International Journal of Sports Science 2021, 11(2): 31-38
DOI: 10.5923/j.sports.20211102.02

Self-Determined Motivation for Physical Activity in Adolescents with and without Developmental Coordination Disorder in School Physical Education

Symeon P. Vlachopoulos, Ermioni S. Katartzi*, Maria G. Kontou

Laboratory of Social Research on Physical Activity, Department of Physical Education and Sport Science at Serres, Aristotle University of Thessaloniki, AgiosIoannis, Serres, Greece

Abstract Links were examined between the presence of developmental coordination disorder (DCD) in adolescents and psychosocial variables related to students' self-determined motivation in school physical education (PE). Adolescents (N = 336) with and without DCD were compared on perceived autonomy support by the PE teacher, fulfillment of the needs for autonomy, competence, and relatedness, amotivation, external regulation, introjected regulation, identified regulation, intrinsic motivation for PE participation, and PE enjoyment via self-report questionnaires. Neither DCD by gender interaction nor main effects for gender emerged. In terms of DCD main effects, adolescents with DCD reported significantly lower fulfillment of the need for relatedness, higher amotivation, and lower PE enjoyment than typically developing peers. The presence of DCD is linked to lower levels of need for relatedness satisfaction, and PE enjoyment, and higher levels of amotivation posited within self-determination theory among adolescents in school physical education. Need supportive teaching strategies seem to be of high importance in PE classes involving adolescents with DCD.

Keywords Motor difficulties, Motor coordination, Student motivation, Self-determination theory, Psychological needs

1. Introduction

Developmental coordination disorder (DCD) typically refers to movement difficulty children have, that is not attributed primarily to either intellectual disability, visual impairment, or neurological condition affecting movement, with about 5-6% of school-aged children assumed to be affected by this condition. [1] Problems with coordinated movements may continue through adolescence in an estimated 50%-70% of children leading to a number of secondary psychosocial consequences. [1] 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. [2,3] Other DCD consequences include lower educational achievement and therefore fewer life chances in an adolescent's life; [4] poorer self-perceived competence and adequacy related to physical activity; [5] poorer sense of self-worth and athletic competence; [6] reduced physical activity participation and poor physical fitness levels, [7,8] obesity, [1] and the tendency to avoid participating in team play and sports. [9]

* Corresponding author:
noni@phed-sr.auth.gr (Ermioni S. Katartzi)
Received: Jul. 11, 2021; Accepted: Aug. 13, 2021; Published: Sep. 15, 2021
Published online at http://journal.sapub.org/sports

A better understanding of why these children are less physically active may be achieved by shedding more light on how tasks, environments, and patterns of perception may shape children's decision to participate [10]. A number of motivational variables have been linked to the presence of DCD such as lowered generalized self-efficacy toward physical activity, [11] perceived competence, [12] task efficacy and barrier efficacy, [13] likelihood of selecting (i.e., predilection) PA and adequacy of performing PA. [5] Adolescents with DCD tend to rate the same health and fun outcomes in PE as highly important compared to their movement competent peers, feeling that they are doing something meaningful. [14] Given that children and adolescents with DCD should be included into physical activity opportunities in school, improvement of motor competence, and promotion of enjoyment of physical activity for children with DCD become highly important. [14]

Within self-determination theory (SDT), [15] a differentiated view of student motivation is posited in the dual process model [16] based on the two distinct motivational processes of perceived autonomy support and perceived teacher control; the former is followed by needs satisfaction and optimal students' outcomes whereas the latter is followed by needs frustration and maladaptive students' outcomes. [16,17] These processes are conceptually and empirically distinct. [16,17] An

