Anxiety, Confidence and Self-Concept in Adults with and without Developmental Coordination Disorder

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Highlights

- General and movement-specific anxiety, self-efficacy and general resilience were comparatively poorer in adults with diagnosed and suspected DCD than in typically developing adults
- Relationships between these factors support that resilience may play a protective role in mitigating DCD's secondary impacts
- Adults with suspected DCD who cited motor skills difficulties as important to their self-concept had lower movement-specific self-efficacy

Abstract

Background: Previous research suggests that adults with Developmental Coordination Disorder (DCD) report lower general wellbeing and higher general anxiety levels than typically developing (TD) adults.

Aims: To examine and explore relationships between anxiety and confidence (self-efficacy and resilience) generally and in a movement-specific context, along with self-concept among adults with DCD and TD adults.

Methods: 74 adults with diagnosed DCD, 26 adults with suspected DCD and 79 TD adults (18-60 years) completed an online questionnaire composed of a mixture of existent psychometric measures and novel scales.

Results: General and movement-specific anxiety, self-efficacy and general resilience were all poorer in adults with diagnosed and suspected DCD compared to TD adults. Higher resilience was related to higher self-efficacy and lower anxiety in adults with DCD.

Individuals with suspected DCD for whom motor skills difficulties were an important aspect of their self-concept had lower movement-specific self-efficacy.
Conclusions: Interventions to improve the psychosocial wellbeing of adults with DCD should include a focus on lowering anxiety and building self-efficacy and resilience, with particular attention to movement-related domains.
Implications: This would facilitate the effective development of strategies to manage motor skills difficulties and their impact on everyday life for adults with DCD.

Key Words: *DCD, motor skills, anxiety, self-efficacy, resilience, self-concept*

What this paper adds

The findings from this study build on research into the ongoing secondary impacts of DCD beyond childhood and adolescence in terms of factors affecting mental wellbeing including anxiety, self-efficacy, resilience, and self-concept. These offer novel insights into the impacts of these under and unexplored factors on general and movement-specific domains in adulthood for individuals with both diagnosed and suspected DCD. These findings highlight the important role of resilience as a protective factor to be harnessed in the development and use of strategies to effectively manage the secondary impacts of DCD. The relationships between the factors explored here – general and movement-specific – illustrate the importance of addressing the aspects of an individual's perception and experience, especially considering how they are linked together and can potentially therefore affect one another. Finally, our findings open a new conversation about self-concept and DCD in adulthood, suggesting further pathways for research to explore. This study offers a valuable contribution to research on DCD in adults, a research area currently scarce, yet of a widely acknowledged importance.

Introduction

Our confidence and anxiety levels influence how we perceive both ourselves and our interactions with the world around us. These factors may be especially relevant for individuals with Developmental Coordination Disorder (DCD), a condition affecting around 5% of the population whereby motor coordination is less than the expected level for an individual's age, manifesting in fine and gross motor difficulties in childhood and adulthood, which can impact negatively on everyday life (Kirby, Edwards, Sugden & Rosenblum, 2010).

Most of the literature considering these factors in DCD focuses on children (see for example, Omer, Jijon & Leonard, 2019), even though in 50-70% of cases the condition persists into adolescence and adulthood (DSM-5, APA, 2013). Indeed, this is a population in which an urgent need for further research has been identified, given the increasing challenges and demands of facing adult life with motor skills difficulties (Blank et al., 2019; Omer et al., 2019).

In terms of overall wellbeing, a recent study by Engel-Yeger (2020) concluded that some of the negative effects of life with DCD may be linked with lower levels of health-related quality of life in adulthood. In an earlier study, Tal-Saban, Ornoy and Parush (2014) found that young adults aged 22–29 years with DCD reported lower levels of quality of life and life satisfaction. Their analyses showed that psychological health was the domain that most significantly predicted life satisfaction in this group. In addition, Hill, Brown and Sorgardt (2011) had previously found that a group of young adults (aged 18-27 years) with DCD self-reported significantly lower quality of life satisfaction in every domain compared to TD adults.

Regarding anxiety specifically, there is some evidence to suggest that anxiety in individuals with DCD may increase with age. Skinner and Piek (2001), for example, found higher anxiety levels among adolescents with DCD (aged 12-14 years) than among younger children with DCD (aged 8-10 years). Looking beyond early adolescence, Doering et al. (2019) have illustrated that anxiety in adolescence, specifically at age 15 years, comprises an important risk factor in the development of psychiatric issues in later adolescence and young adulthood. Hill and Brown (2013) carried out one of the first investigations into mood disorders (symptoms of anxiety and depression at a clinical level) among adults with DCD. They found significantly higher symptoms of state and trait anxiety in the DCD group compared to their TD peers. This initial evidence supports the notion that higher anxiety rates continue from childhood into adulthood in this population. Kirby, Williams, Thomas and Hill (2013) took a different angle and considered the effect of employment status on psychosocial wellbeing in adults with DCD. Results showed high levels of self-reported anxiety in both the employed and unemployed adults with DCD, with most falling outside the 'normal' range according to the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983). Overall, previous research does suggest that anxiety is heightened in individuals with DCD compared to their TD peers, and that this seems to be linked to motor skills. There is a lot more evidence of this in younger populations (Harrowell, Hollén, Lingam & Emond, 2017; Missiuna, 2003; Sigurdsson, Van Os & Fombonne, 2002). Since there are currently only two

studies which specifically investigated anxiety in adults with DCD (Hill & Brown, 2013; Kirby et al., 2013), the extent to which heightened anxiety persists in adulthood, why this may be and what else it may link to, remains unclear and warrants further research.

