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# Monozygotic Twins Concordant and Discordant for DCD: Two Sides to the Story

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Being an identical twin does not necessarily mean having identical perceptions of family functioning, nor of the twin relationship. Using the co-twin control design, the aim of this study was to explore perceptions of family dynamics and the twin relationship in monozygotic (MZ) twins discordant and concordant for Developmental Coordination Disorder (DCD). It was hypothesized that, as has been found in twins discordant for cerebral palsy, twins without DCD would perceive family functioning as less healthy than would their co-twins with DCD. It was also hypothesized that the twin relationship would be regarded generally as mutually supportive. Questionnaire data on 866 sets of MZ twins aged 6 to 17 years were used to identify seven sets discordant, and two sets concordant for DCD. Quantitative (General Functioning Scale of the Family Assessment Device — FAD), and qualitative (semi-structured interview) measures were used to assess family dynamics and the twin relationship. In discordant sets, six of seven twins without DCD rated family functioning at a less healthy level than did their co-twins with DCD. All twins in the DCD concordant sets rated their family functioning at a healthy level. From the semi-structured interviews, emergent themes included friendship, support, minimal sibling rivalry, and minor difficulties. It was concluded that, overall, the twin relationship was regarded as close and mutually supportive, with an ambivalent polarity between the best and most difficult aspects of being an identical twin. Implications for research, policy and clinical practice are discussed.

■ **Keywords:** monozygotic co-twin control, discordant, concordant, developmental coordination disorder, Family Assessment Device, qualitative

Developmental Coordination Disorder (DCD) is the term applied to movement disorder as described in the *Diagnostic and Statistical Manual of Mental Disorders — Fourth Edition Text Revision* (DSM-IV-TR; American Psychiatric Association, 2000). Diagnostic criteria are characterized by a marked impairment in the development of motor coordination (Criterion A); a diagnosis is made only if the impairment significantly interferes with academic achievement or activities of daily living (Criterion B); the diagnosis is made provided the movement disorder is not due to a medical condition such as cerebral palsy (CP), hemiplegia or muscular dystrophy, nor must criteria be met for Pervasive Developmental Disorder (Criterion C). If mental retardation is present, motor deficits must be more than anticipated with mental retardation (Criterion D). Specific Developmental Disorder of Motor Function (International Statistical Classification of Diseases and Health Related Problems 10th Revision, Second Edition — ICD-10, World Health Organization, 2004), has similar diagnostic criteria.

There has been little exploration into the long-term implications for families caring for children and young people with DCD, and for the young people themselves. Stephenson and Chesson (2008) used questionnaire data from 35 families of children with DCD, and semi-structured interviews with 12 of those mothers six years after attendance at a screening clinic, to ascertain outcome in their children aged 11 to 17 years. All 12 mothers reported

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that, compared to other children, their child with DCD had persistent motor and academic difficulties. The mothers also noted emotional problems in their children, expressed as anger, frustration, unhappiness, distress, depression, low self-esteem, shyness and embarrassment. They believed that the entire family, and in some instances the extended family, was impacted.

The sibling relationship is one of the most important and enduring. This is the case whether the relationship is largely rewarding and satisfying, or unpleasant and alienating. For instance, in their longitudinal study of the nature of positive sibling relationships, Gass and colleagues (2007) concluded that supportive and affectionate sibling relationships were protective, especially during stressful times. This was the case irrespective of the quality of the mother–child relationship. Similarly, negative effects of a poor sibling relationship have been found. After adjusting for quality of parent–child relationships, Waldinger and colleagues (2007) found that a poor sibling relationship in men prior to 20 years of age predicted major depression at the age of 50 years.

Siblings of chronically ill and disabled children have expressed both benefits and tribulations. Children and young people aged 4 to 16 years who participated in the Ontario Child Health Study were at twofold risk for emotional disorders, including depression, anxiety, obsessive–compulsive disorder, and social adjustment problems, than were siblings of matched well children (Cadman et al., 1988). There was a one-point-sixfold increase in risk for poor peer relationships. There was no increased risk for adjustment problems.