autonomy-supportive environment is assumed to satisfy the psychological needs for autonomy, competence, and relatedness. These in turn, create stronger autonomous behavioral regulations for engaging in the activities (e.g., identified regulation, i.e., engaging in a behavior because it is viewed as important to the person; and intrinsic motivation, i.e., engaging in a behavior because it is enjoyable), and weaker controlled regulations (e.g., external regulation, i.e., engaging in the behavior to avoid teacher's punishment; introjected regulation, i.e., engaging in the behavior to avoid feelings of guilt or shame), and amotivation (i.e., the state of lacking the intention to act). [15] These types of regulations are theoretically situated on a self-determination continuum ranging from amotivation to controlled regulations to autonomous regulations [15] with the autonomous regulations being conducive to optimal motivational outcomes. [17] Higher levels of autonomous regulations are assumed to be conducive to higher levels of enjoyment and intention to participate in the activity. [18] The need for autonomy is satisfied when persons feel their behavior as an expression of who they are, and feel initiative with regard to this behavior; the need for competence is satisfied when individuals feel effective in performing the task; the need for relatedness is fulfilled when one feels authentically connected to others and a sense of belonging to one's group. [15] In support of the relevance of SDT constructs to the understanding of the activity-deficit in children with DCD, [19] qualitative data have emerged showing that adults who were low skilled when they were children in PE [20] reported intimidating behaviors by PE teachers (i.e., a controlling motivating style); feeling forced to participate in activities the students disliked in the first place (i.e., low need for autonomy satisfaction); experiencing athletic skills at a very low level (i.e., low need for competence fulfillment); feeling marginalized and humiliated (i.e., low need for relatedness fulfillment). No study todate to our knowledge has examined the links of the presence of DCD with self-determined motivational processes assumed to be energized by an autonomy-supportive motivating style. [16] Therefore, differences were examined between adolescents with and without DCD on perceptions of an autonomy-supportive PE teacher's motivating style; satisfaction of students' needs for autonomy, competence, and relatedness; motivational regulations of external regulation, introjected regulation, identified regulation, intrinsic motivation, and amotivation; and levels of PE enjoyment. It was hypothesized that adolescents with DCD would report lower levels of the adaptive motivational variables and PE enjoyment compared to typically developing peers, and higher levels of the controlling regulations, and amotivation. Further, the role of gender was also examined given research showing that boys perceived competition and winning as more important than girls did; [21] boys were attracted more by activities where physical prowess and social status are displayed such as competition, meaning that vigorous physical activity is regarded as more gender-appropriate for boys; [22] boys reported higher athletic competence than girls; [6] and being competent at sports was found to be the most important criterion for rating male popularity, for both male and female adolescents, something that was not the case for female popularity. [23]

2. Materials and Methods

Participants

Data were derived from adolescents attending middle schools in an urban area of average socioeconomic status in Northern Greece. There were 336 adolescents (156 boys; 46.4% and 180 girls; 53.6%) from three schools and nine classes with an age range 13-16 yrs. (M = 13.47 yrs., SD = 0.55). Students' height ranged 135 - 186 cm (M = 164.01, SD = 8.58) and their weight ranged 28 - 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). Sports activities included handball, badminton, cycling, basketball, tennis, swimming, taekwondo, and skiing.

Students with motor difficulties were identified using the Movement-Assessment Battery for Children – 2 (MABC-2). [24] Out of 336 adolescents, 32 participants (9.5%) were classified as having motor coordination difficulties (18 boys, 56.3% and 14 girls, 43.8%)compared to typically developing peers (n = 304; 138 boys, 45.4% and 166 girls, 54.6%). This was achieved using a total score below 67 inclusive and percentile range below the 15th percentile inclusive. Participation in PE was compulsory and took place twice a week with each lesson lasting 45 min.

Measures

Perceived autonomy support by the PE teacher (PAS). Students' perceptions of PE teachers' autonomy supportive behaviors were assessed using the short (6-item) version of the Health Care Climate Questionnaire (HCCQ) [25] modified for PE. Sample items are "I feel that my PE teacher provides me choices and options in regard to the way I participate in PE" and "My PE teachers encourages me to ask questions". Responses were provided on a 7-point Likert scale anchored by 1 ("*Strongly disagree*") and 7 ("*Strongly agree*"). Evidence supportive of internal reliability and nomological validity of scale scores has been provided by Vlachopoulos, Katartzi, and Kontou [26].

Basic psychological needs in physical education scale (BPN-PE). The BPN-PE [26] was used to assess the extent to which the psychological needs for autonomy, competence, and relatedness were satisfied in PE. Responses were provided following the stem "Generally in PE..." on a Likert scale ranging from 1 ("*Strongly disagree*") to 7 ("*Strongly agree*"). Sample items are for autonomy (e.g., "I feel like the activities we are doing have been chosen by me"); for competence (e.g., "I feel I perform correctly even the tasks considered difficult by most of the children"); and relatedness (e.g., "I feel like I have a close bond with my classmates"). Evidence supportive of the factor structure and nomological validity of scale scores with Greek students has been provided by Vlachopoulos et al. [26].