Turning to consider the role of confidence in this study we have conceptualised confidence as consisting of general self-efficacy, domain-specific self-efficacy and resilience. General self-efficacy is an individual's judgment in relation to themselves of how well they can enact courses of action needed to successfully navigate and deal with prospective situations (Bandura, 1982). Resilience is defined as the ability to adapt positively and "bounce back" in the face of adverse experiences (Southwick, Bonanno, Masten, Panter-Brick & Yehuda, 2014). These concepts are linked with Schwarzer and Warner's (2012) assertion that having high self-efficacy may help an individual show resilience when facing adversity.

Previous research considering self-efficacy and DCD has only done so amongst children, but these studies highlight the distinction between general and domain-specific self-efficacy (Batey et al., 2013; Cairney et al., 2005). Cairney et al. (2005) used a cross-sectional investigation of elementary school children in Canada and found that the effect of DCD on physical activity was mediated by general self-efficacy. Their model showed that 28% of the variance in children's physical activity was predicted by general self-efficacy and DCD. In direct contrast to this, a subsequent study by Batey et al. (2013) found that children with DCD have lower task and barrier self-efficacy in relation to physical activity than typically developing children. This was despite neither task nor barrier self-efficacy mediating the relationship between DCD and physical activity. Interestingly, this later study used more domain-specific efficacy scales. Batey et al. (2013) suggest that this difference may indicate that general self-efficacy, as a different construct, may impact the physical activity of children with DCD more than the more domain-specific measures of task and barrier efficacy. Another study by Nobre, Valentini, Ramalho and Sartori (2019) suggested that DCD in children leads to lower perceived self-efficacy in daily activities, and most prominently leisure activities and global (i.e., general) self-efficacy. The authors conclude that the motor skill difficulties experienced by these children influence how effective they perceive themselves to be at performing all kinds of daily actions. In contrast, Rodger et al. (2007) found that children with DCD showed perceived self-efficacy of their physical and cognitive functioning within the average normative range of scores at the ages of 5-6 years. Yet, in another study Engel-Yeger and Kasis (2010) found that children with DCD (aged 5-10 years) had significantly lower self-efficacy scores across all domains. What's more, lower self-efficacy correlated with both lower motor performance and lower preference to participate in leisure activities. The authors concluded that while motor difficulties may limit participation preference in children with DCD, low self-efficacy could act as a further hindrance to participation. These varied findings support Bandura's (2006) assertions that self-efficacy is ultimately domain-specific and that, as such, it forms an attitude towards a specific task in a specific context. The current study therefore sought to measure both general and domain-specific (i.e., movement-specific) self-efficacy to try and tease apart the nuances of which facets may mediate the relationship between DCD and movement.

In terms of research into resilience in DCD populations, most studies have flagged up the positive role it can play in coping strategies individuals with DCD use to mitigate the negative impact of their motor skills difficulties on their physical and psychosocial wellbeing (e.g., Zwicker, Suto, Harris, Vlasakova & Missiuna, 2018). Several studies focusing on late adolescence and young adulthood found that higher resilience related strongly to the effective employment of behavioural and cognitive strategies to manage motor differences, and that an important focus for interventions should be promotion of resilience to boost, among other factors, self-esteem (Harrowell et al., 2017; Missiuna, Moll, King, Stewart & Macdonald, 2008). To date there has been relatively little research into how resilience is related to other variables in DCD.

Finally, we look towards how anxiety and confidence may relate to how we perceive ourselves. The term 'self-concept' is defined as qualities which constitute individuals' perceptions of long-term and enduring aspects of their identity and is also closely linked to mood and wellbeing (Marsh & Shavelson, 1985; Rathbone, Holmes, Murphy & Ellis, 2015). Self-concept has been measured in various ways in DCD, although none have explored it in relation to the specific factors under investigation in the current study or in adults. For example, Cocks, Barton and Donelly (2009) looked specifically at the self-concept of boys (aged 7-12 years) with DCD in relation to a range of academic and non-academic domains. Their results suggested that boys with DCD suffered from a significantly more negative self-concept in the domains of peer relations and physical abilities in general compared with normative values among age-matched TD children. Furthermore, severity of motor difficulties related significantly to aspects of self-concept related to physical abilities. This was supported by Yu et al.'s (2016) finding that children with DCD (aged 7-10 years) had a more negative view of their self-concept in relation to physical coordination, sporting ability and physical health. In a recent review, Hands et al. (2020) considered self-concept in both children and adolescents with DCD and identified that, by adolescence, if individuals with DCD did not believe physical aptitude to be important, even if their self-perceptions in relation to physical ability were low, this did not necessarily lead to diminished self-concept since they were able to disregard domains that were unimportant to their own self-related belief system.