Chesson and colleagues (1990) reported on family relationships and dynamics of 31 children, aged 5 to 11 years, with motor/learning difficulties. The authors found diverse interactions, from close and loving to total rejection. Some brothers, particularly, reportedly ignored, resented and at times were jealous of their sibling with motor deficits. Some resented the disproportionate amount of time parents spent with the sibling with motor difficulties, and the fact that family routines and activities were frequently tailored to meet the needs of their sibling.

The relationship between twins has been recognized as being closer than the relationship of non-twin siblings. Unlike relationships between singleton siblings, the relationship between multiples begins in the womb. Rende and colleagues (2005) compared levels of sibling contact and mutual friendships in monozygotic (MZ — 'identical') and dizygotic (DZ — fraternal) twins, biological non-twin siblings, half-siblings and non-biological siblings. They found that MZ twins had the highest level of sibling contact and mutual friendships. Smith (2007) compared 93 sets of MZ and 98 sets of same-sex DZ twin pairs aged 9 to 18 years on companionship, empathy, directiveness/teaching, avoidance, rivalry and aggression. She found that MZ twins reported higher levels of companionship and empathy than did same-sex DZ twins, and lower levels of avoidance, rivalry and aggression. On self- and parental-report, MZ twins were perceived as having a more positive relationship than DZ twins. Noller and colleagues (2008) found that MZ twins were more positive than DZ twins in competitive situations, and suggested that MZ twins regarded their close twin relationship as creating a buffer against difficulties created by comparison and competition.

There is little literature on the relationship between MZ twins in pairs discordant for movement disorder. A study of depressive symptomatology in a larger sample of MZ twins discordant for DCD and attention deficit hyperactivity disorder (ADHD), that included the twins in the present study, found higher levels of depressive symptomatology in MZ twins with either DCD or ADHD compared to their co-twins without DCD or ADHD (Piek et al., 2007). In another study based on the same twins as those in the present study, the authors found significantly higher levels of anxious symptomatology in twins with motor disorder in discordant pairs compared to their co-twins without motor disorder and controls. They found significantly higher levels of anxious symptomatology in twins with motor disorder in discordant sets than in sets of twins concordant for DCD, who in turn had significantly greater levels of anxious symptomatology than did control twins (Pearsall-Jones et al., in press).

Over five decades ago, Shere (1956, 1957) explored psychosocial dynamics in families of 30 pairs of twins aged 18 months to 16 years discordant for mild-to-severe CP. Among these were five sets each of identical male and female twins. Shere found that parents treated the twins alike, but were more understanding towards the twin with CP, and that there was less disciplinary friction between parents and twins with CP than with co-twins without CP. Furthermore, Shere found that parents did not appear to be aware that the unaffected co-twins regarded themselves as unfairly treated. Three earlier studies of MZ multiples in which one had CP and the other not, also reported on the influence of parental behavior on emotional and social adjustment of the twin with and the co-twin without CP (Bradway, 1937; Jenkins, 1935; Newell, 1930). No more recent qualitative studies of twins discordant for movement disorders were found.

## The Present Study

### Aims and Hypotheses

The aim of this study was to explore aspects of twin perceptions of family dynamics in families of MZ twins in which either one or both had a movement disorder. Both quantitative and qualitative measures were administered to achieve this aim. First, the General Functioning Scale of the Family Assessment Device (FAD — Epstein et al., 1983) was administered to gain twin perceptions of family functioning as a whole. It was hypothesized that in sets discordant for movement disorder, siblings without movement disorder would report less healthy family functioning



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than would their siblings with movement disorder, as has been found in sets of twins discordant for CP (Shere, 1956, 1957). Second, we used qualitative interviews to explore the relationship between co-twins from each of their perspectives independently.

