Psicologia Escolar e Educacional

PAPER

DOI: http://dx.doi.org/10.1590/2175-35392020208374

Elocid - e208374

THE CONCEPT OF TIME IN CHILDREN WITH TYPICAL MOTOR DEVELOPMENT AND DEVELOPMENTAL COORDINATION DISORDER

Rafaela Zortéa Fernandes Costa [1]; **Inara Marques** [1]; **Dalberto Luiz de Santo** [1]; **Josiane Medina-Papst** [1]

ABSTRACT

The objective of this study was to compare the development of the notion of time between children with Typical Development (TD) and with Developmental Coordination Disorder (DCD). Divided into groups, 34 children participated in this research: TD ages 6-7 years (n = 9), TD ages 8-9 years (n = 8), DCD ages 6-7 years (n = 7), and DCD ages 8-9 years (n = 10). Children with DCD were indicated by teachers through the MABC-2 checklist and children with TD for presenting a good performance. Subsequently, all of them were evaluated using the MABC-2 battery. For an analysis of the concept of time, an adaptation of a test proposed by Piaget was used, which aims to understand the succession of perceived events, carried out in an experimental context. Therefore, two wooden toys that performed different movements in relation to time and destination were used. The concept of this task was adapted for two running tasks in an applied context. The children were asked separately about task time issues and their responses were recorded and transcribed. The Mann-Whitney test was used and it was possible to observe that children with DCD reached the operational thought stage showing no significant difference between groups.

Keywords: cognitive development; motor skills; motor disorders.

Noción temporal de niños con desarrollo típico y trastorno del desarrollo de la coordinación

RESUMEN

El objetivo del estudio fue comparar el desarrollo de la noción de tiempo entre niños con Desarrollo Típico (TD) y con Trastorno do Desarrollo de la Coordinación (DCD). Participaron 34 niños, divididos en los grupos: TD 6-7 años (n=9), TD 8-9 años (n=8), DCD 6-7 años (n=7) y DCD 8-9 (n=10). Los niños con DCD fueron indicadas por los profesores por intermedio del *checklist* del *MABC-2* y los niños con TD por presentar buen rendimiento. Posteriormente, todos fueron evaluadas con la batería del *MABC-2*. Para el análisis de la noción temporal, se utilizó una adaptación de una prueba propuesta por Piaget, que tiene por objetivo comprender la sucesión de los acontecimientos percibidos, realizada en contexto experimental. Siendo así, se utilizaron dos juguetes de madero que realizaban movimientos distintos en relación al tiempo y al punto de llegada. El concepto de esa tarea fue adaptado para dos tareas de corrida en contexto aplicado. Se indagó, a los niños, separadamente sobre cuestiones temporales de las tareas y sus respuestas gravadas y transcritas. Se empleó el test *Mann-Whitney*, observándose que los niños con DCD expresaron niveles operatorios de pensamiento, no demostrando diferencia significativa entre grupos.

Palabras clave*:* desarrollo infantil; destreza motora; trastornos motores.

Noção temporal de crianças com desenvolvimento típico e transtorno do desenvolvimento da coordenação

RESUMO

O objetivo do estudo foi comparar o desenvolvimento da noção de tempo entre crianças com Desenvolvimento Típico (TD) e com Transtorno do Desenvolvimento da Coordenação (DCD). Participaram 34 crianças, divididas nos grupos: TD 6-7 anos (n=9), TD 8-9 anos (n=8), DCD 6-7 anos (n=7) e DCD 8-9 (n=10). As crianças com DCD foram indicadas pelos professores por meio do *checklist* do *MABC-2* e as crianças com TD por apresentarem bom desempenho. Posteriormente, todas foram avaliadas com a bateria do *MABC-2*. Para a análise da noção temporal, utilizou-se uma adaptação de uma prova proposta por Piaget, que visa compreender a sucessão dos acontecimentos percebidos, realizada em contexto experimental. Sendo assim, utilizaram-se dois brinquedos de madeira que realizavam movimentos distintos em relação ao tempo e ao ponto de chegada. O conceito dessa tarefa foi adaptado para duas tarefas de corrida em contexto aplicado. As crianças foram questionadas separadamente sobre questões temporais das tarefas e suas respostas gravadas e transcritas. Empregou-se o teste *Mann-Whitney*, observando-se que as crianças com DCD expressaram níveis operatórios de pensamento, não demonstrando diferença significativa entre grupos.