It is worth noting that in the current study, in contrast to studies by Cocks et al., (2009) and Yu et al. (2016), we did not measure the positive/negative valence of self-concept, but rather the presence or absence of self-concepts related to movement or motor ability. We were interested in whether the presence of movement-related self-concepts in people with DCD was related to the other factors under investigation. Previous studies that have explored self-concept in people with DCD have used self-description questionnaires which offer domain-specific and composite scores resulting from closed-ended questions with, for example, Likert scale scoring across a range of subscales, including those relating specifically to physical self-concept. The current study however purposely used open-ended 'I am…' statements (based on the Twenty Statements Task; Kuhn & McPartland, 1954), which are subsequently coded to examine how adults with DCD define themselves in their own words.

We aimed to first describe and compare general and movement-specific anxiety, self-efficacy, general resilience, and movement-related self-concept among adults with DCD and TD adults. We aimed subsequently to explore the relationships between these factors in adults with DCD. Based on the literature to date, we first hypothesised that anxiety (both general and movement-specific) would be higher in adults with DCD than in TD adults. Secondly, we hypothesised that movement-specific self-efficacy would be lower in adults with DCD than in TD adults. We were interested in whether this effect also extends to general self-efficacy. We thirdly hypothesised that adults with DCD with lower self-efficacy (both general and movement-specific) would have higher anxiety levels (see e.g., Bandura, 1988). The relationships between resilience and the other factors remain underexplored in relation specifically to movement and in a DCD population. However, based on previous research in other contexts and populations, we hypothesised that individuals with higher resilience might experience lower anxiety levels and higher self-efficacy (Schwarzer & Warner, 2013; Zwicker et al., 2018). However, our investigation into resilience and its relationships with the other factors was predominantly exploratory. Similarly, our investigation into the relationship between self-concept and the other factors was exploratory.

Methods

Participants

Although DCD is the official term for the condition used in the DSM-5 (American Psychiatric Association, 2013) many adult individuals in the UK self-identify as having Dyspraxia (Purcell, Scott-Roberts & Kirby, 2015) as this is the terminology often used in . many educational and clinical settings, Therefore, to ensure the best chance of accessing a larger sample from this population, we chose to use both terms during the recruitment process. 79 TD adults, 74 adults with formally diagnosed DCD / Dyspraxia and 26 adults with self-reported suspected DCD / Dyspraxia between the ages of 18 and 60 years completed the questionnaire. We elected to include both formally diagnosed and suspected DCD so that our work may be usefully comparable with other studies in the field. Many of these use the terms ‘probable DCD’ or ‘suspected DCD’, given that formal diagnosis is not always feasible in the context of samples from certain populations, particularly in the case of large samples (e.g., Cairney et al., 2005). Data from individuals who suspect they may have DCD / Dyspraxia without a formal diagnosis can also offer valuable insights, particularly in the case of this questionnaire study in which self-perception has an important role. This was an opportunistic sample. Participants were recruited via social media, a voluntary research participation panel at Oxford Brookes University and a database of individuals with DCD who had previously taken part in research studies.

Table 1. Demographic details of participants in the three samples

Group	N	Age Range (years)	Mean Age (years)	% Female	% Male	% Non-Binary	% Prefer to Self-Describe Gender

Diagnosed DCD	74	18-60	33.7 (SD: 11.0)	77% (N=57)	20% (N=15)	1% (N=1)	1% (N=1)*
Suspected DCD	26	18-60	37.8 (SD: 12.1)	77% (N=20)	15% (N=4)	8% (N=2)	None
TD	79	20-60	40.5 (SD:11.5)	75.9% (N=60)	22.8% (N=18)	1.3% (N=1)	None

Materials and Measures

Having been invited to complete an anonymous online questionnaire, participants completed an eight section questionnaire which included an opening section to provide informed consent and a closing section to provide demographic information. The other six sections included questions from validated, standardised scales, as well as items that were specifically developed to focus on the domain of movement around the everyday environment. The six sections described below were presented in counterbalanced order.

Data collection began in August 2020 and was completed in October 2020. The study was pre-registered on the Open Science Framework (reference: osf.io/dxp56) and a preview copy of the full questionnaire is available on the pre-registration document via a hyperlink.

(i) New General Self-Efficacy Scale (NGSE)

Chen, Gully and Eden's (2001) eight-item scale uses a five-point rating scale with "strongly disagree" at one end and "strongly agree" at the other. An example item is "I am confident that I can perform effectively on many different tasks." Higher scores imply higher GSE levels. Developed and used with adults, it shows evidence of being a psychometrically sound instrument with adequate reliability and validity for measuring and differentiating between individuals with different levels of general self-efficacy (GSE) (Chen, Gully & Eden, 2004; Scherbaum, Cohen-Charash & Kern, 2006). Item responses showed internal consistency ranging from .85 to .90, exceeding the generally accepted .70 cut-off for exploratory research (Henson, 2001; Nunnally & Bernstein, 1994). Having ranged from r = .62 to r = .65, this scale's stability coefficients are moderately high for variables relating to trait-like individual differences (Crocker & Angina, 1986; Chen et al., 2001; 2004). Regarding construct validity, evidence to date suggests a single-factor structure, supported by replication studies using confirmatory and exploratory factor analysis techniques (Chen et al., 2001; 2004).