Revised perceived locus of causality in physical education scale (PLOC-R). The behavioral regulations of amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation were measured in PE using the PLOC-R [27] Students indicated their reasons for participation in PE following the stem "I take part in PE…". Sample items are for amotivation (e.g., "But I really feel I am wasting my time in PE"), external regulation (e.g., "Because in this way I will not get a low grade"), introjected regulation (e.g., "Because I would feel bad if the other students thought that I am not good at PE"), identified regulation (e.g., "Because it is important to me to do well in PE"), and intrinsic motivation (e.g., "Because PE is enjoyable"). Responses were provided on a Likert scale anchored by 1 ("*Strongly disagree*") and 7 ("*Strongly agree*"). Evidence has emerged in support of the factor structure and nomological validity of the PLOC-R scores among Greek students. [27]

PE enjoyment. To assess enjoyment in PE, the four items used by Scanlan, Simons, Carpenter, Schmidt, and Keeler [28] to measure sport enjoyment in the context of the sport commitment model, were adapted for use in PE. The items used were "Do you enjoy/are you happy/do you have fun/do you like participating in PE". The response scale options were 1 ("*not at all*"), 2 ("*a little*"), 3 ("*sort of*"), 4 ("*pretty much*"), and 5 ("*very much*"). An alpha of .90 has been reported by Scanlan et al. [28] and .86 with Greek students in school PE. [29]

Procedures

The study has been approved by the Ministry of Education and the institutional research ethics committee before experiment was started and has been conducted in accordance with the principles set forth in the Helsinki Declaration. Prior to data collection, permission to conduct the study was granted from the school head-masters while informed consent was obtained from parents and the students (parents could opt out if they wished by completing a form). Data were collected during second school trimester by research assistants who visited the schools. The purpose of the investigation was explained to the students, they were informed that their participation was voluntary and that their responses would remain in confidence. No pupils denied to participate in the data collection. A coding system was used to match pupils' responses on the questionnaires with their MABC-2 scores to secure anonymity.

Data Availability

The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

Data Analysis

Questionnaire responses were subjected to confirmatory factor analysis (CFA) along estimation of Cronbach's alpha coefficients. [30] For the CFAs factor variances were fixed to unity, factor covariances were allowed to be freely estimated, and item error covariances were fixed to zero. To examine model fit we used the chi-square statistic; the Comparative Fit Index (CFI) [31] with a value of .95 or greater reflecting an excellent fit to the data [32] and a value of .90 or greater indicating a reasonable fit; the Root Mean Squared Error of Approximation (RMSEA) [33] and its' 90% confidence interval (RMSEA 90% CI) with a value lower than .05 indicating a good model fit [32] and a value between .08 and .10 indicating an adequate fit. [34,35] Additionally, Cronbach's alpha coefficients [30] were estimated along with Pearson's correlations between the variables. Next, adolescents were classified into DCD and typically developing peers and the DCD by gender interaction as well as main effects for DCD and gender were examined.

3. Results

Confirmatory Factor Analyses and Internal Consistency

The corrected for non-normality fit indexes were for the BPN-PE S-B scaled χ^2 = 209.68, *df* = 51, robust CFI = .919, robust RMSEA = .096, RMSEA 90% CI = .083 - .110. The fully standardized item loadings ranged .593-.851. For PLOC-R fit indexes were: S-B scaled χ^2 = 409.46, *df* = 142, robust CFI = .915, robust RMSEA = .075, RMSEA 90% CI = .066-.083. The fully standardized item loadings ranged .627 - .862. For the two-factor model including the two single factors of perceived autonomy support, and PE enjoyment, fit indexes were: S-B scaled χ^2 = 138.83, *df* = 34, robust CFI = .943, robust RMSEA =.096, RMSEA 90% CI = .079-.112. The fully standardized item loadings ranged for autonomy support .434-.793 and for PE enjoyment .839-.936. Alpha values were .84 for perceived autonomy support, .83 for autonomy,.85 for competence,.86 for relatedness, .86 for amotivation, .81 for external regulation, .76 for introjected regulation, .86 for identified regulation, .87 for intrinsic motivation, and .93 for PE enjoyment.

Descriptive Statistics and Pearson's Correlations

Generally, there were above average mean levels of perceived autonomy support, needs satisfaction, autonomous regulations, and introjection while there were low levels of amotivation, and external regulation. Also, above average were mean levels of PE enjoyment (Table 1).

