

Controlling Motivational Experiences of Adolescents with and without Developmental Coordination Disorder in School Physical Education

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Abstract

The purpose of the study was to examine whether higher levels of adolescents' perceptions of intimidating behavior and negative conditional regard by the PE teacher, thwarting of the psychological needs for autonomy, competence, and relatedness, fear of failure, contingent self-worth, and challenge avoidance are linked to the presence of developmental coordination disorder (DCD) in physical education. Motor proficiency was evaluated using the Movement Assessment Battery for Children (2nd ed.) in a sample of 336 adolescents. Students' perceptions on motivational constructs were measured via self-report questionnaires and compared between adolescents with DCD and typically developing peers. Independent of gender, presence of DCD was linked to significantly higher levels of the above negative motivational constructs. Independent of DCD, boys reported significantly higher levels on all negative motivational constructs than girls except contingent self-worth. Among adolescents with DCD, boys reported greater autonomy and competence thwarting compared to girls. Within boys, those with DCD reported greater levels of intimidation, autonomy thwarting, competence thwarting, and fear of failure compared to typical boys. No differences emerged between girls with and without DCD. Adolescents with DCD seem to report higher levels of negative motivational experiences in school physical education compared to their typically developing peers. The present study extends the evidence base of psychosocial variables of a motivational nature in physical activity linked to the presence of DCD.

Keywords: Student motivation; movement difficulties; motor difficulties; self-determination theory.

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INTRODUCTION

Motivation for Physical Activity in Adolescents with and without DCD

Developmental Coordination Disorder (DCD) is a neurodevelopmental disorder characterized by a substantial lower acquisition and execution of coordinated motor skills than that expected, given the individual's chronological age. It causes motor difficulties affecting functional performance in activities of daily living and/or academic achievement and health. Its prevalence in children aged 5-11 years is thought to be 5%-6%, and it is more frequent in males than females, with a male/female ratio between 2:1 and 7:1. Although there may be improvement in the longer term, problems with coordinated movements continue through adolescence, in an estimated 50%-

70% of children leading to a number of secondary psychosocial consequences (APA, 2013). These consequences have been investigated to better understand the activity-deficit between individuals with and without DCD, mainly in studies with children populations (Noordstar, & Volman, 2020; Batey *et al.*, 2014; Hendrix *et al.*, 2014; Cairney *et al.*, 2009; Cairney *et al.*, 2005). However, in recent years there is a growing body of knowledge, not only in adolescent years but in early adulthood, as well (Barnett & Hill, 2019; Blank *et al.*, 2019).

Longitudinal studies have shown that poor motor proficiency in early and primary education is associated with reduced physical activity participation in later childhood and adolescence (Barnett *et al.*, 2009; Lopes *et al.*, 2009). Some DCD consequences include

lower educational achievement and therefore fewer life chances in an adolescent's life (Harrowel *et al.*, 2018). Moreover, adolescents with DCD compared to typically developed peers showed poorer self-perceived competence (Wright *et al.*, 2019), a construct closely related to the self-efficacy construct (Skinner & Piek, 2001) referring to the individual's perception of mastery of physical skills (Harter, 1982); poorer self-esteem and sense of self-worth (Rose *et al.*, 2015); reduced participation in leisure activities (Barnett, & Hill, 2019; Raz-Silbiger *et al.*, 2015); reduced physical activity participation and poor physical fitness levels (Barnett & Hill, 2019; Raz-Silbiger *et al.*, 2015); obesity (APA, 2013) and poor reported health-related quality of life (Zwicker *et al.*, 2012). Particularly female adolescents with DCD, showed an increased risk of mental health problems, in their late adolescence (Harrowell *et al.*, 2017). They, also tend to avoid participating in team play and sports (Izadi-Najafabadi *et al.*, 2019) which in turn leads to a decrease in their perceived competence and to a further deterioration of motor performance due to a lack of practice (Cermack, & Larkin, 2002) and to social isolation (Barnett, & Hill, 2019). As a result they may be engaged to a negative cycle and adopt a sedentary lifestyle avoiding participation in motor activities in line with the activity-deficit hypothesis (Schoemaker & Smits-Engelsman, 2015; Green *et al.*, 2011) with negative consequences in their physical and psychosocial health (Dewey & Volkovinskaia, 2018).

In order to reverse these undesirable secondary consequences, a better understanding of why adolescents with DCD display lower physical activity involvement needs to be achieved. Such an understanding may be facilitated by an approach to the study of these adolescents' physical activity behavior from a motivational viewpoint taking into account how various tasks, environments, and patterns of perception might influence adolescents' decision to participate (Barnett & Hill, 2019; Dunn & Watkinson, 2002).

Using qualitative interviews Ruiz-Perez *et al.*, (2018) investigated the experiences, feelings, and cognitions of adults who were self-identified as low skilled and clumsy in physical education classes when they were children/adolescents. Among the various themes that emerged, findings revealed an array of negative motivational experiences including intimidating behavior by PE teachers; perceiving PE classes as a hostile environment generating the tendency to avoid participation and flee from that environment; feelings of marginalization, experiences of athletic skills being at a very low level, feeling forced to participate in activities the students hated in the first place, and feelings of humiliation. Feelings of humiliation along with the tendency to avoid awkwardness in the future for these individuals when they were children have also been reported by Fitzpatrick and Watkinson (2003) when they interviewed adults for their experiences as children.

