmental Coordination Disorder (DCD) or Specific Language Impairment (SLI). Children with a relatively pure DCD were found to have expressive language deficits characterized by poor nonword repetition, sentence recall, and story retelling. As a group, children with DCD had expressive grammatical skills superior to that of children with SLI, although 36% of the DCD group were impaired in grammatical skills as well. Both groups were markedly impaired in nonword repetition however, the SLI group repeated items less accurately than the DCD group. The two clinical groups performed at similar levels on more complex expressive language tasks including sentence recall and story retelling. Three children in the DCD group performed in the average range on all of the language measures included in the present study, 18% were impaired on story retelling only and 9% on nonword repetition only. Forty-five percent scored below age level on at least three of the four expressive measures (nonword repetition, grammatical structures, sentence recall, story retelling). Interestingly, the articulation rate of the DCD group was faster than that of the SLI group although still slower than that of typically developing children of the same age.

Despite being selected as having a relatively pure DCD, the children with DCD in the present study were impaired also in language tasks requiring verbal recall and narrative skills. For a substantial proportion of the group, the profile of expressive language deficits was similar to that of children with SLI with impairments across a number of tests tapping different skills including grammatical abilities. These results suggest that a co-occurring language impairment similar to that of SLI may be a common occurrence in DCD. Such results are complemented by reports that co-occurring deficits in attention, reading, and language are more the rule than the exception in DCD (Kaplan et al., 1998; Piek & Dyck, 2004; Wilson, 2005).

Not all of the expressive language deficits followed the SLI profile, however. Almost 20% of the DCD group had difficulty with narrative skills without additional impairments in expressive language. One possibility is that the expressive language deficit of this group was so mild as to be measurable only in the more difficult language tasks. Results from the SLI group, however, suggest that the demands were greater for sentence recall than story retelling whereas the opposite pattern was evident for the DCD group: a higher proportion of the children with DCD obtained low scores on the story retelling than sentence recall task. This latter finding also argues against an interpretation that the impaired verbal recall skills of the DCD group accounted for other language deficits such as those in the narrative task. Thus, these results raise the possibility that the core language deficit may not be the same for children with SLI and at least some children with DCD.

The present results indicate that while some portion of children with DCD may have a co-occurring linguistic deficit similar to that of children with SLI, a substantial group has other language difficulties. It is tempting to suggest that these findings provide support for a modular view of language with specific deficits giving rise to two different developmental pathologies. It must be acknowledged, however, that the measures employed in the present study were broad and may not have been sensitive to subtle linguistic deficits shared by the two groups. The findings do highlight the potentially unrecognized clinical needs of children with DCD. Some children with DCD may have a co-occurring SLI, a familiar pattern typically identified in school settings and referred for speech and language services. Others, however, may have a less common language profile which may go unrecognized and thus, may not be addressed with appropriate learning strategies. It is clear that further examination of the language needs of children with DCD is warranted.

In addition to language deficits, both the SLI and DCD groups had a slower articulation rate than that of typically developing children of the same age. Surprisingly, the DCD group was less impaired on this measure than the SLI group. It may be that the SLI group was a more severely impaired group overall as reflected by their receptive language deficits and lower raw scores on the nonword repetition test. Nevertheless, these findings do suggest that even in children with SLI and no observable articulation or phonological deficits, subtle motor speech deficits may still be present. In line with this view, Goffman (2004) reported that children with SLI have difficulty producing well-organized and stable rhythmic speech motor movements. It may be that children with SLI also have high rates of co-occurring deficits including motor deficiencies (Hill, 2001).

What this paper adds

This study compared the language profiles of children with a relatively pure Developmental Coordination Disorder (DCD) and those with a Specific Language Impairment (SLI). The children with DCD had deficits in verbal recall and narrative skills. A high proportion of these children also had impairments consistent with an expressive-only SLI. The children with SLI were more impaired on the only speech motor measure included in the study, articulation rate. The different profiles across groups have clinical implications both for identification and learning support of children with DCD and SLI.

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Table 1

Descriptive statistics for all standardized measures for the DCD and SLI groups

	Participant Groups											
	DCD				SLI				Age-match			
	Min	Max	*M*	*SD*	Min	Max	*M*	*SD*	Min	Max	*M*	*SD*
Raven's Matrices	85	119	101.36	11.13	90	125	101.36	9.97	88	125	114.09	11.92
BPVS-II	86	121	100.91_{b}	9.18	58	94	76.09_{bc}	10.08	90	122	109.27_{c}	11.25
TROG	86	114	97.55_{b}	10.03	63	91	77.36_{bc}	8.31	94	114	107.36_{c}	6.45
Word Structure RS	19	31	25.82_{b}	4.36	13	27	18.82_{b}	5.25				
Word Structure[a]	4	12	8.09_{b}	2.70	3	7	4.73_{b}	1.74				
Recalling Sentences[a]	3	10	6.91_{b}	2.77	3	5	3.27_{bc}	0.65	6	15	9.18_{c}	2.68
GFTA-2	76	107	95.18	7.69	87	99	91.82_{c}	3.06	87	109	103.18_{c}	6.11

