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Mood impairments in adults previously diagnosed with Developmental Coordination Disorder.

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Running head: Mood impairments in DCD

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Abstract

Background: Developmental coordination disorder (DCD) affects up to 6% of the population and is diagnosed on the basis of poor motor coordination. While we know rather little about its lifetime consequences, clear and significant difficulties remain through the lifespan for the majority. Reduced physical activity and, outside of the motor domain, significant mental health issues exist for many with DCD.

Aims: This study provides the first investigation of the presence of mood disorders in adults with DCD.

Method: Symptoms of anxiety and depression were assessed using the Beck Depression and Spielberger Anxiety Inventories in 36 adults previously diagnosed with DCD vs. 49 age- and gender-matched typical controls. Amount and type of physical activity undertaken each week were also reported.

Results: After controlling for their reduced level of weekly physical activity, the group with DCD reported significantly more symptoms of depression, state and trait anxiety than their peers.

Conclusions: This finding has important implications for consideration of intervention in DCD, as well as for investigation of the risk and protective factors at play in long term outcome. Finally the findings highlight the need for awareness of motor difficulties in those presenting with high levels of anxiety and depression, and vice versa.

In recent years there has been growing recognition of anxiety disorders in childhood, and that those with a neurodevelopmental disorder can show increased levels of anxiety or depression in relation to their typical peers (e.g., Compas et al., 2004; Emck et al., 2009; Rockhill et al., 2010; Sigurdsson et al., 2002). These anxieties may be integral to the diagnosed difficulties, or a secondary consequence of them. One such disorder is developmental coordination disorder (DCD). DCD is diagnosed when motor coordination difficulties are out of keeping with the rest of development, not attributable to a learning disability or medical condition and have a significant negative effect on activities of daily living or on academic achievement (DSM-IV-TR; American Psychiatric Association, 2000-TR). DCD is often referred to as dyspraxia, and affects an estimated 2-6% of the population (American Psychiatric Association, 2000-TR; Lingam et al., 2009). It has been referred to previously as clumsy child syndrome (American Psychiatric Association, 1987). Significant motor difficulties are seen across a broad range of motor tasks including motor planning, balance and posture (see for example Sugden & Chambers, 2005). Reduced levels of physical activity are also reported in both cross-sectional and longitudinal samples (e.g., Cairney, Hay et al., 2010; see Green et al., 2011 for an overview). In addition to motor difficulties, children and adolescents with DCD have been reported to have poorer psychological well-being compared to their peers, including poor self-esteem, and mothers perceive their child with DCD to be more depressed than children without the disorder (Stephenson & Chesson, 2008). Furthermore, increased levels of anxiety and depressive symptomatology have been reported in both genetic and non-genetic study designs (Pearsall-Jones et al., 2011; Piek et al., 2007; Pratt & Hill, 2011; Skinner & Piek, 2001). Children and adolescents have been reported to have self-perceptions consistent with their motor abilities (Cantell et al., 1994; Jongmans et al., 1996), indicating awareness of their problems. Furthermore, early motor skill has been reported to predict both anxiety and depression at school age (Piek et al., 2010). Finally, children with anxiety disorders (Axis 1; American Psychiatric Association, 2000) as well as a range of other psychiatric conditions have been reported to have increased motor difficulties compared to their peers without such conditions (Ekornås et al., 2010; Emck et al., 2011; Stins et al., 2009).

Given the significant personal, familial and economic cost of mental health difficulties, this aspect of DCD is a crucial area of investigation. While almost all research into DCD has focused on child samples, DCD is not outgrown by the majority (Cantell et al., 2003; Losse et al., 1991) and the impact of this may be seen, at least in part, in mental health outcomes. Hellgren et al. (1994) reported increased levels of substance abuse and suicide attempts in a longitudinal study of children diagnosed with DAMP (deficits in attention, motor control and perception, used in Scandinavia to include those with DCD) in a follow-up study at 16 years of age. However, studies of *adults* with DCD are distinctly limited. Those that exist have highlighted enduring difficulties in the motor domain (Cousins & Smyth, 2003, 2005) as well as difficulty with handwriting and organisational skills (Kirby et al., 2008). Higher rates of unemployment and lower quality of life satisfaction ratings have also been reported relative to age-matched controls (Cousins & Smyth, 2003; Hill et al., 2011).