In terms of correlations, autonomy support was positively correlated with the three needs, the autonomous regulations, and PE enjoyment; weakly with introjection; and negatively with amotivation and external regulation (Table 2). A similar pattern of correlations emerged between PE grades and these variables except for autonomy support. The three needs were positively intercorrelated. The intercorrelations between the PLOC-R variables approached a quasi-simplex pattern with variables closer to each other showing stronger correlations compared to more distal variables on the self-determination continuum (i.e., relative autonomy continuum; [15] (Table 2).

Being identified as DCD was negatively correlated with

all adaptive motivational variables, positively correlated with amotivation and external regulation, and uncorrelated with introjection and identification. Also having DCD was not correlated with gender. Being a girl was positively correlated with relatedness satisfaction; negatively with amotivation and external regulation; and negatively with weekly frequency of out-of-school sports (Table 2).

Table 1. Means, Standard Deviations, and Effect Sizes for Group Differences

Variables												
	Total Sample		Typical adolescents		DCD adolescents		*ES*	Boys		Girls		*ES*
	M	*SD*	*M*	*SD*	*M*	*SD*	*g*	*M*	*SD*	*M*	*SD*	*g*
1. Perceived autonomysupport	4.16	1.39	4.21	1.38	3.69	1.50	.17	4.05	1.44	4.25	1.35	.14
2. Autonomy satisfaction	4.39	1.55	4.47	1.53	3.67	1.51	.52	4.38	1.71	4.41	1.40	.01
3. Competence satisfaction	4.49	1.49	4.57	1.48	3.76	1.39	.55	4.46	1.65	4.52	1.34	.04
4. Relatedness satisfaction*	5.17	1.48	5.27	1.42	4.21	1.68	.73	4.89	1.62	5.42	1.30	.36
5. Amotivation*	2.37	1.65	2.26	1.59	3.40	1.80	.70	2.69	1.85	2.09	1.39	.37
6. External regulation	3.00	1.80	2.92	1.80	3.76	1.65	.47	3.28	1.89	2.76	1.68	.29
7. Introjected regulation	3.91	1.55	3.91	1.56	3.96	1.44	.03	4.00	1.69	3.83	1.42	.10
8. Identified regulation	5.10	1.54	5.16	1.53	4.60	1.57	.36	5.04	1.67	5.16	1.42	.07
9. Intrinsic motivation	4.90	1.65	4.97	1.65	4.28	1.54	.42	4.88	1.82	4.92	1.49	.02
10. PE enjoyment*	3.72	1.19	3.81	1.16	2.81	1.14	.86	3.63	1.26	3.79	1.13	.13

Note. $N = 336$. Typical adolescents ($n = 304$); DCD adolescents ($n = 32$); Boys ($n = 156$); Girls ($n = 180$). Hedge's g values of .15, .40 and .75 represent small, medium, and large *ES*s respectively. *indicates significant differences between typical and DCD adolescents independent of gender.

Table 2. Pearson's Correlations Between Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Perceived autonomy support	__															
2. Autonomy	.62**	__														
3. Competence	.48**	.71**	__													
4. Relatedness	.39**	.53**	.61**	__												
5. Amotivation	-.26**	-.24**	-.18**	-.15**	__											
6. External regulation	-.29**	-.25**	-.14**	-.09	.72**	__										
7. Introjected regulation	.16**	.27**	.29**	.21**	.17**	.35**	__									
8. Identified regulation	.50**	.64**	.61**	.50**	-.34**	-.19**	.47**	__								
9. Intrinsic motivation	.54**	.75**	.63**	.47**	-.29**	-.24**	.40**	.83**	__							
10. Enjoyment	.44**	.64**	.48**	.38**	-.31**	-.26**	.26**	.61**	.72**	__						
11. PE grades	.09	.18**	.29**	.21**	-.21**	-.15**	.04	.20**	.16**	.14*	__					
12. Age	-.08	-.00	-.04	.-06	.13*	.09	-.01	-.05	-.03	-.00	-.14**	__				
13.Height	-.01	.09	.00	.01	.09	.07	-.02	.01	.00	.02	.06	.19**	__			
14.Weight	-.05	-.00	-.10	-.10	.12*	.07	-.10	-.10	-.03	.00	-.16**	.26**	.68**	__		
15.Frequency out-of school sports	.09	.18**	.26**	.18**	.02	-.03	.08	.21**	.22**	.15**	.24**	-.15**	.07	-.02	__	
16. DCD	-.10*	-.15**	-.15**	-.21**	.20**	.13*	.01	-.10	-.12*	-.24**	-.26**	.05	-.04	.01	-.08	__
17. Gender	.06	.00	.01	.17**	-.18**	-.14**	-.05	.04	.01	.06	.00	.06	-.16**	-.16**	-.19**	-.06