## Method

### Participants

Participating families were recruited from a large cohort of twins from the Australian Twin Registry, as described previously (Martin et al., 2006; Pearsall-Jones et al., 2008, 2009; Piek et al., 2007). From the sample of 2075 eligible sets of twins whose primary caregiver completed the Twin and Sibling Questionnaire, which incorporated the Developmental Coordination Disorder Questionnaire (DCD-Q; Wilson et al., 2000), families with MZ twins discordant or concordant for motor problems were ascertained. None of the twins were reported by major caregivers as having CP, hemiplegia, muscular dystrophy or Pervasive Developmental Disorder, satisfying DSM-IV-TR Criterion C.

Three sets of twins had their status as MZ confirmed by DNA analysis prior to the current study. The remaining 13 sets were mailed DNA kits to collect buccal cells for analysis. The DNA of two sets of female twins indicated that they were DZ twins (Pearsall-Jones et al., 2009). Data on these twins were excluded from analysis for this study.

Following face-to-face assessments using the McCarron Assessment of Neuromuscular Development (MAND) (McCarron, 1997) five sets of twins (three male, two female) were identified as discordant for DCD, with one meeting MAND criteria for DCD, the other not. Also included were two sets of female twins in which one twin did not meet criteria for DCD and the other attained a score on the MAND of 86 rather than the DCD cut-off ≤ 85. Six of the seven twins with DCD in discordant sets were second born, and MAND scores of all twins with DCD in discordant sets fell within the *mild disability* range of movement disorder.

A further two sets of twins, both male, were concordant for DCD, both meeting criteria for DCD. In one concordant set, the MAND score of one twin fell within the *moderate disability* range of movement disorder, the other within the *severe disability* range; the scores of both twins in the second set fell within the *mild disability* range.

Wechsler Intelligence Scale for Children-IV — Australian (Wechsler, 2003) Full Scale Intelligence Quotients (FSIQ) of participants fell within the *Superior to Low Average* range of intellectual functioning (1 *Superior*; 3 *High Average*; 11 *Average*; 3 *Low Average*).

## Measures

***McCarron Assessment of Neuromuscular Development (MAND).*** The MAND (McCarron, 1997) is a standardized measure developed to assess fine and gross motor development in children aged 3.5 years to young adulthood and above. The measure incorporates five measures of fine motor coordination, and five measures of gross motor coordination. The scaled scores on each of these are added and the age norms are used to determine a Neuromuscular Development Index (NDI), with a mean of 100 and standard deviation of 15. A score below 55 is classified as a *severe disability*, 55 to 70 a *moderate disability* and 71 to 85 a *mild disability*. Scores are categorized into four factors: Persistent Control, Muscle Power, Kinesthetic Integration and Bimanual Dexterity. Test–retest reliabilities after a month interval over the 10 tasks ranged from .67 to .98. Tan and colleagues (2001), using an Australian sample, found the MAND to have good specificity, good sensitivity, and to be a valid measure for the identification of motor impairment. This measure was used to satisfy DSM-IV-TR, DCD Criterion A.

***Developmental Coordination Disorder Questionnaire (DCD-Q).*** The DCD-Q (Wilson et al., 2000), a parental report of their child's movement abilities, was included in the Twin and Sibling Questionnaire. The DCD-Q includes four subtypes: general coordination; control during movement; gross motor/planning; and fine motor/handwriting. Parents were asked to complete the questionnaire by comparing their child to children of the same age. The total score is 85. Because the Twin and Sibling Questionnaire has a 4-point scale, to make it easier for parents completing the questionnaire that included the DCD-Q, the 3 was omitted to make a four-point scale of 1, 2, 4, 5. For inter-item reliability, Cronbach's alpha was .88 for the full scale and from .86-.88 for each item if deleted (Martin et al., 2006). Rather than use a fixed score to assign individuals as affected or unaffected, for this measure the cut-off score was calculated using the formula:

$$\text{Cut-off score} = \text{Mean} - (1.65 \times \text{Standard Deviation}).$$

On this scale a low score assigned the participant to the 'affected' group, a high score to the 'unaffected' co-twin control group (Martin et al., 2006; Pearsall-Jones et al., 2008; Piek et al., 2007). This measure was used to satisfy DSM-IV-TR, DCD Criterion B (Shoemaker et al., 2006).