Adaptive and Maladaptive Motivational Processes within Self-determination Theory

Children's successful functioning, and optimal motivation and engagement in school may be seen as a well-coordinated interpersonal process between students and teachers (Roeser *et al.*, 2000). The interpersonal style adopted by the teacher (i.e., how involved and how supportive the teacher is) plays a central role in students' motivation (Reeve & Jang, 2006). Within self-determination theory (SDT) (Ryan & Deci, 2002; Deci & Ryan, 1985), a theory of motivated behavior with important motivational implications for educational practice (Niemeck & Ryan, 2009; Reeve & Halusic, 2009), a distinction is offered between optimal (e.g., autonomy supportive) teacher behaviors creating motivation leading to students' optimal functioning (Reeve & Jang, 2006), and non-optimal (e.g., controlling) teacher behaviors (Van den Berghe *et al.*, 2013; Reeve & Jang, 2006) creating non-optimal motivation and amotivation (De Meyer *et al.*, 2014). The aim of autonomy supportive behaviors is to help students perceive congruence between their in-class behavior and their inner motivational resources such as psychological needs for autonomy, competence, and relatedness, interests, preferences, goals, and values (Reeve & Jang, 2006). Autonomy-supportive behaviors include asking students what they want and providing choices, giving them time to work on a problem on their own way, and providing rationales to explain why an apparently non-interesting activity may truly worth students' attention (Reeve & Jang, 2006). Controlling teaching is characterized by the use of pressuring behaviors to make the student think, feel, and behave in specific ways (Reeve & Jang, 2006). It can be manifested as externally controlling teaching where the teacher uses overt controlling strategies such as yelling, punishments, and controlling language (e.g., "you have to"). Intimidation has been identified as such a controlling strategy including overly critical behaviors aiming to humiliate and belittle (Bartholomew *et al.*, 2010). Also, it can be manifested as internally controlling teaching using less directly observable behaviors aiming to evoke students' feelings of shame, guilt or anxiety; for instance, in the form of negative conditional regard where the teacher may withdraw attention and interest when the student fails to act as expected, and express disappointment when expectations are not met (Bartholomew *et al.*, 2010). In line with SDT autonomy supportive teaching is expected to promote positive educational outcomes via fulfillment of students' basic psychological needs for autonomy, competence, and relatedness (Niemeck & Ryan, 2009). Controlling teaching is expected to lead to negative motivational outcomes via frustration of these basic psychological needs (Haerens *et al.*, 2015). The need for autonomy is fulfilled when individuals feel their behavior is an expression of themselves and feel initiative in regard to this behavior; the need for competence is satisfied when individuals feel effective

in their ongoing interactions with their environment and experience opportunities to express their capacities; the need for relatedness is fulfilled when one feels connected to others, caring for, and being cared for by others, and a sense of belongingness to one's group (Ryan & Deci, 2002). It has been increasingly accepted and demonstrated in the SDT literature (a) a distinction between adaptive and maladaptive motivational processes meaning that need frustration is taken to be distinct from absence of need satisfaction and (b) that processes related to need satisfaction and need frustration have been associated with different motivational and educational consequences (Jang *et al.*, 2016; Haerens *et al.*, 2015; Bartholomew *et al.*, 2011).

Given that school is an environment that achievement is highly valued, students' self-worth is highly likely to be determined in part by their ability to demonstrate competence and success (Crocker *et al.*, 2003). Therefore, because feelings of inadequacy and failure may lead to shame and self-doubt, some students may fear failure, that is, hold beliefs that failing to meet a specific performance standard will lead to aversive consequences (Conroy *et al.*, 2002). Fear of failure may also be seen as a consequence of thwarting of the needs for autonomy and relatedness (Bartholomew *et al.*, 2018). In terms of autonomy thwarting, some students may decide to engage in the task because they "have to" in order to avoid punishment, a reason that represents a form of extrinsically motivated behavior (Bartholomew *et al.*, 2018). Fear of failure may also be experienced in the case of relatedness thwarting when children fear to fail at the task because they expect to be criticized by the teacher in front of their peers (Bartholomew *et al.*, 2018). Thwarting of the need for autonomy may also lead to contingent self-worth as students may feel of lower value as persons if they do not maintain positive relationships with their teacher by performing up to teacher's expectations. Also, when students' autonomy is frustrated and students do not endorse their own behavior they may feel that their self-worth is based on demonstrating the behaviors sought by the teacher even if these behaviors are not part of their identity (Bartholomew *et al.*, 2018; Deci & Ryan, 2000). Further, in a controlling environment when probabilities of success are not clear, students may prefer to avoid challenge as a form of maladaptive coping behavior (Elliot & Church, 1997). Such behavior may minimize shame because in the case of minimal effort exertion failure will not imply incompetence (Dweck, 1999).

Negative Motivational Experiences in Adolescents with and without DCD

Given a scarcity of research studies examining the link of the presence of DCD with negative motivational experiences, self-determination theory, a theory with motivational implications for educational practice (Niemeck & Ryan, 2009; Reeve & Halusic, 2009) was presently used to achieve this goal. Self-determination theory is considered suitable for the study

of negative motivational experiences of children with DCD (Katartzi & Vlachopoulos, 2011) given theoretical constructs corresponding to negative experiences reported by adults self-identified as clumsy during childhood (Ruiz-Perez *et al.*, 2018). Such constructs include PE teacher "intimidating behavior" and "negative conditional regard" toward the students, "need for autonomy thwarting" (e.g., feeling forced to participate in activities), "need for competence thwarting" (e.g., experiences of low level athletic skills), and "need for relatedness thwarting" (e.g., feelings of marginalization). Therefore, the purpose of the present study was to compare adolescents with and without DCD on perceptions of PE teachers' intimidating behavior, negative conditional regard, students' autonomy thwarting, competence thwarting, relatedness thwarting, and maladaptive cognitive-affective (i.e., fear of failure), affective (i.e., contingent self-worth), and behavioral (i.e., challenge avoidance) outcomes. It was hypothesized that adolescents with DCD would perceive higher levels on all of the aforementioned variables compared to their typically developing peers.

MATERIALS AND METHODS

Participants

A sample of adolescents was studied attending middle schools located in an urban area of average socioeconomic status in Northern Greece. Inclusion criteria involved being a student, boy or girl, attending middle school. Information was also collected on age, PE grades of the second trimester, height, weight, weekly frequency and type of out-of-school sports participation. There were 336 adolescents (156 boys; 46.4 % and 180 girls; 53.6 %) attending three schools and nine classes aged 13-16 yrs. ($M = 13.47$ yrs., $SD = 0.55$). Participants' height ranged between 135 and 186 cm ($M = 164.01$, $SD = 8.58$) while their weight ranged between 28 and 100 Kg ($M = 55.55$ kg, $SD = 10.37$). They participated in out-of-school sports between 0 and 6 times weekly ($M = 1.85$, $SD = 1.80$). Activities included cycling, basketball, tennis, swimming, taekwondo, handball, badminton, and skiing.

Measures

Controlling coach behaviors scale (CCBS; Bartholomew et al., 2010)

The two four-item subscales of intimidation (e.g., "My PE teacher shouts at me in front of others to make me do certain things") and negative conditional regard (e.g., "My PE teacher uses the threat of punishment to keep me in line during the lesson") were used from the CCBS and presently adapted for the PE context. Items that were not relevant to PE were excluded (e.g., "My coach tries to control what I do during my free time"). Evidence supportive of factorial validity and internal consistency of the CCBS has been provided by Bartholomew *et al.* (2010).