(ii) The Brief Resilience Scale (BRS)

Smith et al.'s (2008) six-item scale, also developed and used with adults, defines resilience as "the ability to bounce back or recover from stress" (p. 194). The scale consists of three

positively worded (1, 3, 5) and three negatively worded (2, 4, 6) items to curtail positive response bias and social desirability effects. The scale is scored through reverse coding items 2, 4 and 6 before then finding the mean score of the six items. The items are rated using a five-point scale with "strongly disagree" at one end and "strongly agree" at the other. Example items are: "I tend to bounce back quickly after hard times" (item 1) and "It is hard for me to snap back when something bad happens" (item 4, reverse coded). During development, it showed good internal consistency, with Cronbach's alpha values between .80 and .91 across four adult samples. It demonstrated test-retest reliability values (ICC) of .69 for one month in 48 individuals from sample two and .62 for three months in 61 individuals from sample three. It also demonstrated convergent and predictive discriminant validity, while its one-factor solution illustrated that it measures resilience as a unitary construct.

(iii) The Hospital Anxiety and Depression Scale (HADS)

This 14-item scale developed by Zigmond and Snaith (1983) is designed to measure general anxiety and depression. While depression is not under investigation here, this scale is appropriate for measuring general anxiety levels in the current study given its well-established ability to reliably assess the presence and severity of anxiety above and below a clinically significant threshold. The depression items were included in accordance with licensing rules. Asking individuals to choose their answers based on how they have felt during the past week, Zigmond and Snaith (1983) attempted to reduce response bias by alternating response order. To one item the first response implies maximum severity and on the following item the last response indicates maximum severity. An example item is: "I can sit at ease and feel relaxed" 0 = Definitely, 1 = Usually, 2 = Not often and 3 = Not at all.

The HADS was developed with adults aged between 16 and 65 years, aligning with the current study's age range (18-60 years). The anxiety subscale's internal consistency is good, with positive Spearman correlations between individual items and the total score of other subscale items ranging from *rho* = .76 to *rho* = .41 and a significance level of $p<.01$. Spearman correlations of the anxiety subscale scores, and psychiatric ratings calculated from interviews (0-1 considered non-cases of clinical anxiety, 2 considered doubtful cases and 3-4 considered definite cases) were also determined to ascertain whether the anxiety subscale score could signal the severity, as well as the presence, of anxiety (*rho* = .74, $p <.001$). The authors concluded that the anxiety subscale score could effectively measure severity of anxiety.

The sample used to develop the scale were adults in general medical outpatient clinics, and no research has yet been done to specifically validate its use in individuals with DCD. However, some research has been undertaken to validate its use in populations with other neurodevelopmental disorders with which anxiety and depression symptoms can frequently co-occur, such as autism spectrum disorder (e.g., Uljarević et al., 2018).

(iv) Six 'I am…' statements

'I am…' statements are an open-ended measure of self-concept, and their format is based on the widely used Twenty Statements Test (TST) (Kuhn & McPartland, 1954). For this section, participants were asked to complete up to six statements each beginning with 'I am…' by describing long-term and enduring aspects of their identity. Each statement was coded in relation to whether they referenced motor difficulties. The total number of statements generated per participant was also calculated. This task has previously been used to examine self-concept in other developmental disorders in adults (e.g., autism; Tanweer, Rathbone & Souchay, 2010) but has not yet been used in relation specifically to DCD.

(v) Movement-Specific Self-Efficacy

These ten items were developed by the researchers in line with guidance from Bandura (2006) on constructing self-efficacy scales for specific domains; in this case, in relation to moving around an everyday environment. Five items were couched in terms of a quiet environment and five in terms of a busy environment. Participants were asked to rate their ability to carry out five kinds of everyday actions in:

(i) A quiet environment, with the example of a path with no other or very few other people around explicitly given in the instructions.
(ii) A busy environment, with the example of a path crowded with people, bicycles and / or dogs being walked explicitly given in the instructions.

They were asked to rate this by recording a number from zero to 100 using a visual sliding scale, where the lower end (over 0) had 'cannot do at all' written above, the middle (over 50) had 'can do fairly well' written above, and the higher end (over 100) had 'can do very well' written above. Using this visual sliding scale, participants were only able to choose a response that rounded to the nearest 10 (i.e., 0, 10, 20, 30 etc.), limiting them to 11 possible responses. In each item, a concrete example was given in brackets to help participants visualize the action or kind of action they were being asked to consider. These five items consisted of the following:

(i) Moving past objects without bumping into them (for example, past displays in shops)
(ii) Estimating the space I need when walking between two objects (for example, between tables in a restaurant or two parked cars)
(iii) Being able to move from A to B without tripping / falling / bumping into things along the way (for example, from the entrance in a café to the table you wish to sit at)
(iv) Walking on an uneven surface without tripping (for example, a rocky path or a broken pavement)
(v) Avoiding an obstacle that appears in your path (for example, a dog running out in front of you)

(vi) Movement-Specific Anxiety

These were then used to inform the development of ten complementary items designed to tap into anxiety in relation to moving around an everyday environment. Participants were asked to rate the degree of anxiety they generally feel regarding their ability to carry out the same five everyday actions in both a quiet and busy environment (identical description of environments as in the movement-specific self-efficacy scale). They were asked to rate their anxiety by recording a number from zero to 100 where the lower end (over 0) corresponded to 'not at all anxious', the middle (over 50) to 'anxious', and the higher end (over 100) to 'highly anxious'. As previously, using this visual sliding scale participants could only choose a response rounding to the nearest 10 (i.e., 0, 10, 20, 30 etc.), limiting them to 11 possible responses.