***Wechsler Intelligence Scale for Children-IV (WISC-IV) — Australian.*** The WISC-IV (Wechsler, 2003) measures cognitive ability in children aged 6 to 16 years 11 months. The 10 core subtests yield four subtest indices: Verbal Comprehension, Perceptual Reasoning, Working Memory, Processing Speed, and a Full-Scale IQ (FSIQ). The WISC-IV has excellent internal consistency, test-retest reliability, and criterion and construct validity. Reliability coefficients for the WISC-IV Australian subtests averaged from .75 to .89. This measure was administered to satisfy DSM-IV-TR, DCD Criterion A, and to assess for Criterion D.

***General Functioning Scale of the McMaster Family Assessment Device (FAD).*** The 12-item General



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Functioning Scale of the McMaster Family Assessment Device (Epstein et al., 1983) was used to assess perceptions of family functioning. Six of the 12 items on this scale describe healthy family functioning, and six items describe unhealthy family functioning. Ratings of 1, 2, 3 or 4 are given, for responses on the continuum *Strongly agree* to *Strongly disagree*. Instructions are that respondents are to think about their family AS A WHOLE when rating questions. Scores are reversed for the six 'pathological or unhealthy family function' items. Averaged scores above the cut-off of 2.17 place families within the range of 'pathological family functioning'. Overall, this measure has been found to have good reliability and validity (Byles et al., 1988). It has also been found to have suitable construct and concurrent validity, with reports suggesting that the measure can suitably discriminate between groups (Bihun et al., 2002). Although initially designed for family members 12 years and older, in their study examining use of the FAD in school aged children under the age of 12 years, Bihun and colleagues found a Cronbach's alpha of .86 for children 12 years and older, and .79 for children 7 to 12 years of age for the General Functioning Scale of the FAD. In the current study, clarifying statements were provided to children under the age of 12 years, as reported by Bihun and colleagues. Younger twins were also asked whether they would prefer to read and respond to questions themselves, or have the questions read to them by the researchers.

***Qualitative interviews.*** Semi-structured qualitative interviews related to the twin relationship were conducted for a period of approximately five minutes, and audio recorded. Children and young people were asked four questions: 'Can you tell me in as much detail as possible about (name of co-twin)?'; 'What is it like to live in a family with (name of co-twin)?'; 'What is the nicest thing about your relationship with (name of co-twin)?'; 'What is the most difficult thing about your relationship with (name of co-twin)?'

## Procedure

The project was approved by the Curtin University of Technology Human Research Ethics Committee and by the Australian Twin Registry. Following written consent by parents and assent by young people, parents were contacted by telephone and appointments made to visit the homes of 15 of the 16 sets identified as DCD by the DCD-Q prior to DNA confirmation of zygosity. One set chose to be interviewed at Curtin University of Technology.

Twins in a set were interviewed by different researchers — one assessing the first-born twin, while the other assessed the second-born. Assessors were blind to the participant's DCD status. Administration time varied between five and seven hours, with several breaks in between. The FAD and qualitative interviews were the final measures administered, as it was believed that participants would feel more comfortable sharing their stories after five to seven hours spent with the interviewer over the duration of the assessment.

## Data Analysis

***Quantitative:*** To determine whether there was a statistically significant difference between the twins with DCD and those without DCD in discordant sets, a one-tailed Wilcoxon signed rank test was conducted. This non-parametric test was a more suitable analysis as the skewed nature of FAD scores violated the stringent assumptions of the related samples *t* test.