Psychological Need Thwarting Scale (PNTS; Bartholomew *et al.*, 2011)

The PNTS was adapted for the PE context to measure levels of need thwarting for autonomy, competence, and relatedness. Following the stem “During PE...” students provided their responses to the three aforementioned subscales. Sample items are for autonomy thwarting (e.g., “I feel pushed to behave in certain ways”), for competence thwarting (e.g., “There are situations in which I am made to feel incompetent”), and relatedness thwarting (e.g., “I feel I am disliked”). Evidence of factorial validity and internal consistency has been provided by Bartholomew *et al.* (2011).

Performance Failure Appraisal Inventory (PFAI; Conroy *et al.*, 2002)

For the assessment of fear of failure, the short form (five items) of the PFAI was used which is a dispositional measure of appraisals associated with fear of failure (e.g., “When I am failing, I worry about what others think about me”). Evidence in favor of the validity and reliability of the PFAI scores (both the long and short form) has been provided by Conroy and associates.

Contingencies of Self-worth Scale (CSWS; Crocker *et al.*, 2003)

This instrument measures contingencies of self-worth in a number of domains. Four items that measure academic competence-related contingent self-worth were adapted for PE and used in the present study. The scale tapped students’ self-evaluations in relation to whether students’ self-worth increased or decreased following success or failure in PE lessons (e.g., “I feel bad about myself whenever my performance in PE is lacking”). Evidence in favor of construct validity and reliability has been provided by Crocker *et al.*, (2003).

Challenge Avoidance Scale (Assor & Tal, 2012)

This 5-item scale was initially used to measure students’ tendency to withdraw from academic

challenges (Assor & Tal, 2012). It was adapted for the present study to measure students’ tendency to avoid challenging situations in PE (e.g., “If I don’t succeed in a task in PE for the first time, I stop trying”). High levels of internal consistency were found in Assor and Tal’s study.

Procedures

Prior to data collection, permission to conduct the study was obtained from the school head-masters and informed consent was obtained from parents and the students themselves (parents had the option to complete an opt-out form if they wished). Data collection took place in the January-February period (second school trimester) by research assistants who visited the schools. The purpose of the study was explained, participants were informed for the voluntary nature of their participation, and the confidentiality of their responses. No pupils refused to participate in the study. A coding system was developed to match questionnaire responses with participants’ MABC-2 scores to protect anonymity. The research study was approved by the Greek Ministry of Education and the Departmental Research Ethics Committee.

The Movement Assessment Battery for Children - 2 (MABC-2), (Henderson *et al.*, 2007) was used to identify students with motor difficulties. Out of 336 adolescents, 32 (18 boys; 56.3% and 14 girls; 43.8%) were identified as having motor coordination difficulties with a total score below 67 inclusive, and a percentile range below the 15th percentile inclusive. These were categorized as students with DCD compared to their typically developing peers ($n = 304$) (138 boys; 45.4% and 166 girls; 54.6%). Descriptive statistics for the two groups of typical and DCD adolescents are presented in Table 1. Participation in physical education classes was compulsory and took place twice a week with each lesson lasting 45 min. Participants provided data on PE teachers’ controlling behavior, psychological needs thwarting, fear of failure, contingent self-worth, and challenge avoidance.

Table 1: Descriptive Statistics for Typically Developed and DCD Adolescents

Variables	Typical Adolescents ($n = 304$)				DCD Adolescents ($n = 32$)			
	Min.	Max.	<i>M</i>	<i>SD</i>	Min.	Max.	<i>M</i>	<i>SD</i>
Age	13	15	13.46	0.53	13	16	13.56	0.71
Height (cm)	138	186	164.13	8.16	135	184	162.83	12.12
Weight (Kg)	28	100	55.51	10.35	33	75	55.87	10.79
School PE grades	14	20	19.31	0.94	15	20	18.40	1.30
Weekly frequency of out-of-school sports	0	6	1.90	1.80	0	5	1.40	1.79

Note. $N = 336$. Min. = Minimum; Max. = maximum. In the Greek educational system school grades may vary between 0 and 20.

Data Analysis

Initially instrument responses were subjected to confirmatory factor analysis (CFA) while Cronbach’s alpha coefficients (Cronbach, 1951) were also estimated. In CFAs factor variances were fixed to unity,

factor covariances were freely estimated while item error covariances were fixed to zero. CFA model fit was examined using the chi-square statistic; the Comparative Fit Index (CFI) (Bentler, 1990) with a value of .95 or greater indicating an excellent fit to the

data (Hu & Bentler, 1999) and a value of .90 or greater reflecting a reasonable fit; the Root Mean Squared Error of Approximation (RMSEA: Steiger & Lind, 1980) and its' accompanying 90% confidence interval (RMSEA 90% CI) with a value less than .05 indicating a good model fit (Hu & Bentler, 1999) and a value between .08 and .10 representing an adequate fit (Byrne, 2000; Browne & Cudeck, 1993). Additionally, Cronbach's alpha coefficients were computed along with Pearson's correlations between the variables.

Next, adolescents were categorized into the DCD and typical development categories and the interaction was examined of DCD by gender on their perceptions of controlling PE teacher behaviors (i.e., intimidation and negative conditional regard), need for autonomy thwarting, need for competence thwarting, need for relatedness thwarting, fear of failure, contingent self-worth, and challenge avoidance. Analyses of variance were conducted using students' age, PE grades of the second trimester, height, weight, and weekly frequency of out-of-school sports participation as covariates.

RESULTS

Confirmatory Factor Analyses and Internal Consistency

A 2-factor CFA model was estimated for the CCBS (Controlling Coach Behaviors Scale) and a 3-factor model for PNTS (Psychological Need Thwarting Scale). Single factor CFAs were estimated for PFAI (Performance Failure Appraisal Inventory), CSWS (Contingencies of Self-worth Scale), and CAS (Challenge Avoidance Scale). Generally, for all of the scales a good model fit emerged.