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

Differences Between Typical and DCD Adolescents

A two-way MANCOVA was estimated to examine the interaction of DCD by gender in relation to the outcome variables of perceived autonomy support, needs for autonomy, competence, and relatedness, amotivation, external regulation, introjected regulation, identified regulation, intrinsic motivation, and PE enjoyment controlling for trimester PE grades, age, height, weight, and weekly frequency of out-of-school sports. Neither a DCD by gender multivariate interaction [Wilk's lambda = .957, $F(10, 296) = 1.34$, $p = .207$, partial eta squared = .043] nor a multivariate main effect for gender emerged [Wilk's lambda = .965, $F(10, 296) = 1.07$, $p = .379$, partial eta squared = .035]. However, a multivariate main effect emerged for DCD group membership [Wilk's lambda = .908, $F(10, 296) = 2.99$, $p = .001$, partial eta squared = .092]. Significant DCD univariate effects were found for relatedness [$F(1, 305) = 6.32$, $p = .012$, partial eta squared = .020], amotivation [$F(1, 305) = 6.38$, $p = .012$, partial eta squared = .020] and PE enjoyment [$F(1, 305) = 14.66$, $p = .000$, partial eta squared = .046] but not for autonomy support [$F(1, 305) = 1.65$, $p = .199$, partial eta squared = .005], autonomy [$F(1, 305) = 2.97$, $p = .085$, partial eta squared = .010], competence [$F(1, 305) = 1.99$, $p = .159$, partial eta squared = .007], external regulation [$F(1, 305) = 2.13$, $p = .145$, partial eta squared = .007], introjected regulation [$F(1, 305) = .413$, $p = .521$, partial eta squared = .0051, identified regulation [$F(1, 305) = .520$, $p = .471$, partial eta squared = .002], and intrinsic motivation [$F(1, 305) = 1.31$, $p = .253$, partial eta squared = .004]. Overall, DCD adolescents reported significantly lower scores on fulfillment of the need for relatedness, higher amotivation, and lower PE enjoyment (Table 1).

Hedge's *g* effect size (*ES*) was computed for each outcome variable group comparison (Table 1). Values of .15, .40, and .75 are considered to represent small, medium, and large *ES*s respectively. [36] Hedge's *g* has been considered approriate in group comparisons with small sample sizes. [37] In terms of the significant DCD main effects, there were moderate *ES*s for relatedness satisfaction and amotivation, and a large *ES* for PE enjoyment (Table 1).

4. Discussion

The present findings extend the evidence base of motivational variables linked to the presence of DCD including SDT basic psychological needs, behavioral regulations, the interpersonal element of the autonomy supportive motivating style adopted by the PE teacher, and PE enjoyment. The present findings are situated within the dual process model embedded in SDT. [16] Given distinctiveness of these motivational processes at a conceptual and an empirical level, information is provided on the links of the presence of DCD with motivational variables embedded in the adaptive motivational process of the dual process model.

DCD was significantly linked to lower levels of relatedness fulfillment, higher amotivation, and lower PE enjoyment. The finding of low relatedness fulfillment may be interpreted through the reported experiences of adults who were low skilled when children in PE. [20] In these interviews, participants reported experiences where classmates ignored them in PE, did not count on them during games (i.e., not passing the ball to them even if they were close to typical classmates), suffering harassment and disinterest from their classmates, laughter in class, humiliation, contempt, and exclusion in very specific situations such as the formation of teams and playing games. [20,38] Also murmurs by the classmates when the teacher told them something and indifference by the classmates when they failed in a group activity. Motor competence may be important in terms of acceptance by peers [39] given that motor competence is subjected to the social examination of the class [20], and being competent at sports has emerged as the most important criterion for rating male popularity among male and female adolescents, a criterion that was not important for female popularity. [23] Also, a feeling of exclusion from the group had been reinforced by particular PE teacher behaviors such as allowing the students themselves to form the teams. [20] In agreement with these findings, in a qualitative account of sources of amotivation in PE, it was found that reasons leading to amotivation included getting negative comments from peers and disliking being the last one picked. [40]