***Qualitative:*** Each of three raters independently read the 14 transcripts (five of the seven discordant sets, both concordant sets) numerous times, and coded them for emergent themes (thematic analysis; Braun & Clarke, 2006). Analysis was done without any instruction to reviewers. All reviewers were blind to DCD status of the participants. Themes were clearly identifiable, and there were no significant disagreements between raters.

## Results

### Family Assessment Device

FAD data were collected for all 18 participants. On this measure, the ratings of two first born and two second born twins placed their families within the pathological range of family functioning. Three of these were twins without DCD in discordant pairs, the other was a co-twin with DCD in a pair in which both twins rated the family as functioning at a pathological level. All discordant sets who rated their families as functioning at a pathological level were male.

In DCD discordant sets, all but one of the twins without DCD rated family functioning as less healthy, or more pathological, than did their co-twins with DCD. Using a one-tailed Wilcoxon signed rank test, this difference did not reach significance ($z$ = -1.52; $p$ = .064; $n$ = 14). In DCD concordant sets, all four twins rated their families as functioning within the healthy range. FAD scores for DCD discordant and concordant twins can be found in Tables 1a and 1b respectively.

Examining responses to each question individually, twins in concordant sets rated all questions with a mean < 2.17. Twins without DCD in discordant sets rated four of the 12 questions with a mean > 2.17, the threshold for *pathological family functioning*. These included two of four questions which referred specifically to family functioning. Scores of discordant twins on individual questions can be found in Table 2.

### Qualitative Interviews

Thematic analysis revealed a number of themes, which were frequently repeated, regardless of which of the four questions was being answered. Themes included friendship, support, minimal sibling rivalry, and minor difficulties.



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**TABLE 1A**

DCD Discordant Twins: Sex, Age, WISC-IV FSIQ, MAND NDI, FAD

| | | Unaffected Twin | | | Affected Twin | | |
|---|---|---|---|---|---|---|---|
| Sex | Age | FSIQ | NDI | FAD | FSIQ | NDI | FAD |
| M | 16.75 | 102 | 93 | 2.66* | 95 | 78 | 2.5* |
| F | 15.58 | 111 | 89 | 1.25 | 124 | 80 | 2 |
| M | 13.75 | 101 | 93 | 2.83* | 94 | 84 | 2 |
| F | 15.58 | 97 | 93 | 1.83 | 100 | 83 | 1.42 |
| M | 8.42 | 94 | 88 | 2.25* | 108 | 82 | 1.17 |
| F | 9.58 | 112 | 104 | 2.08 | 108 | 86 | 1.92 |
| F | 8.67 | 89 | 94 | 1.5 | 90 | 86 | 1.42 |
| Average (*SD*) | 12.62 (3.6) | 100.85 (8.5) | 93.4 (5.9) | 2.06 (5.8) | 102.7 (11.6) | 82.7 (2.98) | 1.49 (1.8) |
| Range | 8.42–16.75 | 89–112 | 88–104 | 1.25–2.83 | 90–124 | 78–86 | 1.17–2.5 |

Note: *Scores ≥ 2.17 reflect pathological family functioning

**TABLE 1B**

DCD Concordant Twins: Sex, Age, WISC-IV FSIQ; MAND NDI; FAD

| | | Twin 1 | | | Twin 2 | | |
|---|---|---|---|---|---|---|---|
| Sex | Age | FSIQ | NDI | FAD | FSIQ | NDI | FAD |
| M | 8.33 | 93 | 78 | 1.25 | 85 | 71 | 1.58 |
| M | 16.67 | 111 | 57 | 1.83 | 84 | 48 | 2.08 |
| Average (*SD*) | 12.5 (5.9) | 102 (12.7) | 67.5 (14.9) | 1.54 (.4) | 84.5 (.7) | 58.5 (16.3) | 1.83 (.35) |
| Range | 8.3–16.7 | 93–111 | 57–78 | 1.25–1.83 | 84–85 | 48–71 | 1.58–2.08 |