Data Processing and Statistical Analysis

A priori sample size target was set at 100 participants with DCD and 100 TD participants. This was met for the pooled DCD sample but fell slightly short for the TD sample. However, the sample size here greatly exceeds that seen in similar previous studies and sufficient power is present throughout. Some participants were missing data in the movement-specific measures. These participants were removed from the analyses involving the movement-specific measures. This resulted in sample sizes for these analyses of N = 64 (DCD diagnosed group), N=23 (DCD suspected group) and N = 63 (TD group). For analyses which did not involve the movement-specific measures, the whole sample was used, i.e., N = 74 (diagnosed DCD), N=26 (suspected DCD) and N=79 (TD).

The open-source computer software jamovi was used to conduct statistical analyses on the data (The jamovi project, 2021). A principal component analysis (PCA), using oblimin rotation, was performed on the movement-specific scales as a method of data reduction. Parallel analysis (the use of the scree plot alongside eigenvalues) was used to determine the number of components to extract and mean values were then calculated for each component. Details of the PCA and corresponding tables can be found in supplementary materials A and Supplementary Table 1. Kruskal Wallis tests were conducted to compare general self-efficacy, general anxiety, and general resilience levels across group (diagnosed DCD, suspected DCD and TD). These were also conducted to compare self-efficacy and anxiety specifically in relation to movement across group. Non-parametric tests were undertaken due to violation of the assumptions of normality and equal variances. Dwass-Steel-Critchlow-Fligner pairwise comparisons were used where appropriate. Effect size was reported as epsilon squared which is equivalent to R^2. Spearman correlations were used to determine relationships between the various measures, and this was done for the TD group as compared to the DCD group (with the DCD suspected and DCD diagnosed combined). Fisher's z transformation was used to determine levels of significance across correlation coefficients which showed differences in the patterns across the groups. For self-concept analysis chi-squared was used to determine differences in frequency of explicit mention of motor skills difficulties / dyspraxia and Kruskal-Wallis tests followed up whether differences in the

general and specific measures existed between those who did explicitly mention motor skills difficulties / dyspraxia and those who did not. Alpha level for significance was set at 0.05 throughout.

Results

General and Movement-Specific Measures: Anxiety, Self-Efficacy and Resilience in Adults with DCD and TD adults

With regard to the descriptive data, a main effect of group was found for all three general measures, general anxiety $H(2) = 30.3$, $p < .001$, $\varepsilon^2 = .17$, general resilience $H(2) = 28.0$, $p < .001$, $\varepsilon^2 = .16$ and general self-efficacy $H(2) = 43.8$, $p < .001$, $\varepsilon^2 = .25$. Differences were demonstrated between the TD group and the two DCD groups (diagnosed DCD and suspected DCD), but no differences were observed between the diagnosed DCD and suspected DCD group. General anxiety was significantly higher in both DCD groups compared to the TD group and resilience and self-efficacy were lower. The group data for each of these measures are summarised in Table 2.

For the movement-specific measures both anxiety and self-efficacy demonstrated a significant effect of group, $H(2) = 80.3$, $p < .001$, $\varepsilon^2 = .54$ and $H(2) = 40.8$, $p < .001$, $\varepsilon^2 = .27$ respectively. These differences were due to significantly higher anxiety and significantly lower self-efficacy in both DCD groups compared to the TD group. No differences were observed between the DCD groups (diagnosed DCD and suspected DCD).

Table 2. Mean and median scores for general and movement-specific measures with standard deviation and inter-quartile range (IQR) given in brackets

		Diagnosed DCD Mean (SD) Median (IQR)	Suspected DCD Mean (SD) Median (IQR)	TD Mean (SD) Median (IQR)
		N = 74	N = 26	N = 79
General	Anxiety	12.8 (3.8)	11.2 (4.23)	8.1 (3.8)
		13.0 (5.0)	11.0 (7.0)	8.0 (5.0)
	Resilience	2.45 (.75)	2.49 (.92)	3.19 (.85)
		2.42 (1.0)	2.50 (1.2)	3.33 (1.3)
	Self-efficacy	3.00 (.79)	3.17 (.82)	3.69 (.71)
		3.00 (1.13)	3.13 (1.13)	3.81 (.75)
		N = 64	N = 23	N = 63
		46.7 (22.1)	41.9 (24.4)	19.0 (22.4)
Movement	Anxiety	48.5 (30.3)	44.0 (36.0)	11.0 (24.0)
specific	Self-efficacy	43.2 (17.1)	51.8 (22.5)	83.1 (15.5)
		40.5 (25.5)	48.0 (37.0)	86.0 (15.5)

Relationships between the Measures

Correlation coefficients and *p* values are given in Table 3 for the DCD group and can be found in Supplementary Table 2 for the TD group. For these analyses, unlike those described previously, the diagnosed and suspected DCD group were combined due to low numbers in the suspected group and a lack of difference between the groups up to this point. In terms of the general measures, the results indicated a significant positive association between self-efficacy and resilience, and significant negative associations between self-efficacy and anxiety and between resilience and anxiety. As shown in Table 3, within the DCD group there was a significant positive association between general self-efficacy and movement-specific self-efficacy, and a significant negative association between resilience and movement-specific anxiety. A significant positive association was also shown between general anxiety and movement-specific anxiety. Interestingly, no significant association was found between movement-specific anxiety and movement-specific self-efficacy, ($p = .061$).