Despite the significant mental health implications seen in children and adolescents with DCD, no study has considered the state of mental health in adults with DCD. Given the strength of such characteristics in children/adolescents with DCD and the negative effects of poor mental health more broadly, it is crucial to chart the mental health of adults with DCD. This then was the purpose of the current study, which provides the first study of depression and anxiety in adults with DCD. Self-report data were collected focusing on well-known measures of depression and anxiety in adults who had previously been given a diagnosis of DCD, in comparison to typical peers. Given the known association between physical activity and mental health (Penedo & Dahn, 2005), participants also reported on the amount, and nature, of exercise that they undertook each week. Thus the study provides a

preliminary investigation of whether mental health difficulties are a significant issue in a previously diagnosed adult DCD population. The findings of this study will have important implications for adult support services in further/higher education, in the community and in occupational settings. They also have the potential to influence treatment plans directed towards this cohort at an earlier stage in order to prevent the increased social or emotional difficulties that may appear later in life.

Methods

Participants

85 people participated in the study: 36 adults who had previously been diagnosed with DCD (henceforth, adults with DCD) and 49 typical adults. Adults with DCD had been diagnosed (35 as children) according to the DSM criteria for the condition. Diagnostic reports were made available to the research team for confirmation. Assessments generally included parent/teacher reports of motor skill and difficulties, assessment of functional skill, performance on a standardised motor test battery and cognitive ability assessment. Participants were recruited via support groups for adults with DCD and UK higher education institutions (predominantly in London). Members of the typical group were recruited from the same higher education institutions (HEI) and local community centres, broadly on a pair-by-pair basis. (Results did not differ between HEI and community groups and therefore pooled data are reported.) On the basis of self-report, participants were excluded from either group if they reported non-motor diagnoses such as dyslexia or ADHD. There was no significant difference in either the gender distribution [$\chi^2(1)=.447, p=.504$], or age [$t(83)=.723, p=.472$] of the two groups. Participant characteristics are shown in Table 1. Ethics approval for the study was granted by the Goldsmiths College Ethics Committee, following the guidelines laid down by the ESRC and British Psychological Society.

Materials

All participants provided information on the number of hours of exercise they undertook each week by reporting this to the experimenter. They also reported the nature of this exercise by indicating which type of sport(s) they undertook and whether these fell into either the individual or team sport category. This was included to provide information consistent with a diagnosis of DCD (cf. reduced physical activity, above) and to act as a covariate in the analyses of the anxiety and depression symptomatology collected (cf. Penedo & Dahn, 2005). Data were considered for exercise undertaken for the purpose of maintaining fitness (e.g., football, hockey, running) and not exercise reported under descriptors such as “walking to the shop”. Following this, participants completed two self-report questionnaires.

The 40-item *State-Trait Anxiety Inventory* Form Y (STAI-Y; Spielberger, 1983). Both the state and trait portions of the scale were completed. Responses were totalled (range of scores, 20-80) for each part of the scale.

The 21-item *Beck Depression Inventory* (BDI; Beck et al., 1988) was used to provide an indication of the presence of a depressive episode at the *time* of the study. Scores were totalled, as well as being categorised using established cut-off scores to assign participants to a group of those considered to exhibit non-depressed functioning (score of 10 or less), dysphoria (score of 11-14), dysphoria/depression (score of 15-19) or clinical depression (score of 20 or more).

<<Tables 1 & 2 about here>>

Results

Amount of weekly exercise, along with levels of state and trait anxiety and depression for each participant group are shown in Table 2. There was a significant difference in the amount of weekly exercise undertaken by the two groups [$t(82)=3.714$, $p<.001$]. Given this, as well as the reported associations between gender as well as physical exercise and mental health, the total scores on the state and trait anxiety and depression measures were analysed using a between-subjects ANCOVA with group and gender as independent variables and hours of physical exercise per week as a covariate. In each ANCOVA, the only significant effect was the group factor (state anxiety, $F(1,79)=23.386$, $p<.001$, partial $\eta^2 .228$; trait anxiety, $F(1,79)=43.455$, $p<.001$, partial $\eta^2 .355$; depression, $F(1,79)=25.463$, $p<.001$, partial $\eta^2 .244$). Self-reported levels of both state and trait anxiety, as well as depression were significantly higher in the DCD vs. typical group (see Table 1). Furthermore, there was a significant difference in the proportion of each participant group falling into each depression category on the BDI [$\chi^2(3)=25.837$, $p<.001$], with the comparison group falling overwhelmingly (92%) into the non-depressed category, while those with DCD were categorised across all categories.