**TABLE 2**

Mean FAD Scores of Twins With and Without DCD in Discordant Sets

| FAD Questions | No DCD (*n* = 7) | DCD (*n* = 7) |
|---|---|---|
| 1. Planning family holidays is difficult because we misunderstand each other | 2.43* (.98) | 1.86 (.69) |
| 2. In times of crisis we can turn to each other for support | 1.43 (.53) | 1.86 (.69) |
| 3. Individuals in the family are accepted for who they are | 2.00 (.82) | 1.57 (.53) |
| 4. We avoid discussing our fears and concerns | 2.57* (1.13) | 1.71 (.49) |
| 5. We express feelings to each other | 2.29* (.95) | 1.71 (.76) |
| 6. There are lots of bad feelings in our family | 2.14 (.38) | 1.71 (1.11) |
| 7. We feel accepted for what we are | 1.71 (.76) | 1.71 (.49) |
| 8. Making decisions is a problem for our family | 2.57* (.53) | 2.00 (.82) |
| 9. We confide in each other | 1.57 (.53) | 2.00 (.82) |
| 10. We cannot talk to each other about the sadness we feel | 1.86 (.69) | 1.71 (.49) |
| 11. We are able to make decisions about how to solve problems | 2.14 (.69) | 1.86 (.69) |
| 12. We don't get along well together | 1.86 (.91) | 1.57 (.79) |

Note: *Questions on which the mean scores of twins without DCD were > 2.17

Individual quotes from a wide range of interviewees demonstrate these themes.

There were no conceptual differences in responses between twins with DCD and those without in discordant sets, or between discordant and concordant sets.

***Question 1: 'Can you tell me in as much detail as possible about (name of co-twin)?'*** Most twins reported their relationship as being mutually companionable and supportive, especially in novel situations. Many spoke of their twin being their best friend, always available, and being an understanding and accepting companion. When describing their co-twin, only a few commented on physical features or birth order:

> 'We're really close to each other, and we tell each other pretty much everything, and that's really good because when we change schools, or when we're doing something, it's better than … having to do it all on your own, because you know that you've got someone there, automatically, and … it's good, it's like a safety net.'

> 'He's my twin brother … But he's more than that, … he's a friend to me, he's someone that's always there, that I can depend on … it's like a best friend, more so, … we understand each other. That's always good, because I've always got someone there, same age.'

> 'It's very advantageous having a twin, 'cos you have someone who is your own age … and when you go to do new things, you've got someone else with you.'

> 'He's nice, he's friendly to me, he helps me … and when I'm feeling a bit left out he lets me play with him and his friends.'

> 'He's a kind boy, he is really nice when I get hurt, he helps me all the time, he shares … He's my best friend. He loves me very much.'

> 'He's about two centimetres shorter than me … he has the same colour eyes, same colour hair.'

> '… someone that's younger than me.'



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***Question 2: 'What is it like to live in a family with (name of co-twin)?'*** An ongoing theme was the perceived benefit of a same-age companion and best friend, who enjoyed the same things, and who was constantly available. A number mentioned that having a twin acted as a buffer in new situations. Shared times and companionship were reported as special. Some female twins mentioned short-lived disagreements, and some male twins reported physical fights.

'It's … taking your best friend home and having them there all the time.'

'…. I always have someone else my age with me, so it's always fun, … like when we go to new schools, … and being in this family with [name of co-twin] is really fun because … [identical twins] can play lots of tricks on your parents, … and when I'm with her … it makes me think of those people out there that don't have twins, they just go home from school, do their homework, and have to play by themselves and watch TV.'

'…she will play the same type of game … It's amazing because we're both the same age.'

'If we have an argument, it's … 5 minutes …'

'… a little painful because we sometimes fight, we sometimes argue.'

'It has its ups and downs … because sometimes [name of co-twin] … gets a little more attention.'