Palavras-chave: desenvolvimento infantil; habilidades motoras; transtornos motores.

[1] Universidade Estadual de Londrina– Londrina – PR –Brasil; rafaela_zortea@hotmail.com; inaramarques@hotmail.com; dalbertodesanto@gmail.com; josi_medina@hotmail.com

INTRODUCTION

It is known by the Cognitive Development Theory that, approximately at the age of seven, children reach the Concrete-Operational Stage (Piaget, 1958), which is characterized by a crucial transition from action to operation (Piaget, 1978). Just like in other stages of cognitive development, in the Concrete-Operational Stage notions go through transformations and completely new structures are built. However, the overcoming of obstacles in order to construct operations produces, simultaneously, the overly complex development of new notions such as time, velocity, causality, and so on. Until then, those notions were understood as simple action and intuition schemes. The new notions provide individuals with information in order to establish new relationships among objects moving in space (Rosa Neto, 2002). Such relationships are infinitely important all the time for everyday tasks such as crossing the street, as well as recreational or sports activities such as calculating distance and velocity in order to intercept an object or a ball.

One of the first researchers to worry about these matters was Piaget, who realized, in an experimental context, several studies on the development of such notions throughout childhood. In general, during these studies, each child would sit at the experiment table and observe the materials and situations presented while answering the questions asked by the researcher. With that limitation in mind but from the perspective of the Physical Education professional in the educational context, whose intention is to promote the development of motor as well as cognitive skills in students, our initial question concerned how this representation of the notion of time happened, when the child quits the position of mere observer of the movement of objects and becomes the performer of the movements observed.

This necessary connection of the cognitive development, by means of situations experienced, is a challenge for educators. In comparison to researchers, educators aim at their students' continuous learning by means of the introduction of situations in which the students will act on the information and the elements of an environment. Another obstacle rises out of individual characteristics such as the children's own motor limitations. Thus, from the perspective of combined analyses of the motor and cognitive development, it is possible to observe that, approximately, the age of seven is a developmental milestone in the transformations observed in childhood. This is the age around which children are expected to start using a combination of fundamental motor skills (Manoel, 1994). There is a need for the integration of skills, which will only take place after the modification and reorganization of time and space structures, so that the performer will be able to anticipate the next action in sequence (Gimenez, Manoel, Oliveira, Dantas, & Marques, 2012; Tani, Basso, & Corrêa, 2012). In other words, skills such as kicking, running, jumping, spinning, and so on, when in combination will be modified in accordance to time and space so that they can be applied to sports, leisure time and, most importantly, in everyday life situations. Besides that, in order to reach higher complexity in the realization of skills, individuals need mature movement patterns for a great variety of motor skills. However, it is known nowadays that some children, even though they do not present any trouble in their development, have difficulty in realizing tasks that demand gross and fine motor skills. These children sometimes are described as "clumsy" or "lacking coordination".

Literature points out that approximately 6% of the schoolchildren, ages between 5 and 11 years, go through highly compromised processes of motor development (American Psychiatric Association [APA], 2014). These children have difficulty to accomplish tasks that demand fine and gross motor skills, whether during everyday life or recreational activities. In 1994, the American Psychiatric Association proposed the use of a term that could represent the motor difficulties observed in these children. Therefore, the term "Developmental Coordination Disorder" – DCD, described in the Diagnostic and Statistical Manual of Mental Disorders – DSM 5 (APA, 2014), became the one adopted by studies in diverse fields of knowledge, such as education and health.

For some time, diverse areas of study have attempted to understand how the development of this specific segment of the young population takes place. Many researchers have contributed to advancements in the field especially in order to find a solution, or at least some mitigation, to the negative impact produced by the disorder. Besides motor difficulty, it is known that children with motor coordination problems struggle with space-related skills as well as with tasks demanding time management (Estil, Ingvaldsen, & Whiting, 2002). Literature also points at the fact that DCD is generally associated with mental health problems such as depression and anxiety (Omer, Jijon, & Leonard, 2018) in addition to problems with the self-concept of physical competence (Yu et al., 2016), poor quality of life (Cleaton, Lorgelly, & Kirby, 2019), poor social interaction (Poulsen, Ziviani, Johnson, & Cuskelly, 2008), and hyperactivity disorders (Okuda, 2015).