For CCBS ("intimidation" and "negative conditional regard" factors) the corrected for non-normality fit indexes were: S-B scaled $\chi^2 = 30.13$, $df = 19$, robust CFI = .973, robust RMSEA = .042, RMSEA 90% CI = .000-.069. The fully standardized item loadings ranged from .594 to .831. For PNTS fit indexes were: S-B scaled $\chi^2 = 67.40$, $df = 51$, robust CFI = .980, robust RMSEA = .031, RMSEA 90% CI = .000-.049. The fully standardized item loadings ranged from .377 to .862. For PFAI, fit indexes were: S-B scaled $\chi^2 = 9.10$, $df = 5$, robust CFI = .977, robust RMSEA = .049, RMSEA 90% CI = .000-.100 with item loadings ranging .560 - .807. For CAS fit indexes were: S-B scaled $\chi^2 = 7.81$, $df = 5$, robust CFI = .987, robust RMSEA = .041, RMSEA 90% CI = .000-.093 with item loadings ranging .586-.832. For CSWS where multivariate normality was evident (normalized estimate = 0.44) fit indexes were: $\chi^2 = 2.25$, $df = 2$, CFI = .999, RMSEA = .019, RMSEA 90% CI = .000 - .112. Item loadings ranged .570-.814 with the reverse item displaying a weak item loading of -.128. Given (a) the

need to remove that item as it did not contribute to construct measurement, and (b) that a 3-item CFA model cannot be estimated due to identification problems, a more encompassing CFA measurement model was tested including the three single factors of fear of failure (PFAI: 5 items), challenge avoidance (CAS: 5 items) and self-worth contingencies (CSWS: 3 items after removing the reverse item). Fit indexes for this model were: S-B scaled $\chi^2 = 111.73$, $df = 62$, robust CFI = .940, robust RMSEA = .049, RMSEA 90% CI = .034-.063. Cronbach's alpha coefficients were .77 for intimidation, .78 for negative conditional regard, .80 for autonomy thwarting, .81 for competence thwarting, .80 for relatedness thwarting, .78 for fear of failure, .74 for self-worth contingencies, and .85 for challenge avoidance.

Descriptive Statistics and Pearson's Correlations

Generally levels of the negative motivational experiences presently studied appeared to be relatively low (Table 2). The two dimensions of controlling teacher's behavior were positively correlated. Positive correlations emerged between autonomy, competence, and relatedness thwarting (Table 2). Positive correlations were found between negative conditional regard and intimidating behavior with thwarting of the three psychological needs for autonomy, competence, and relatedness.

Negative conditional regard and intimidating behavior were positively correlated with fear of failure, contingent self-worth, and challenge avoidance. These three variables were also positively correlated with all three needs thwarting except the correlation between autonomy thwarting and contingent self-worth that was nonsignificant (Table 2). Trimester PE grades were negatively correlated with the two controlling teaching dimensions, all three needs thwarting, fear of failure, and challenge avoidance but not contingent self-worth (Table 2).

Being categorized as having DCD was positively correlated with negative regard, intimidating behavior, thwarting of the needs for autonomy, competence, relatedness, fear of failure, contingent self-worth, and challenge avoidance, and negatively correlated with PE grades (Table 2). In terms of gender, being a girl was linked to lower scores for all negative motivational variables and weekly frequency of participation in out-of-school sports (i.e., negative correlations) except for a nonsignificant correlation with contingent self-worth (Table 2). Regarding the association between DCD and gender, the correlation was nonsignificant (Table 2) with the findings being supported by a chi-square test of association (chi square = 1.37, $p = .24$).

Table 2: Means, Standard Deviations, and Pearson's Correlations between Study Variables

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Negative regard	1.98	1.15	—													
2. Intimidating behavior	1.94	1.22	.70**	—												
3. Autonomy thwarting	2.53	1.50	.53**	.54**	—											
4. Competence thwarting	1.91	1.19	.55*	.57**	.58**	—										
5. Relatedness thwarting	1.74	1.15	.47**	.41**	.35**	.62**	—									
6. Fear of failure	1.66	0.76	.49**	.41**	.45**	.65**	.55**	—								
7. Contingent self-worth	1.77	0.81	.21**	.17**	.10	.23**	.28**	.30**	—							
8. Challenge avoidance	1.68	1.07	.44*	.48**	.33**	.51**	.51**	.49**	.26**	—						
9. Age	13.47	0.55	-.09	-.03	-.09	-.02	-.07	-.11*	-.05	.11*	—					
10. PE grades	19.22	1.01	-.11*	-.13*	-.13*	-.13*	-.15**	-.12*	-.01	-.17**	-.14*	—				
11. Height	164.01	8.58	-.04	-.04	-.03	-.00	-.02	-.05	-.01	.02	.19*	.06	—			
12. Weight	55.55	10.37	-.04	-.05	-.05	.03	.05	.00	.03	.08	.26*	-.16**	.68**	—		
13. Out-of-school sports weekly frequency	1.85	1.80	-.08	-.08	.02	-.06	-.01	-.02	.01	-.14*	-.15**	.24**	.07	-.02	—	
14. DCD	—	—	.30**	.29**	.21**	.34**	.34**	.31**	.12*	.25**	.05	-.26**	-.04	.01	-.08	—
15. Gender	—	—	-.23**	-.20**	-.15**	-.14**	-.24**	-.13*	-.05	-.16**	.06	.00	-.16**	-.16**	-.19**	-.06

Note. N = 336. *p < .05; **p < .01. DCD has been coded as 1 (typical adolescent) and 2 (DCD adolescent). Gender has been coded as 1 (boy) and 2 (girl).

DCD versus Typically Developing Peer Differences

Initially, the typically developed and DCD categories were compared on the demographics of age, height, weight, PE grades, and out-of-school sports frequency using a one-way MANOVA. There was a significant multivariate effect [Wilk's lambda = .932, $F(5, 308) = 4.52$, $p = .001$, partial eta squared = .068]. Follow-up univariate one-way ANOVAs revealed a significant effect only for trimester PE grades [$F(1, 312) = 21.93$, $p = .000$, partial eta squared = .066] with DCD adolescents obtaining lower PE grades than typical peers. Remaining effects were nonsignificant for age [$F(1, 312) = .14$, $p = .706$, partial eta squared = .000], height [$F(1, 312) = 1.29$, $p = .256$, partial eta squared = .004], weight [$F(1, 312) = .00$, $p = .965$, partial eta squared = .000], and frequency of out-of-school sports [$F(1, 312) = 1.89$, $p = .169$, partial eta squared = .006].

DCD by Gender Interaction

A two-way MANCOVA was estimated to examine the effects of the interaction between DCD and gender on scores of intimidation, negative conditional regard, need for autonomy thwarting, need for competence thwarting, need for relatedness thwarting, fear of failure, contingent self-worth, and challenge avoidance using as covariates age, second trimester student PE grades, height, weight, and weekly frequency of out-of-school sports. Findings revealed a significant DCD by gender multivariate interaction [Wilk's lambda = .947, $F(8, 298) = 2.08$, $p = .037$, partial eta squared = .053]. Follow-up two-way ANCOVAs revealed significant interaction effects for intimidation, autonomy thwarting, competence thwarting, and fear of failure. Indexes were for intimidation [$F(1, 305) = 4.30$, $p = .039$, partial eta squared = .014], negative conditional regard [$F(1, 305) = .78$, $p = .376$, partial eta squared = .003], need for autonomy thwarting [$F(1, 305) = 5.71$, $p = .017$, partial eta squared = .018], need for competence thwarting [$F(1, 305) = 11.42$, $p = .001$, partial eta squared = .036], need for relatedness thwarting [$F(1, 305) = 1.65$, $p = .199$, partial eta squared = .005], fear of failure [$F(1, 305) = 4.94$, $p = .027$, partial eta squared = .016], contingent self-worth [$F(1, 305) = 2.72$, $p = .100$, partial eta squared = .009] and challenge avoidance [$F(1, 305) = 1.61$, $p = .205$, partial eta squared = .005]. For all eight outcome variables and independent of gender, adolescents with DCD reported higher means compared to typically developed adolescents. Also, independent of DCD, boys reported higher means on all negative outcome variables compared to girls.