Table 3. Spearman correlations between measures in the DCD group (diagnosed and suspected combined)

	General Anxiety	General Self-Efficacy	Resilience	Movement-Specific Anxiety
General Self-Efficacy	$rs(87) = -.295$ $p = .005$	-	-	-
Resilience	$rs(87) = -.412$ $p < .001$	$rs(87) = .327$ $p = .002$*	-	-
Movement-Specific Anxiety	$rs(87) = .264$ $p = .014$	$rs(87) = -.209$ $p = .052$*	$rs(87) = -.222$ $p = .039$	-
Movement-Specific Self-Efficacy	$rs(87) = -.140$ $p = .196$*	$rs(87) = .261$ $p = .015$*	$rs(87) = .060$ $p = .582$	$rs(87) = -.202$ $p = .061$*

Dark grey shading indicates non-significant correlations. *Relationships where a difference in pattern of significance was indicated between DCD and TD groups

Five of the correlations followed different patterns across the DCD and TD group, i.e., they were significant in one group but not the other. Of the correlations which showed differences in significance across groups, only two (the relationships between movement-specific self-efficacy and movement-specific anxiety and movement-specific self-efficacy and general anxiety both of which are significant in the TD group but not the DCD group) were actually significantly different across the groups. In this case, Fischer's z transformation resulted in a z difference of 3.72 p = .002 and 2.99 p = .003 respectively. The Fischer's z transformation scores for all five correlations with different significance patterns across DCD and TD groups can be found in Supplementary Table 3.

Self-Concept in Adults with DCD and TD Adults

There was no significant difference in the number of identity statements (up to six in total for each participant) across groups; $H(2) = 2.39$, $p = .303$, diagnosed DCD (Mean = 5.35, Mdn = 6), suspected DCD (Mean = 5.54, Mdn = 6) and TD groups (Mean = 5.76, Mdn = 6). Of 74 participants with diagnosed DCD, 25 directly mentioned motor skills difficulties and / or referred to being 'dyspraxic' in their six 'I am' statements (34%), while of 26 participants with suspected DCD, 8 directly mentioned motor skills difficulties and / or being 'dyspraxic' (31%). Chi-squared indicated no greater frequency of mentions of motor skills difficulties in one group over another $\chi^2(1,100) = .0791$, $p = .779$. For the diagnosed DCD group, we found no difference in either the general or the movement-specific measures for those who did mention motor skills difficulties and / or dyspraxia compared to those who did not (all $p > .05$). For the suspected DCD group we found that movement-specific self-efficacy was significantly lower in those individuals who mentioned motor skills difficulties and / or dyspraxia, $H(1) = 5.88$, $p = .015$ (Mention Mean = 37.4, SD = 20.6, Mdn = 31.0, IQR = 21.5, No Mention Mean = 59.5, SD = 19.9, Mdn = 53.0, IQR = 25.0). No other differences were found, $p > .05$.

Discussion

The results of the current study are multifaceted. Firstly, they indicate that general and movement-specific anxiety, self-efficacy, and general resilience are all poorer in adults with DCD compared to TD adults. These findings support our hypotheses that anxiety (both general and movement-specific) would be higher, and that movement-specific self-efficacy would be lower in adults with DCD than in TD adults. This supports what has been found in previous studies among adults with DCD in relation to general anxiety (e.g., Hill & Brown, 2013), and extends previous findings among children with DCD to adults with DCD in relation to movement-specific self-efficacy (e.g., Batey et al., 2013). The results also suggest that adults with DCD have lower general self-efficacy compared with TD adults, a novel aspect we aimed to explore, and an effect already identified in children with DCD (e.g., Cairney et al., 2005). This is further strengthened by the finding that movement-specific self-efficacy was significantly positively associated with general self-efficacy in adults with DCD, the potential implications of which are discussed further below.

The fact that no differences were found between the diagnosed and suspected DCD groups in any of the general or movement-specific measures suggests that a diagnosis for DCD may not make a difference to these as standalone measures, or – given the size of the smaller suspected DCD sample – that no difference was able to be detected in this case. Our initial findings offer novel insights while adding further evidence to the preliminary and emerging literature focusing specifically on adults with DCD, whether suspected or diagnosed. This also contributes to reducing the reliance on extrapolating findings about children to apply to an adult population.

Another novel aspect has been the identification of significant relationships in the combined suspected and diagnosed DCD group. Our prediction that adults with DCD who had lower general self-efficacy would show higher general anxiety was supported by a significant negative association between these factors. This effect has not been identified in adults with DCD until now, but further adds to evidence of a relationship between self-efficacy and anxiety, at least in their general forms. In the DCD group, this makes sense in line with Bandura's (1988) assertion that the level of perceived control over potential threats in the surrounding environment has a key role in anxiety arousal. If, as according to social cognitive theory, the interpretation of threat reflects the connection between perceived competence and potentially threatening aspects of the surrounding environment, then this could help explain the relationship between self-efficacy and anxiety in people with DCD. Thus, people with motor skill difficulties may be more likely, due to this connection between perceived competence and potential threat, to interpret their environment in more threatening terms.