The higher levels of amotivation and the lower levels of enjoyment reported by the DCD adolescents seem to emerge from a number of negative emotional experiences in PE such as anxiety, humiliation, frustration, martyrdom, agony, rejection, exclusion, and sadness for these children. [20] As reported, these experiences were the reason for the adoption of a non-active lifestyle leading to a lack of motivation toward sports and physical activities. [20]Given the central role of the PE teacher in this environment, research has highlighted the important role of adequate teacher-to-student social support in the form not only of autonomy support (i.e., creating an environment providing choice and opportunity for self-direction) but also of competence support (i.e., providing support of competence and mastery) and relatedness support (i.e., providing a stable, secure, and nurturing relationship with the students). [41] Students who felt unimportant by their PE teachers, or ignored, wondered why they should participate in PE displaying higher amotivation. [41] In the present study, it seems that PE enjoyment was the variable mostly impacted by DCD. This finding corroborates the central role attached to enjoyment of physical activity for children with DCD. [14] Indeed, the appropriate design of inclusive PE classes and adaptation of teaching methods aiming to improve motor competence and promote enjoyment in PE has been recognized as a priority. [14] Educational practices grounded in SDT that are conducive to adaptive motivational outcomes have been reported. [42-44,19] Need supportive behaviors are considered an important addition to the PE teacher's behavioral repertoire working with adolescents with DCD,

over and beyond the teaching style used in interacting with these children. [14]

Further, despite studies showing the greater importance boys attach to competition and winning than girls; greater attraction of boys to activities where physical prowess may be displayed; higher levels of perceived athletic competence for boys compared to girls; and sports competence being the most important criterion for rating male popularity rather than female popularity, gender was not found to play a role in the differences presently studied between typical and DCD adolescents in a host of adaptive motivational variables embedded in SDT. That is, the emerging differences were found independent of gender, meaning that the influence of the DCD condition was found to be much stronger on the variables studied compared to the possible influence of gender. Clearly, further research may be needed on this topic to substantiate these findings.

Limitations of the study include (a) that the findings cannot be generalized as the samples were not of a representative nature; (b) that identification of children with DCD might had been enhanced if additional measures had been obtained of the impact of DCD on adolescents' daily living activities. [45] Future research might explore among adolescents with and without DCD the links of elements of the motivational processes originating within SDT with behavioral indexes of student engagement in physical activity in PE.

5. Conclusions

Adolescents with DCD report reduced adaptive physical activity motivational experiences posited within SDT compared to typically developing peers in school PE. The present findings extend the evidence base of adaptive physical activity motivational variables linked to the presence of DCD in an effort to better understand the sources of physical activity-deficit in this population in school PE.

Conflicts of Interest

The authors certify that there is no conflict of interest with anyfinancial organization regarding the material discussed in the manuscript.

Funding

The authors report no involvement in the research by the sponsor that could have influenced the outcome of this work.

ACKNOWLEDGEMENTS

The authors appreciate the willingness and collaboration of teachers, students, and research assistants who were involved in the study.

REFERENCES

[1] American Psychiatric Association (APA). DSM-5: Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC: American Psychiatric Association; 2013.

[2] Barnett LM, van Beurden E, Morgan PJ, O'Brook L, Beard JR. Childhood motor skill proficiency as a predictor of adolescent physical activity. J of Adolesc Health 2009; 44: 252–259.

[3] Lopes VP, Rodrigues LP, Maia JAR, Malina R M. Motor coordination as predictor of physical activity in childhood. Scand J Med Sci Sports 2011; 21: 663-669. doi: 10.1111/j.1600-0838.2009.01027.x.

[4] Harrowell I, Hollén L, Lingam R, Emond A. The impact of developmental coordination disorder on educational achievement in secondary school. Res Dev Disabil 2018; 72: 13 - 22. doi.org/10.1016/j.ridd.2017.10.014.

[5] Wright KE, Furzer BJ, Licari MK, Thronton AL, Dimmock JA, NaylorNH, et al. Physiological characteristics, self-perceptions, and parental support of physical activity in children with, or at risk of, developmental coordination disorder. Res Dev Disabil 2019; 84: 66-74. doi: https://doi.org/10.1016/j.ridd.2018.05.013.