Analysis of the DCD by gender interaction using four independent samples *t*-tests ($p = .012$ after Bonferroni adjustment) revealed that among typically developed adolescents, boys reported significantly higher intimidation than girls ($t = 2.80$, $p = .005$). No differences existed for autonomy thwarting ($t = 1.76$, $p = .079$), competence thwarting ($t = 1.28$, $p = .200$) and

fear of failure ($t = 1.41$, $p = .159$). Among adolescents with DCD, boys reported significantly higher scores than girls on autonomy thwarting ($t = 2.98$, $p = .006$) and competence thwarting ($t = 3.28$, $p = .003$) but not on intimidation ($t = 2.29$, $p = .029$), and fear of failure ($t = 2.15$, $p = .039$). Among boys, those with DCD reported significantly higher scores on all four variables compared to typical boys for intimidation ($t = -3.70$, $p = .002$), autonomy thwarting ($t = -4.51$, $p = .000$), competence thwarting ($t = -4.40$, $p = .000$) and fear of failure ($t = -3.81$, $p = .001$). Among girls, no significant differences emerged between those with and without DCD on intimidation ($t = -1.57$, $p = .137$), autonomy thwarting ($t = -0.59$, $p = .563$), competence thwarting ($t = -1.48$, $p = .157$), and fear of failure ($t = -2.16$, $p = .032$). However, the direction of the differences were consistent for all four outcome variables with DCD girls reporting higher scores of these negative motivational variables compared to typical girls.

Main Effects for DCD

Main effects were examined for DCD and gender separately. There was a significant multivariate main effect for DCD [Wilk's lambda = .863, $F(8, 298) = 5.89$, $p = .000$, partial eta squared = .137]. Univariate effects were significant for intimidation [$F(1, 305) = 22.02$, $p = .000$, partial eta squared = .067], negative regard [$F(1, 305) = 25.73$, $p = .000$, partial eta squared = .078], need for autonomy thwarting [$F(1, 305) = 10.42$, $p = .001$, partial eta squared = .033], need for competence thwarting [$F(1, 305) = 31.15$, $p = .000$, partial eta squared = .093], need for relatedness thwarting [$F(1, 305) = 30.08$, $p = .000$, partial eta squared = .090], fear of failure [$F(1, 305) = 26.20$, $p = .000$, partial eta squared = .079], contingent self-worth [$F(1, 305) = 4.96$, $p = .000$, partial eta squared = .027], and challenge avoidance [$F(1, 305) = 14.78$, $p = .000$, partial eta squared = .046]. For all of the outcome variables and independent of gender, DCD adolescents reported significantly higher mean scores compared to typically developed peers (Table 3).

Main Effects for Gender

For gender, a significant multivariate main effect emerged [Wilk's lambda = .921, $F(8, 298) = 3.18$, $p = .002$, partial eta squared = .079]. Significant univariate effects were found for intimidation [$F(1, 305) = 16.70$, $p = .000$, partial eta squared = .052], negative regard [$F(1, 305) = 10.14$, $p = .002$, partial eta squared = .032], need for autonomy thwarting [$F(1, 305) = 12.30$, $p = .001$, partial eta squared = .039], need for competence thwarting [$F(1, 305) = 18.88$, $p = .000$, partial eta squared = .023], need for relatedness thwarting [$F(1, 305) = 11.33$, $p = .001$, partial eta squared = .036], fear of failure [$F(1, 305) = 8.75$, $p = .003$, partial eta squared = .028] and challenge avoidance [$F(1, 305) = 8.47$, $p = .004$, partial eta squared = .027] but not contingent self-worth [$F(1, 305) = 2.92$, $p = .088$, partial eta squared = .010]. For all of the outcome variables and independent of DCD,

boys reported significantly higher means compared to girls except contingent self-worth (Table 3).

Hedge's *g* effect sizes (*ES*) for each one of the outcome variable group comparisons are presented in Table 3. For Hedge's *g*, the values of .15, .40, and .75 are considered to represent small, medium, and large *ES*s respectively (Brydges, 2019). Hedge's *g* has been

recommended when small sample sizes are involved in group comparisons (Lakens, 2013). For gender comparisons all *ES*s were small except for medium *ES*s for negative conditional regard and relatedness thwarting. For DCD comparisons, all *ES*s were large except for a medium effect for negative conditional regard (Table 3).

Table 3: Means, Standard Deviations, and Effect Sizes for Outcome Variables Between Typical and DCD Adolescents and Between Boys and Girls

Outcome variables	Typical adolescents		DCD adolescents		<i>g</i>	Boys		Girls		<i>g</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Intimidation	1.82	1.09	3.04	1.76	1.04	2.20	1.36	1.71	1.04	.40
Negative conditional regard	1.86	1.02	3.08	1.71	1.10	2.27	1.26	1.73	0.99	.48
Need for autonomy thwarting	2.42	1.42	3.55	1.87	.76	2.79	1.63	2.31	1.35	.32
Need for competence thwarting	1.78	1.02	3.17	1.85	1.23	2.11	1.34	1.75	1.01	.30
Need for relatedness thwarting	1.61	0.96	2.96	1.88	1.25	2.05	1.28	1.48	0.94	.51
Fear of failure	1.58	0.67	2.39	1.13	1.11	1.77	0.86	1.56	0.65	.27
Contingent self-worth	1.74	0.80	2.09	0.86	.43	1.82	0.79	1.73	0.83	.11
Challenge avoidance	1.59	0.96	2.53	1.56	.91	1.86	1.20	1.52	0.92	.32

Note. *N* = 336; typical adolescents (*n* = 304); DCD adolescents (*n* = 32); boys (*n* = 156); girls (*n* = 180). Hedge's *g* has been used as the *ES* measure.