Clear associations between movement-specific anxiety and general anxiety and between movement specific self-efficacy and general self-efficacy were found in the DCD group as we would perhaps expect in a population in which motor skill difficulties can permeate most aspects of everyday life. Notably no significant association was found between movement-specific self-efficacy and movement-specific anxiety in the DCD group. We suggest that the

lack of relationship here may relate to the fact that living with motor skills difficulties leads to both a realistic appraisal of one's movement-related self-efficacy, as well as a kind of 'normalisation' of this in terms of its impact on everyday life, so that it may not affect anxiety in the domain of movement specifically. Interestingly, however, no significant association was found between general self-efficacy and movement-specific anxiety or between general anxiety and movement-specific self-efficacy in the DCD group. These findings support that the differences between the general and domain-specific constructs may influence their interactions, and particularly in this population and in relation to the domain of movement. This links with suggestions from Batey et al. (2013) and Bandura (2006) that general self-efficacy and domain-specific self-efficacy, as distinct constructs, may relate to and impact upon other variables – be it physical activity or anxiety levels – in different ways.

As for resilience, a significant negative association was evident between resilience and general anxiety, while a significant positive association was evident between resilience and general self-efficacy in the DCD group. These findings support our hypothesis that higher resilience would be linked with lower anxiety and higher self-efficacy (e.g., Schwarzer & Warner, 2013; Zwicker et al., 2018). In terms of the movement-specific measures, in the DCD group there was a significant negative association between resilience and movement-specific anxiety, while no significant association was identified with movement-specific self-efficacy. This difference further supports the notion that general and movement-specific self-efficacy differ both in their composition as constructs, and in how they interact with other psychological variables such as anxiety and resilience. However, the relationship between resilience and movement-specific anxiety does suggest that movement-specific anxiety may be more closely related to general anxiety than movement-specific self-efficacy is to general self-efficacy.

These results offer further evidence, and this time in an adult population, in support of Zwicker et al.'s (2018) findings regarding the effectiveness of resilience as a protective mechanism and to foster coping abilities to mitigate the negative impacts of DCD. These may be particularly pertinent for adults with DCD, especially given the increased and well-documented challenges they face in living life with motor skills difficulties. As an individual with these challenges, a more developed ability to recover from stress, linked with the connection between self-efficacy and anxiety noted previously, may positively impact how threatening that individual interprets the environment to be and, in turn, how capable they feel navigating it. As such, this could be a worthwhile avenue for future research in this field to pursue further.

Finally, the results relating to self-concept suggest that individuals with suspected DCD for whom motor skills difficulties are a dominant component of their self-concept have lower movement-specific self-efficacy. It is notable that this effect was only present in the suspected DCD group – for participants with a formal diagnosis there was no significant difference in movement-specific self-efficacy in those who referred to movement-related self-concepts compared to those who did not. Future research will be needed to explore the potential reasons for these findings, but one possibility is that people who self-report having

undiagnosed DCD - and for whom motor skills difficulties are a key part of their self-concept - may be particularly conscious of their movement-related problems.

Indeed, the finding that a focus on motor skills difficulties in self-concept statements is linked solely to movement-specific self-efficacy leaves it difficult to ascertain how positively or negatively those individuals view their movement-related self-concepts. The fact that a focus on movement lowered movement-specific but not general self-efficacy may mean that these individuals do not view this aspect of their self-concept negatively, but perhaps just realistically given the impact of DCD on motor skills and movement abilities. For some individuals, recognition of their clumsiness could be a source of unhappiness or anxiety and therefore they might rate this as a negative aspect of their identity, while for other individuals, recognition of their clumsiness might be just that – recognition – and they may feel fine about that aspect of their identity.

An interesting area for future research to delve into could build on the initial finding in the current study to investigate whether the emotional valence of self-concepts – rather than the presence or absence of a specific type of self-concept (e.g., in this case movement-related) – might relate significantly to factors such as anxiety, resilience and self-efficacy in adults with DCD.

Limitations

The DCD group comprised participants with both formally diagnosed and suspected DCD. Whilst this is an established approach (e.g., Batey et al., 2014; Kirby et al., 2013) and no group differences were found between diagnosed and suspected DCD - apart from in relation to movement-related self-concept statements - it is important to note that inclusion in the DCD group was based on self-report. As such, we cannot be certain, for example, that participants in the diagnosed DCD group had a formal diagnosis. Second, the assessments developed to target movement-specific anxiety did not target movement as a whole but focused only on mobility on foot (a sub-category of motor skills). As the motor implications of DCD extend far beyond mobility on foot, it is important not to generalise the findings of the present study beyond this domain. Future work assessing a more comprehensive overview of motor skills in relation to anxiety and self-efficacy will be needed to examine whether these results can be extended more broadly. Finally, it is unsurprising that many of the DCD group (both diagnosed and suspected) included statements about motor skills difficulties in their self-concept, as they were aware they were taking part in a study about movement disorders, and this is likely to have primed this aspect of their identity. However, this does not affect the interpretation of our analyses (within the DCD groups) into whether those with DCD who did define themselves in relation to motor skills difficulties differed in their responses to the self-efficacy, resilience and anxiety measures compared to those with DCD who did not define themselves in this way.