***Question 3: What's the nicest thing about your relationship with (name of co-twin)?*** Again, often mentioned was mutual reciprocal friendship and companionship with an understanding age mate, with whom they could share thoughts, and upon whom they could rely for support. The nonjudgmental nature of the relationship was highly appreciated by most twins.

'The best thing about my relationship with [name of co-twin] is that he understands me … I've always got someone to turn to, who will know what I'm about, and what I want, and if I've got troubles he'll know what to do, … he understands me, it's like having a best friend, but the best thing is, he is the same age.'

'The nicest thing is the fact that we can really talk to each other, and we're really close, … we can tell each other pretty much anything … it's just really good to have someone there to talk to who won't judge you .'

'It's really fun being able to be with her all the time … the best thing about her being with me is that she always will be with me.'

'You always have your best friend around you … all the time … twins have a bond … the friendship bond and the sisterly bond.'

'It's like having a best friend, but the best thing is, he is the same age, so it means that we've always got someone there who you relate to.'

'We know that we're always there for each other, and backing each other up … sticking up for each, always … helping each other out.'

***Question 4: What's the most difficult thing about your relationship with (name of co-twin)?*** Even when asked this question about difficulties, answers often reflected the special and enduring nature of the twin relationship. Paradoxically, as might have been expected, there was ambivalence about being an identical twin, in that aspects of the relationship that were most appreciated, were also those frequently cited as most difficult. Disagreements and disputes were overall reported as minor, and most were short lived:

'The difficulty is probably that we're always on each other's back. That's what being a twin is, it's just a special connection between two people which can't happen to anybody else.'

'Because we see each other all the time at home, and all the time at school, sometimes, it's … you're in my face … we'll just need a bit of space.'

'When we go out at lunch, they (friends at school) … try to identify, saying, "This is how you can tell them apart, no, this is how you …". So that's how it's hard being a twin, because you want to get on with playing.'

'The most difficult thing is probably the fact that we're the same age, that we look the same, and people mix us up …'

'Always being together … it's a good thing and a bad thing 'cos you get sick of them after a while. And it's like you want your own time.'

'She sometimes helps me when I don't need help … she plays with me when I don't want her playing with me …'

'We seem to both like things to go our way, so … we sort of argue over the real small things that don't really matter.'

'He's always got to be right, even if he's wrong.'

## Discussion

The two measures used in this study provided different perspectives on family functioning and the twin relationship, and when considered in conjunction, provided a rich tapestry of perspectives of family dynamics in these MZ twins concordant and discordant for DCD.

The FAD results indicated that when only one twin met criteria for DCD, in all but one instance the twin without DCD perceived family functioning as less healthy than did the co-twin with DCD. The FAD instructions place emphasis on the fact that respondents must consider the family as a whole when answering questions. It was interesting that on two of the four questions in which 'family' was explicitly mentioned, averaged responses for twins without DCD in discordant sets were within the *pathological* range of family functioning. Particular difficulties for



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these twins related to decision-making and planning in the family as a whole. It was not clear why this was the case. Ratings were also within the *pathological* range for questions indicating avoidance of discussing fears and concerns, and difficulties expressing feelings to each other in the family. This was in sharp contrast to responses in the qualitative interviews, which explored the twin relationship in particular. Although there were differences between twins with and without DCD on the FAD, there was no distinction between twins with and without DCD in themes identified in the qualitative interviews. In the interviews, most twins commented on the fact that they could talk to each other about anything, without fear of being judged. They indicated that being a twin created a buffer, as found by Noller and colleagues (2008), against anxieties when faced with unknown situations, such as changing schools. The high level of companionship expressed, as also reported by Smith (2007) and Rende and colleagues (2005), in their samples of MZ twins, posed the question as to whether some MZ twins without DCD in discordant sets, who rated their families as functioning at a less healthy level on the FAD, did so because their close relationship with their co-twin resulted in perceptions of relationships within the rest of the family as being less functional by comparison. It also raised the possibility that family members in some way behaved differently towards twins with and without movement disorder, even if they were unaware of doing so. Further research on siblings discordant for DCD may help elucidate whether even mild movement disorder in one child disrupts family routines and functioning, which would have implications for clinical practice and policy, such as provision of services currently reserved for families of children and adolescents with more severe movement disorders such as CP (Pearsall-Jones et al., 2010).