[6] Rose E, Larkin D, Parker H, Hands B. Does motor competence affect self-perceptions differently for adolescent males and females? SAGE Open 2015; 5: 1-9. doi: 10.1177/2158244015615922.

[7] Raz-SilbigerS, Lifshitz N, Katz N, Steinhart S, Cermak SA, Weintraub N. Relationship between motor skills, participation in leisure activities and quality of life of children with developmental coordination disorder: Temporal aspects. Res Dev Disabil2015; 38: 171-180. doi: 10.1016/j.ridd.2014.12.012.

[8] Barnett AL, Hill E. Understanding motor behaviour in developmental coordination disorder. London, UK: Routledge; 2019.

[9] Izadi-Najafabadi S, Rayan N, Ghafooripoor G, Gill K, Zwicker JG. Participation of children with developmental coordination disorder. Res Dev Disabil 2019; 84: 75-84. doi: 10.1016/j.ridd.2018.05.011.

[10] Dunn JC, Watkinson EJ. Considering motivation theory in the study of developmental coordination disorder. In: Cermack SA, Larkin D. (editors.). Developmental coordination disorder Clifton Park, NY: Delmar, Cengage Learning; 2002. p. 185-199.

[11] Cairney J, Hay J, Faught B, Mandigo J, Flouris A. Developmental coordination disorder, self-efficacy toward physical activity, and play: Does gender matter? APAQ 2005; 22: 67-82. doi: https://doi.org/10.1123/apaq.22.1.67.

[12] Skinner RA, Piek JP. Psychosocial implications of poor motor coordination in children and adolescents. Hum. Mov. Sci. 2001; 20: 73-94. doi: 10.1016/s0167-9457(01)00029-x.

[13] Batey CA, Missiuna CA, Timmons BW, Hay JA, Faught BE, Cairney J. Self-efficacy toward physical activity and the physical activity behavior of children with and without

developmental coordination disorder. Hum. Mov. Sci. 2014; 36: 258-271. doi: 10.1016/j.humov.2013.10.003.

[14] Hands B, Parker HE. Physical education and activity in children and adolescents with DCD. In: Barnett AL, Hill EL (editors) Understanding motor behaviour in developmental coordination disorder. New York, NY: Routledge; 2019. p. 137-158.

[15] Ryan RM, Deci EL. Overview of self-determination theory: An organismic dialectical perspective. In: Deci EL, Ryan RM (editors). Handbook of self-determination research. Rochester. NY: University of Rochester Press; 2002. p. 3-33.

[16] Jang H, Kim EJ, Reeve J. Why students become more engaged or more disengaged during the semester: A self-determination theory dual process model. Learn Instr 2016; 43: 27-38. doi: https://doi.org/10.1016/j.learninstruc.2016.01.002.

[17] Haerens L, Aelterman N, Vansteenkiste M, Soenens B, Petegem SV. 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. Psychol Sport Exerc 2015; 16: 26-36. doi: https://doi.org/10.1016/j.psychsport.2014.08.013.

[18] Vallerand RJ. Toward a hierarchical model of intrinsic and extrinsic motivation. In: Zanna MP (editor). Advances in experimental social psychology Vol. 29. San Diego, CA: Academic Press; 1997. p. 271-360.

[19] Katartzi ES, Vlachopoulos SP. Motivating children with developmental coordination disorder in school physical education: The self-determination theory approach. Res Dev Disabil 2011; 32: 2674–2682. doi: 10.1016/j.ridd.2011.06.005.

[20] Ruiz-Perez LM, Palomo-Nieto M, Gomez-Ruano MA, Navia-Manzano JA. When we were clumsy: Some memories of adults who were low skilled in physical education at school. *J*. Phys. Educ. *Sport* Manag. 2018; 5: 30-36. doi: 10.15640/jpesm.v5n1a4.

[21] Hands B, Parker HE, Rose E, Larkin D. Gender and motor competence affects perceived likelihood and importance of physical activity outcomes among 14 year olds. *Child Care Health* Dev. 2015; 42: 246-252.

[22] Brustad RJ. Attraction to physical activity in urban schoolchildren: Parental socialization and gender influences. Res Q Exerc *Sport* 1996; 67: 316-323.

[23] Thirer J, Wright SD. Sport and social status for adolescent males and females. Sociol. SportJ. 1985; 2: 164-171.

[24] Henderson SE, Sugden DA, Barnett AL. Movement Assessment Battery for Children-2 (2nd ed.) (Movement ABC-2). London, UK: The Psychological Corporation; 2007.