Discussion

This is the first study to investigate mental health in adults previously diagnosed with DCD and confirms significantly raised depression, state and trait anxiety symptomatology from self-report in this group in comparison to their typical peers. This symptomatology is unlikely to be explained by gender or by the reduced level of physical exercise that these adults report that they undertake each week, although it should be noted that more sensitive measures of activity are needed to form a view of the contribution that this variable made. The findings from this adult sample support the continuation of increased rates of anxiety and depression from childhood into adulthood since they are consistent with studies identifying increased levels of anxiety in children and adolescents with DCD (Pearsall-Jones et al., 2011; Piek et al., 2007; Pratt & Hill, 2011; Skinner & Piek, 2001). It is, however, the first study to investigate anxiety and depression in adults with DCD (albeit in a group who were diagnosed predominantly as children), and as such should be considered a preliminary investigation in need of replication. However, the reasonable sample size and the size of the statistical effects suggest that the results are reliable and therefore worthy of further consideration.

The study findings raise the question of whether the increased symptoms of mood disorders identified here are a core part of the diagnosed motor disorder or a secondary consequence of it. The cerebellum has been cited as a putative common neuroanatomical substrate that these components may have in common (Dennis et al., 2009), although more research is needed to consider this possibility. An alternative explanation is provided by the Environmental Stress Hypothesis. This considers mood disorders to be a secondary consequence of a primary stressor (motor impairment) which leads to a cascading effect of negative psychosocial consequences (secondary stressors) and negative self evaluations, resulting in increased symptoms of anxiety and depression (see Cairney, Veldhuizen et al., 2010). Research has identified a range of possible contributors to this cascading effect in children and adolescents with DCD, including fitness and obesity (Cairney et al., 2005; Schott et al., 2007), playground activity (Bouffard et al., 1996; Smyth & Anderson, 2000), peer victimisation (Piek et al., 2005) and low self-worth (Piek et al., 2006; Skinner & Piek, 2001; see Cairney et al., 2010). The significantly high levels of mood disorders reported here, along with reduced levels of quality of

life satisfaction across a range of domains in adults (Hill et al., 2011) remains compatible with both possibilities outlined here. Future research will be required to probe the relationships between motor difficulties and mood impairments identified in child and adolescent samples across the lifespan, and supported by the current study.

Clearly this study has a number of limitations, particularly the possible over-representation of HE students in the sample and a lack of information about the likely mediators of relationships between motor skill and mental health (including gender, weight, BMI, obesity, cardiovascular fitness and muscle strength), as well as current motor abilities measured on a motor assessment battery. Given the frequent co-occurrence of DCD with other conditions such as ADHD and dyslexia, the exclusion of these groups may be a concern to some (e.g., Dyck, Piek & Patrick, 2011). Nonetheless, the study highlights a significant issue and a clear need to pursue substantial investigations considering the nature, range and impact of mood impairments in the DCD population. Future studies should assess mental health alongside motor assessment batteries. Prospective studies charting early symptomatology in both domains with later outcomes should be extended into adulthood (Piek et al., 2010), consider the complex relationship between motor and psychological variables developmentally and across the lifespan, and how these impact on typical and atypical development. A further focus of future studies of mood impairments in DCD should consider individual differences since not all of those in the group previously diagnosed with DCD reported higher levels of depression and anxiety than seen in the typical comparison group (see overlap in the range of scores in Table 2). Given the exploratory nature of the current study, it is not possible to investigate potential risk and resilience factors surrounding mental health in those with DCD, and these should be considered in future studies. Finally, the current study highlights the need for awareness of motor difficulties in those presenting with high levels of anxiety and depression, and vice versa. Given the significant personal and societal costs of mental health issues, it will be crucial to pursue these questions through cross-disciplinary collaboration.

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Table 1
Participant characteristics

| | DCD adults (n=36) | Typical adults (n=49) |
|-------------------------|----------------------|--------------------------|
| Gender, M:F (% male) | 15:21 (42) | 24:25 (49) |
| Age – years (Mean (SD)) | 29.28 (10.69) | 27.84 (7.7) |
| Range | 19-59 | 18-56 |

Table 2
Mean (SD) and range of self-report measures of depression, state and trait anxiety and physical activity for each participant group

| | DCD adults (n=36) | Typical adults (n=49) |
|-------------------------|----------------------|--------------------------|
| Weekly exercise – hours | 2.34 (1.97) | 4.9 (3.71) |
| Range | 0-7 | 0-20 |
| State Anxiety | 47.44 (13.54) | 30.69 (11.88) |
| Range (20-80) | 22-77 | 20-68 |
| Trait Anxiety | 51.44 (10.79) | 30.94 (11.96) |
| Range (20-80) | 30-79 | 20-69 |
| Depression | 12.81 (8.54) | 3.33 (4.92) |
| Range (0-63) | 3-39 | 0-21 |
| Depression category (%) | | |
| Normal | 41.67 | 91.84 |
| Dysphoria | 27.77 | 2.04 |
| Dysphoria/depression | 13.89 | 4.08 |
| Clinical depression | 16.67 | 2.04 |