DISCUSSION

The purpose of the study was to examine the links of negative physical activity motivational experiences embedded in self-determination theory with the presence of DCD in adolescents in school PE. The data supported the study hypothesis revealing that adolescents with DCD reported to a higher degree, compared to their typically developing peers, intimidating behaviors by their PE teacher, negative conditional regard, need for autonomy thwarting, need for competence thwarting, need for relatedness thwarting, fear of failure, contingent self-worth, and challenge avoidance. That is, they perceived to a higher degree PE teachers yelling at them in front of others to make them do certain things during class (i.e., intimidating behaviors); using the threat of punishment to keep students in line during the lesson (i.e., negative conditional regard); and forcing students to participate in activities in which students do not want to participate (i.e., need for autonomy thwarting). Additionally, they reported to a higher degree feeling very low skilled and incompetent at various tasks (i.e., need for competence thwarting); feeling marginalized (i.e., need for relatedness thwarting); experiencing fear of possible aversive consequences if not doing well at tasks; for instance, expecting to be criticized by the teacher (i.e., fear of failure); feeling that their self-worth depends upon performing up to the teacher's expectations in order to maintain satisfactory relationships with the PE teacher (i.e., contingent self-worth); and avoiding challenging tasks to reduce the possibility of demonstrating incompetence (i.e., challenge avoidance) in order to minimize shame (Dweck, 1999) leading to a withdrawal of children from physical activity.

Among adolescents with DCD, boys reported greater autonomy and competence thwarting compared to girls. Within boys, those with DCD reported greater levels of intimidation, autonomy thwarting, competence thwarting, and fear of failure compared to typical boys whereas no differences emerged between girls with and without DCD. Also, independent of DCD, boys reported greater levels on all negative motivational variables compared to girls.

The findings of the present study extend the evidence base linking the presence of DCD with psychosocial variables in an attempt to better understand the activity-deficit in this population. To date, the variables linked to the presence of DCD from a motivational standpoint to explain the activity-deficit are lower levels of generalized self-efficacy toward physical activity (Cairney *et al.*, 2005), perceived competence (Skinner & Piek, 2001), task efficacy and barrier efficacy (Batey *et al.*, 2014), adequacy of performing PA, likelihood of selecting PA and parental logistic support for PA (Wright *et al.*, 2019), social acceptance for overweight DCD children compared to children with DCD only or typical children along with lower athletic competence than typical children (Noordstar & Volman, 2020). The present findings expand this evidence base highlighting the important role of particular dimensions of the interpersonal style of the PE teacher, taking into account the plea by Dunn and Watkinson (2002) to consider aspects of the environment in the context of motivation theory to better understand this activity-deficit.

Further, despite that the centrality of competence-related constructs in motivation theories (Dunn & Watkinson, 2002) is supported once again in relation to the construct of need for competence thwarting (e.g., boys with DCD reported higher levels of competence thwarting), other constructs (i.e., basic psychological needs) such as autonomy and relatedness needs thwarting were also found to be linked to the presence of DCD. That is, being forced to execute tasks that have not been internalized into one's sense of self (Deci & Ryan, 2000) and are not felt as an expression of oneself (Ryan & Deci, 2002) (i.e., need for autonomy thwarting), and feeling marginalized (i.e., need for relatedness thwarting), highlighted the role of basic psychological needs suggested by Ryan and Deci (2002) to be a central source of negative motivational experiences and ill-being if frustrated (or positive motivational experiences and well-being if fulfilled). Further, higher levels of cognitive-affective constructs such as fear of failure, contingent self-worth, and behavioral constructs such as challenge avoidance had not been linked in the past with the presence of DCD.

The links of these negative motivational experiences with the presence of DCD contribute to a better understanding of the activity-deficit phenomenon. Research on SDT in the domain of school physical education has demonstrated that controlling PE teacher behaviors have been associated with frustration of the needs for autonomy, competence, and relatedness as well as fear of failure, contingent self-worth, and challenge avoidance, and have been found to maximize amotivation (i.e., lack of motivation) for participation in PE (Bartholomew *et al.*, 2018). Such negative experiences have also been reported to maximize abstinence from PE lessons in children self-identified as clumsy (Ruiz-Perez *et al.*, 2018) as well as among typically developing children in classroom (Jang *et al.*, 2016). To eliminate such negative experiences, PE teachers should minimize controlling teaching and instead emphasize an autonomy-supportive communication style to maximize psychological need fulfillment, positive motivation, and optimal physical activity experiences (Haerens *et al.*, 2018; Ntoumanis & Standage, 2009). A number of teacher behaviors designed to support students' psychological needs in line with SDT have been reported (Niemic & Ryan, 2009; Ntoumanis & Standage, 2009; Reeve & Halusic, 2009; Katartzi & Vlachopoulos, 2011). Such behaviors have also been recognized as an important element of the PE teacher's behavior working with children and adolescents with DCD independent of the teaching style used when interacting with these children (Hands & Parker, 2019).

Limitations of the study include that findings cannot be generalized as no random sampling was used to determine the sample. Further, identification of children with DCD took place via the MABC-2, a

standardized instrument rather than clinical diagnosis, something that may have led to some misclassification of cases. It might have been of greater benefit to also obtain measures of the impact of DCD on daily living activities (Sugden, 2006) in order to further improve case identification, and therefore the external validity of the study. Taking into account the dual-process model within SDT (Jang *et al.*, 2016) that posits how either an autonomy-supportive or a controlling environment energize either positive or negative motivational processes respectively, future research may focus on examining the links of the presence of DCD with the elements of adaptive motivational processes to better understand the links of this condition with optimal motivation for physical activity in this population. Additionally, taking into account results concerning the role of gender, future studies may focus on the interpersonal dynamics between students with DCD and PE teachers to shed light on these interactions involving a possibly differentiated interpersonal approach of PE teachers to students with DCD depending on gender both for PE teachers and students with DCD.

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REFERENCES

- American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorder (5th Ed.)*. Washington, DC: American Psychiatric Association.
- Assor, A., & Tal, K. (2012). When parents' affection depends on child's achievement: Parental conditional positive regard, self-aggrandizement, shame and coping in adolescents. *Journal of Adolescence*, 35, 249-260. doi: 10.1016/j.adolescence.2011.10.004
- Barnett, A. L., & Hill E. (2019). *Understanding motor behavior in developmental coordination disorder*. London, UK: Routledge.