[25] Williams GC, Grow VM, Freedman ZR, Ryan RM, Deci EL. Motivational predictors of weight loss and weight-loss maintenance. J PersSocPsychol 1996; 70: 115-126. doi: 10.1037//0022-3514.70.1.115.

[26] Vlachopoulos SP, Katartzi ES, Kontou MG. The basicpsychological needs in physical education scale. J Teach Phys Educ 2011; 30: 263-280. doi: https://doi.org/10.1123/jtpe.30.3.263.

[27] Vlachopoulos SP, Katartzi ES, Kontou MG, Moustaka FC, Goudas M. The revised perceived locus of causality in physical education scale: Psychometric evaluation among youth. Psychol Sport Exerc 2011; 12: 583-592. doi: https://doi.org/10.1016/j.psychsport.2011.07.003.

[28] Scanlan TK, Simons JP, Carpenter PJ, Schmidt GW, Keeler B. The sport commitment model: Measurement development for the youth-sport domain. J Sport Exerc Psychol 1993; 15: 16-38. doi: https://doi.org/10.1123/jsep.15.1.16.

[29] Leptokaridou ET, Vlachopoulos SP, Papaioannou AG. Experimental longitudinal test of the influence of autonomy-supportive teaching on motivation for participation in elementary school physical education. Educ. Psychol. 2016; 36: 1138-1159. doi: https://doi.org/10.1080/01443410.2014.950195.

[30] Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951; 16: 297–334. doi: https://doi.org/10.1007/BF02310555.

[31] Bentler PM. Comparative fit indices in structural models. Psychol. Bull. 1990; 107: 238-246. doi: 10.1037/0033-2909.107.2.238.

[32] Hu L, Bentler PM. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. STRUCT EQUMODELING1999; 6: 1-55. doi: https://doi.org/10.1080/10705519909540118.

[33] Steiger JH, Lind JM. Statistically based tests for the number of common factors. Paper presented at the meeting of the Psychometric Society, Iowa City, IA; 1980, June.

[34] Browne MW, Cudeck R. Alternative ways of assessing model fit. In: Bollen KA, Long SJ (editors). Testing structural equation models. Newbury Park, CA: Sage; 1993. p. 445-455.

[35] Byrne BM Structural equation modeling with AMOS: Basic concepts, applications, and programming. Mahwah, NJ: Lawrence Erlbaum Associates; 2000.

[36] Brydges CR. Effect size guidelines, sample size calculations, and statistical power in gerontology. Innov Aging 2019; 3: 1-8. doi:10.1093/geroni/igz036.

[37] Lakens D. Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. Front. Psychol. 2013; 4: 1-12. https://doi.org/10.3389/fpsyg.2013.00863.

[38] Fitzpatrick DA, Watkinson EJ. The lived experience of physical awkwardness: Adults' retrospective views. APAQ 2003; 20: 279-297.

[39] Piek JP, Rigoli D. Psychosocial behavioural difficulties in children with developmental coordination disorder. In: Cairney J (editor). Developmental coordination disorder and its consequences Toronto: University of Toronto Press; 2015. p. 108-137.

[40] Ntoumanis N, Pensgaard A, Martin C, Pipe K. An idiographic analysis of amotivation in compulsory school physical education. J Sport Exerc Psychol 2004; 26: 197-214.

[41] Shen B, Li W, Sun H, Rukavina PB. The influence of inadequate teacher-to-student social support on amotivation of physical education students. J TeachPhys Educ2010; 29: 417-432.

[42] Niemiec CP, Ryan RM. Autonomy, competence, and relatedness in the classroom: Applying self-determination theory in educational practice. TheoryRes. Educ. 2009; 7: 133-144. doi: https://doi.org/10.1177/1477878509104318.

[43] Ntoumanis N, Standage M. Motivation in physical education classes: A self-determination perspective. Theory Res. Educ. 2009; 7: 194-202. doi: https://doi.org/10.1177/1477878509104324.

[44] Reeve J, Halusic P. How K-12 teachers can put self-determination theory principles into practice. Theory Res. Educ. 2009; 7: 145-154. doi: https://doi.org/10.1177/1477878509104319.

[45] Sugden D. Leeds consensus statement: Developmental coordination disorder as a specific learning difficulty. ESRC Research Seminar Series 2004-2005, United Kindgom, 1-8; 2006.