Chesson and colleagues (1990) reported that non-twin brothers of children with movement disorder were jealous of their sibling with motor disorder. All twins without DCD in discordant sets who rated their families within the pathological range were male. However, given the small sample size, and the lack of mention of jealousy in the qualitative interviews, there is no evidence that this was the case for twins interviewed in the present study. Considering that their co-twins with DCD had movement disorder in the mild range, it is not possible to draw any conclusions as to whether this negative perception of family functioning was related to their co-twins' motor difficulties. However, in their study on the effects of DCD on the family, Stephenson and Chesson (2008) reported that the whole family was impacted by the long-term difficulties experienced by young people with DCD. Shere (1956, 1957), who reported on twins discordant for mild, moderate and severe CP noted that, because of attention paid to, and allowances made for, the sibling with movement disorder, twins without CP reported family functioning less favorably than did the co-twins with CP. This indicated that in both DCD and mild-to-severe CP, effects of movement disorder affecting one young person had significant impact on the wider family. Further exploration of implications for families of children and adolescents with DCD may lead to modifications in clinical practice and policy, such as provision of services for parents and siblings of children and adolescents with DCD for educational purposes, and to minimize the impact of DCD on the entire family.

The finding that, despite status for disorder, all twins were mutually and reciprocally supportive, is consistent with previous reports of the MZ twin relationship. There was little evidence of rivalry between the twins. Differences mentioned were primarily comparisons of height and other physical means of distinguishing between them. Smith (2007) found that MZ twins reported higher levels of companionship than did same-sex DZ twins, and lower levels of avoidance, rivalry and aggression. Noller and colleagues (2008) found that MZ twins were more positive than DZ twins in situations in which the twins were competing or comparisons were being made. Twins in the present study also reported spending much time together and many shared friendships, as found by Rende and colleagues in their study of MZ and DZ twins, biological non-twin siblings, half-siblings and non-biological siblings (2005).

The finding of the paradoxical greatest strength of the twin relationship also being the aspect regarded as the most challenging was to be expected. Twins reported on the uniqueness and pleasure of spending much of their time together, which also became a challenge as they had little time on their own. The help and support of the co-twin was appreciated, yet simultaneously help offered when it was not required became burdensome. Having an identical twin could be fun, as parents and teachers could be confused about who was who, yet at other times twins regarded confusion by friends and teachers as annoying.

A limitation of this study was the small sample size, despite a large initial sample of over 2000 twin pairs. However, the power of the co-twin control study design cannot be underestimated (Vitaro et al., 2009). This design has the great advantage of allowing a match not only for age and gender, but also for family environment, socio-economic status, siblings, and importantly, genetic makeup — an aspect possible using only this design. The possible impact of even mild movement disorder, on siblings without DCD, could be further explored in a larger sample of both MZ and DZ twins discordant and concordant for DCD, and in singleton siblings. Previous literature on twins and CP has explored the parent-child relationship, and such an examination would be a valuable extension of research in the area of DCD in MZ and DZ twins.



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## Conclusion

This is the first study of which the authors are aware that examines family functioning and the relationship between twins in MZ sets discordant and concordant for DCD. It was concluded that, overall, the MZ twin relationship was close and mutually supportive regardless of status for DCD; however, perceptions of family functioning differed between twins affected and unaffected for DCD in DCD discordant pairs. It was suggested that, as with non-twin siblings (Stephenson & Chesson, 2008), this might relate to differences in family attitude towards twins with and without DCD. Consequently, this study assists in forming the foundation for further research into the effects of even minor and moderate movement disorder on family functioning and sibling relationships, and possible implications for policy and clinical practice.

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