- Barnett, L. M., van Beurden, E., Morgan, P. J., O'Brook, L., & Beard, J. R. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. *Journal of Adolescent Health, 44*, 252–259.
- Bartholomew, K. J., Ntoumanis, N., & Thøgersen-Ntoumani, C. (2010). The controlling interpersonal style in a coaching context: Development and initial validation of a psychometric scale. *Journal of Sport and Exercise Psychology, 32*, 193-216. doi: <https://doi.org/10.1123/jsep.32.2.193>
- Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J., & Thøgersen-Ntoumani, C. (2011). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin, 37*, 1459-1473. doi: <https://doi.org/10.1177/0146167211413125>
- Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., & Thøgersen-Ntoumani, C. (2011). Psychological need thwarting in the sport context: Assessing the darker side of athletic experience. *Journal of Sport and Exercise Psychology, 33*, 75-102. doi: <https://doi.org/10.1123/jsep.33.1.75>
- Bartholomew, K. J., Ntoumanis, N., Mouratidis, A., Katartzi, E., Thøgersen-Ntoumani, C., & Vlachopoulos, S. (2018). Beware of your teaching style: A school-year long investigation of controlling teaching and student motivational experiences. *Learning and Instruction, 53*, 50-63. doi: <http://dx.doi.org/10.1016/j.learninstruc.2017.07.006>
- Batey, C. A., Missiuna, C. A., Timmons, B. W., Hay, J.A., Fought, B. E., & Cairney, J. (2014). Self-efficacy toward physical activity and the physical activity behavior of children with and without developmental coordination disorder. *Human Movement Science, 36*, 258-271. doi: [10.1016/j.humov.2013.10.003](https://doi.org/10.1016/j.humov.2013.10.003)
- Bentler, P.M. (1990). Comparative fit indices in structural models. *Psychological Bulletin, 107*, 238-246. doi: [10.1037/0033-2909.107.2.238](https://doi.org/10.1037/0033-2909.107.2.238)
- Blank, R., Barnett, A. L., Cairney, J., Green, D., Kirby, A., Polatajko, H., ... Vinçon, S. (2019). International clinical practice recommendations on the definition, diagnosis, assessment, intervention, and psychosocial aspects of developmental coordination disorder. *Developmental Medicine in Child Neurology, 61*, 242-285. doi: [10.1111/dmcn.14132](https://doi.org/10.1111/dmcn.14132)
- Browne, M.W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen & S. J. Long (Eds.), *Testing structural equation models* (pp. 445-455). Newbury Park, CA: Sage.
- Brydges, C. R. (2019). Effect size guidelines, sample size calculations, and statistical power in gerontology. *Innovation in Aging, 3*, 1-8. doi: [10.1093/geroni/igz036](https://doi.org/10.1093/geroni/igz036)
- Byrne, B. M. (2000). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Cairney, J., Hay, J., Fought, B., Mandigo, J., & Flouris, A. (2005). Developmental coordination disorder, self-efficacy toward physical activity, and play: Does gender matter? *Adapted Physical Activity Quarterly, 22*, 67-82. doi: <https://doi.org/10.1123/apaq.22.1.67>
- Cairney, J., Hay, J., Veldhuizen, S., Missiuna, C., & Fought, B. (2009). Developmental coordination disorder, sex, and activity-deficit over time: A longitudinal analysis of participation trajectories in children with and without coordination difficulties. *Developmental Medicine and Child Neurology, 52*, e67-e72. doi: [10.1111/j.1469-8749.2009.03520.x](https://doi.org/10.1111/j.1469-8749.2009.03520.x)
- Cermak, S., & Larkin, D. (2002). *Developmental coordination disorder*. Delmar, NY: Cengage Learning.
- Conroy, D. E., Willow, J. P., & Metzler, J. N. (2002). Multidimensional fear of failure measurement: The Performance Failure Appraisal Inventory. *Journal of Applied Sport Psychology, 14*, 76-90. doi: <https://doi.org/10.1080/10413200252907752>
- Crocker, J., Luhtanen, R. K., Cooper, M. L., & Bouvrette, A. (2003). Contingencies of self-worth in college students: Theory and measurement. *Journal of Personality and Social Psychology, 85*, 894-908. doi: <https://doi.org/10.1037/0022-3514.85.5.894>
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297–334. doi: <https://doi.org/10.1007/BF02310555>
- De Meyer, J., Tallir, I. B., Soenens, B., Vansteenkiste, M., Aelterman, N., Van den Berghe, L., ... Haerens, L. L. (2014). Does observed controlling teaching behavior relate to students' motivation in physical education. *Journal of Educational Psychology, 106*, 541-554. doi: <http://dx.doi.org/10.1037/a0034399>
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268. doi: http://dx.doi.org/10.1207/S15327965PLI1104_01
- Dewey, D., & Volkovinskaia, A. (2018). Health-related quality of life and peer relationships in adolescents with developmental coordination disorder and attention-deficit–hyperactivity disorder. *Developmental Medicine & Child Neurology, 60*, 711 - 717. <https://doi.org/10.1111/dmcn.13753>
- Dunn, J. C., & Watkinson, E. J. (2002). Considering motivation theory in the study of