Note. All measures are in standard scores (*M*=100, *SD*=15) unless otherwise indicated; Raven's Matrices = Raven's Colored Progressive Matrices; BPVS-II = British Picture Vocabulary Scales, 2nd ed.; TROG = Test for Reception of Grammar; CNRep =

Children's Test of Nonword Repetition; GFTA-2 = Goldman Fristoe Test of Articulation – 2; RS = raw score. Means in the same row with like subscripts differ at p<.007.

a - scaled score (M=10, SD=3)

Figure Captions

Figure 1. Side-by-side boxplots comparing CNRep raw score for the DCD, SLI, and Age-match groups.

Figure 2. Side-by-side boxplots comparing story retelling (% events retold) for the DCD, SLI, and Age-match groups.

Figure 3. Side-by-side boxplots comparing articulation rate in syllables per second (s/sec) for the DCD, SLI, and Age-match groups.

Figure 1. TOP

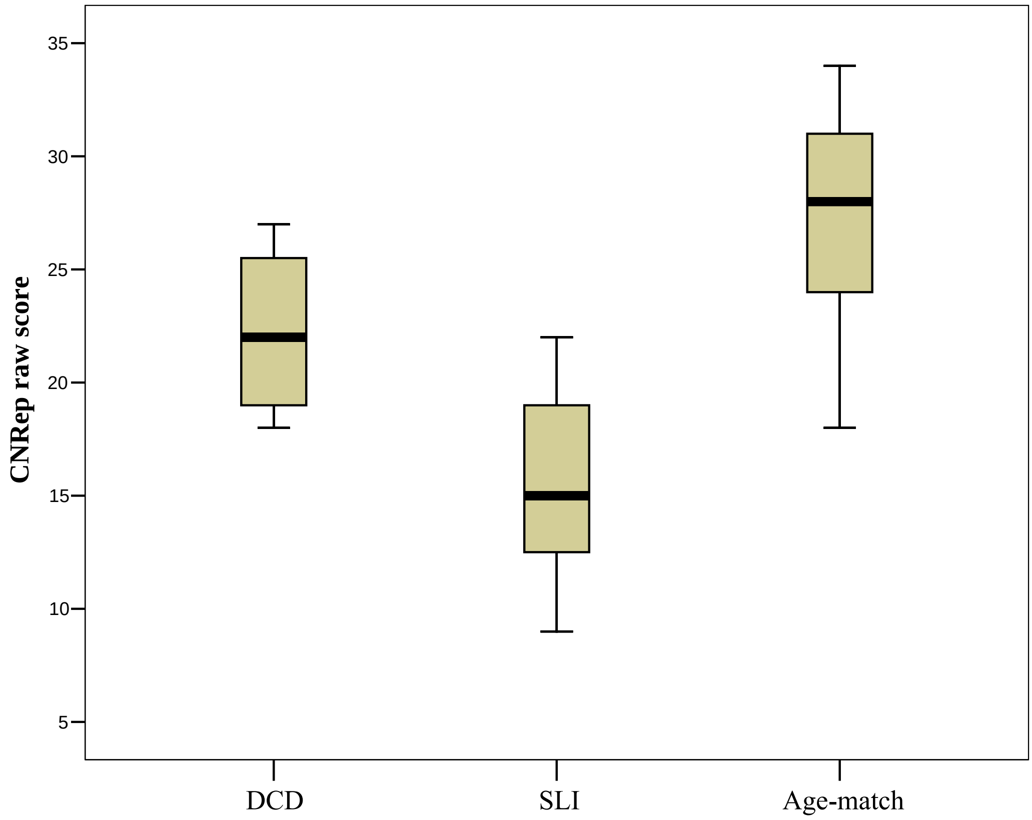


Figure 2. TOP

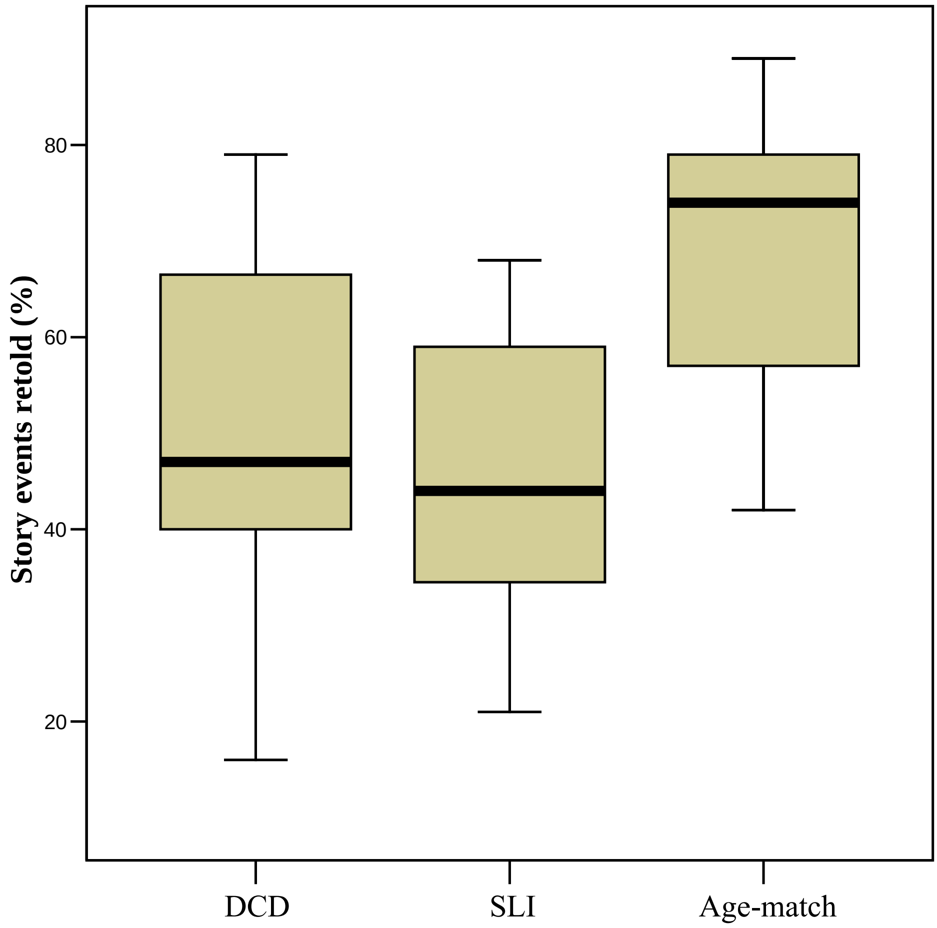
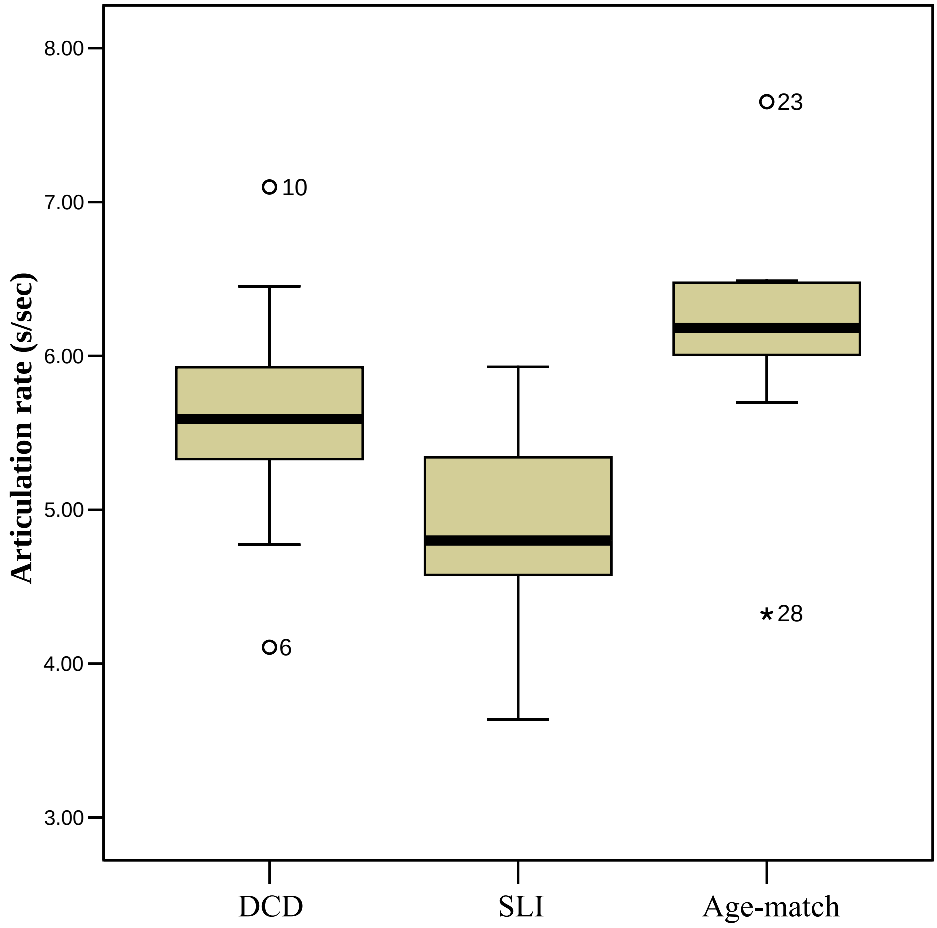


Figure 3. TOP



8.00
7.00
6.00
5.00
4.00
3.00
Articulation rate (s/sec)
10
6
23
28
DCD
SLI
Age-match