As discussed earlier, the current study did not measure the emotional valence of participants' self-concept (i.e., whether the 'I am' statements were positive or negative). Considering this, a limitation of the current study is the consequent inability to compare its findings in this

domain with previous studies on DCD and self-concept, which not only sampled children and adolescents rather than adults, but which all also directly measured and discussed the positivity and negativity of self-perceptions (Cocks et al, 2009; Hands et al., 2020; Yu et al., 2016).

Conclusion

To conclude, the current study offers insight into the nature of and relationships between general and movement-specific anxiety, self-efficacy, and resilience among adults with suspected and diagnosed DCD compared with TD adults. Its findings indicate that general and movement-specific anxiety, self-efficacy, and general resilience are all poorer in adults with DCD compared to TD adults. Results also show that where motor skills difficulties featured in the self-concept of adults with suspected (but not diagnosed) DCD, movement-specific self-efficacy was lower.

Taken together, these findings contribute to the growing body of evidence showing that DCD continues to significantly challenge psychosocial wellbeing into adulthood. We suggest that interventions to improve the psychosocial wellbeing of adults with DCD may benefit from targeting anxiety, self-efficacy, and resilience, with a particular focus on movement-related domains. These could offer valuable contributions to the development of effective strategies to manage the multifaceted and interrelated impacts that motor skills difficulties have on everyday life for adults with DCD.

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Supplementary Materials

Section A

Principal Component Analysis

A principal component analysis (PCA), using oblimin rotation, was performed on all the data from the movement-specific scales, i.e. from the DCD and TD groups together. This was done to verify whether the data were reliably capturing the dimensions the scale was aiming to measure, namely movement-specific self-efficacy and movement-specific anxiety. Using parallel analysis, the data (N=150) loaded freely onto two components which in total explained 78.3% of the overall variance in the data. Sample size was confirmed to be sufficient using the MKO sampling adequacy measure with all values sitting above .885 and an overall value of .908. The assumption of sphericity was met using Bartlett's test of sphericity (X^2=4333(190), p<.001), and as might be expected the two components were moderately negatively correlated (r_s = -0.526). The way in which the questions loaded onto the components is shown in Table 1. The first component represents all of the questions focusing on movement-specific self-efficacy while the second on movement specific anxiety.

Supplementary Table 1. Loading of self-efficacy and anxiety questions in quiet and busy environments onto components

Environment	Focus	Question	Component 1	Component 2
Quiet	Self-Efficacy	Moving past objects	0.908	
		Estimating space	0.904	
		Not tripping / falling / bumping	0.892	
		Uneven surface without tripping	0.780	
		Avoiding obstacle	0.836	
	Anxiety	Moving past objects		0.942
		Estimating space		0.930
		Not tripping / falling / bumping		0.928
		Uneven surface without tripping		0.860
		Avoiding obstacle		0.910
Busy	Self-Efficacy	Moving past objects	0.980	
		Estimating space	0.924	
		Not tripping / falling / bumping	0.940	
		Uneven surface without tripping	0.780	
		Avoiding obstacle	0.862	
	Anxiety	Moving past objects		0.803
		Estimating space		0.846
		Not tripping / falling / bumping		0.825
		Uneven surface without		0.728

	tripping	
	Avoiding obstacle	0.757

Supplementary Table 2. Spearman correlations between measures in the TD group. Dark grey shading indicates non-significant correlations.

	General Anxiety	General Self-Efficacy	General Resilience	Movement-Specific Anxiety
General Self-Efficacy	*rs*(63) = -.427 *p* < .001	-	-	-
General Resilience	*rs*(63) = -.427 *p* <.001	*rs*(63) = .247 *p* = .051*	-	-
Movement-Specific Anxiety	*rs*(63) = -.184 *p* = .148	*rs*(63) = -.324 *p* = .009*	*rs*(63) = -.324 *p* = .001	-
Movement-Specific Self-Efficacy	*rs*(63) = .356 *p* = .004*	*rs*(63) = .121 *p* = .346*	*rs*(63) = .247 *p* = .051	*rs*(63) = -.611 *p* <.001*

Dark grey shading indicates non-significant correlations. *Relationships where a difference in pattern of significance was indicated between DCD and TD groups

Supplementary Table 3 Fisher z transformations and z differences for the DCD and TD group, given for the correlation coefficients which differed in terms of significance between the two groups. Two-tailed p values are provided.

Variables	DCD		TD		Difference in z	P value
	Details	Fisher z	Details	Fisher z		
Resilience General self-efficacy	*rs* = .327 N = 87	.339	*rs* = .247 N = 63	.252	.516	.610
Movement specific anxiety General self-efficacy	*rs* = -.209 N = 87	-.212	*rs* = -.324 N = 63	-.336	.734	.465
Movement specific self-efficacy General anxiety	*rs* = -.140 N = 87	-.141	*rs* = .356 N = 63	.372	-3.036	.002*
Movement specific self-efficacy General self-efficacy	*rs* = .261 N = 87	.267	*rs* = .121 N = 63	.142	.741	.459
Movement specific self-efficacy Movement specific anxiety	*rs* = -.202 N = 87	-.205	*rs* = -.611 N = 63	-.711	2.99	.003*