- developmental coordination disorder. In S. A. Cermack & D. Larkin (Eds.), *Developmental coordination disorder* (pp. 185-199). Clifton Park, NY: Delmar, Cengage Learning.
- Dweck, C. S. (1999). *Self-theories: Their role in motivation, personality, and development*. New York, NY: Psychology Press.
 - Elliot, A. J., & Church, M. A. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology*, 72, 218-232. doi: <https://doi.org/10.1037/0022-3514.72.1.218>
 - Fitzpatrick, D. A., & Watkinson, E. J. (2003). The lived experience of physical awkwardness: Adults' retrospective views. *Adapted Physical Activity Quarterly*, 20, 279-297. doi: <https://doi.org/10.1123/apaq.20.3.279>
 - Green, D., Lingam, R., Mattocks, C., Riddoch, V., Ness, A., & Emond, A. (2011). The risk of reduced physical activity in children with probable developmental coordination disorder: A prospective longitudinal study. *Research in Developmental Disabilities*, 32, 1332-1342.
 - Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B., & Petegem, S. V. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychology of Sport and Exercise*, 16, 26-36. doi: <https://doi.org/10.1016/j.psychsport.2014.08.013>
 - Haerens, L., Vansteenkiste, M., De Meester, A., Delrue, J., Tallir, I., Vande Broek, G., ... Aelterman, E. (2018). Different combinations of perceived autonomy support and control: Identifying the most optimal motivating style. *Physical Education and Sport Pedagogy*, 23, 16-36. doi: <https://doi.org/10.1080/17408989.2017.1346070>
 - Hands, B., & Parker, H. E. (2019). Physical education and activity in children and adolescents with DCD. In A. L. Barnett & E. L. Hill (Eds.), *Motor behaviour in developmental coordination disorder* (pp. 137-158). New York, NY: Routledge.
 - Harrowell, I., Hollén, L., Lingam, R., Emond, A. (2017). Mental health outcomes of developmental coordination disorder in late adolescence. *Developmental Medicine in Child Neurology*, 59, 973-979. doi: 10.1111/dmcn.13469
 - Harrowell, I., Hollén, L., Lingam, R., & Emond, A. (2018). The impact of developmental coordination disorder on educational achievement in secondary school. *Research in Developmental Disabilities*, 72, 13 - 22. doi.org/10.1016/j.ridd.2017.10.014
 - Harter, S. (1982). The perceived competence scale for children. *Child Development*, 53, 81-97. doi: <https://doi.org/10.2307/1129640>
 - Henderson, S. E., Sugden, D. A., & Barnett, A. L. (2007). *Movement Assessment Battery for Children-2 (2nd ed.) (Movement ABC-2)*. London, UK: The Psychological Corporation.
 - Hendrix, C. G., Prins, M. R., & Dekkers, H. (2014). Developmental coordination disorder and overweight and obesity in children: A systematic review. *Obesity Reviews*, 15, 408-423. doi: 10.1111/obr.12137
 - Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1-55. doi: <https://doi.org/10.1080/10705519909540118>
 - Izadi-Najafabadi, S., Rayan, N., Ghafooripoor, G., Gill, K., & Zwicker, J. G. (2019). Participation of children with developmental coordination disorder. *Research in Developmental Disabilities*, 84, 75-84. doi: 10.1016/j.ridd.2018.05.011
 - Jang, H., Kim, E. J., & Reeve, J. (2016). Why students become more engaged or more disengaged during the semester: A self-determination theory dual-process model. *Learning and Instruction*, 43, 27-38. doi: <https://doi.org/10.1016/j.learninstruc.2016.01.002>
 - Katartzi, E. S., & Vlachopoulos, S. P. (2011). Motivating children with developmental coordination disorder in school physical education: The self-determination theory approach. *Research in Developmental Disabilities*, 32, 2674-2682. doi: 10.1016/j.ridd.2011.06.005.
 - Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for *t*-tests and ANOVAs. *Frontiers in Psychology*, 4, 1-12. <https://doi.org/10.3389/fpsyg.2013.00863>
 - Lopes, V. P., Rodrigues, L. P., Maia, J. A. R., & Malina, R. M. (2009). Motor coordination as predictor of physical activity in childhood. *Scandinavian Journal of Medicine*, 21, 663-9. doi: 10.1111/j.1600-0838.2009.01027.x
 - Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory in educational practice. *Theory and Research in Education*, 7, 133-144. doi: <https://doi.org/10.1177/1477878509104318>
 - Noordstar, J. J., & Volman, M. J. M. (2020). Self-perceptions in children with probable developmental coordination disorder with and without overweight. *Research in Developmental Disabilities*, 99, 103601. doi: 10.1016/j.ridd.2020.103601
 - Ntoumanis, N., & Standage, M. (2009). Motivation in physical education classes: A self-determination perspective. *Theory and Research in Education*, 7, 194-202. doi: <https://doi.org/10.1177/1477878509104324>

- Raz-Silbiger, S., Lifshitz, N., Katz, N., Steinhart, S., Cermak, S. A., & Weintraub, N. (2015). Relationship between motor skills, participation in leisure activities and quality of life of children with developmental coordination disorder: Temporal aspects. *Research in Developmental Disabilities*, 38, 171-180. doi:10.1016/j.ridd.2014.12.012.
- Reeve, J., & Jang, H. (2006). What teachers say and do support students' autonomy during a learning activity. *Journal of Educational Psychology*, 98, 209-218. doi: <https://doi.org/10.1037/0022-0663.98.1.209>
- Reeve, J., & Halusic, P. (2009). How K-12 teachers can put self-determination theory principles into practice. *Theory and Research in Education*, 7, 145-154. doi: <https://doi.org/10.1177/1477878509104319>
- Roeser, R. W., Eccles, J. S., & Sameroff, A. J. (2000). School as a context of early adolescents' academic and socio-emotional development: A summary of research findings. *Elementary School Journal*, 100, 443-471. doi: <https://doi.org/10.1086/499650>
- Rose, E., Larkin, D., Parker, H., & Hands, B. (2015). Does motor competence affect self-perceptions differently for adolescent males and females? *SAGE Open*, 5, 1-9. doi:10.1177/2158244015615922
- Ruiz-Perez, L. M., Palomo-Nieto, M., Gomez-Ruano, M. A., & Navia-Manzano, J. A. (2018). When we were clumsy: Some memories of adults who were low skilled in physical education at school. *Journal of Physical Education and Sports Management*, 5, 30-36. doi:10.15640/jpesm.v5n1a4
- Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci, & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3-33). Rochester, NY: University of Rochester Press.
- Schoemaker, M. M., & Smits-Engelsman, B. C. (2015). Is treating motor problems in DCD just a matter of practice and more practice? *Current Developmental Disorder Reports*, 2, 150-156. doi: 10.1007/s40474-015-0045-7
- Skinner, R. A., & Piek, J. P. (2001). Psychosocial implications of poor motor coordination in children and adolescents. *Human Movement Science*, 20, 73-94. doi: 10.1016/s0167-9457(01)00029-x
- Steiger, J. H., & Lind, J. M. (1980, June). *Statistically based tests for the number of common factors*. Paper presented at the meeting of the Psychometric Society, Iowa City, IA.
- Sugden, D. (2006). *Leeds consensus statement: Developmental coordination disorder as a specific learning difficulty*. ESRC Research Seminar Series 2004-2005, United Kingdom, 1-8.
- Van den Berghe, L., Soenens, B., Vansteenkiste, M., Aelterman, N., Cardon, G., & Tallir, I. B. (2013). Observed need-supportive and need-thwarting teaching behavior in physical education: Do teachers' motivational orientations matter? *Psychology of Sport and Exercise*, 14, 650-661. doi: <http://dx.doi.org/10.1016/j.psychsport.2013.04.006>
- Wright, K. E., Furzer, B. J., Licari, M. K., Thronton, A. L., Dimmock, J. A., Naylor, N. H., ... Jackson, B. (2019). Physiological characteristics, self-perceptions, and parental support of physical activity in children with, or at risk of, developmental coordination disorder. *Research in Developmental Disabilities*, 84, 66-74. doi: <https://doi.org/10.1016/j.ridd.2018.05.013>
- Zwicker, J. G., Missiuna, C., Harris, S. R., & Boyd, L. A. (2012). Developmental coordination disorder: A review and update. *European Journal of Paediatric Neurology*, 16, 573-581. doi:10.1016/j.ejpn.2012.05.005