However, nowadays few studies attempt to understand the behavior of children with DCD in the school environment or the changes in the cognitive development of this young population (Roebers & Kauer, 2009). It is perceived that, despite the increasing number of studies in this period, few teachers are aware of the existence of this disorder, let alone strategies in

order to mitigate the difficulties faced by these children. According to Santos et al. (2015), it is important for Physical Education professionals to be able to identify children with DCD. Physical Education professionals should also be prepared to plan strategies and interventions in order to minimize the impact caused by motor disorders. In this sense, because Physical Education is a school subject that deals directly with motor skills, professionals in the area must be alert and prepared for the identification of possible motor difficulties in the students and the adoption of adequate procedures.

In order to provide an education that helps each child come over their difficulties, we need research that attempts to investigate the relationship between DCD and the changes taking place in the cognitive devices of these children. Such investigation will be conducive to the development of better learning environments. This study is our contribution and its objective was to analyze the development of the notion of time in children with Typical Motor Development (TD) and with Developmental Coordination Disorder (DCD), in situations involving the observation of objects in movement as well as in the execution of motor tasks. One of the study premises was that, within the same age group and in the two proposed situations, children with TD would display a better comprehension of the notion of time when compared to children with DCD.

METHOD

This is a qualitative, observational, field study (Thomas, Nelson, & Silverman, 2012).

Participants

The children participating in this research studied at two schools in the Metropolitan Region of Londrina. In order to select the participants, we initially requested Physical Education teachers and classroom managers to fill up the MABC-2 checklist for every child they believed had motor difficulties while performing school activities. This checklist is a screening device for the observation of children's behaviors in different situations. After selection, the children were assessed by the researcher by means of the MABC-2 battery of tests, which consists of activities in order to assess skills in areas such as manual dexterity, dynamic and static balance, and ball-handling skills (Henderson, Sugden, & Barnett, 2007). Subsequently, Physical Education teachers were requested to help identify children with Typical Development, which means good motor performance in tasks involving the handling of objects, static and dynamic balance, and ball games. Afterwards, the researcher also assessed the children by means of the MABC-2 tasks in order to make sure they really did not have any motor impediment that could prevent them from successfully participating in the research.

Since individuals are diagnosed as having DCD or TD according to different degrees of certain presented behaviors, the sample was put together by convenience and adopted the percentage equal to or less than 9 as cutoff for the classification of DCD and percentage equal to or greater than 63 as cutoff for the selection of children with TD.

After these initial procedures, 34 children were selected to participate in the study (25 boys and 9 girls), ages between 6 and 9 years distributed into four groups: Typical Development ages 6 – 7 years (TD 6 –7 years; n=9), Typical Development 8 – 9 years (TD 8 – 9 years; n=8), Developmental Coordination Disorder ages 6 – 7 years (DCD 6 – 7 years; n=7) and Developmental Coordination Disorder 8 – 9 years (DCD 8 – 9 years; n=10), according to Table 1.

All parents or legal guardians signed a free informed consent term allowing the children to participate in the study. The research was approved by the Committee for Ethics in Research on Human Beings of the State University of Londrina (Decision no. 56826).

Tasks

The tasks employed in order to investigate the development of the notion of time in the children were based on a test used by Piaget (2012) to analyze the succession of perceived events. Therefore, in this study, the tasks were conducted in two ways: in an experimental context (EC), according to Piaget's proposal, and in an applied context (AC). The decision to realize tasks also in AC is due to our intention to connect the task to the context of Physical Education lessons and give teachers an opportunity for analysis.

Table 1. Number of participating children in the sample.

	Ages 6-7 years		Ages 8-9 years		Total	
	N	**%**	**N**	**%**	**N**	**%**
TD	9	26.47%	8	23.53%	17	50.00%
DCD	7	20.59%	10	29.41%	17	50.00%
Total	16	47.06%	18	52.94%	34	100%

Source: the author.

The children were assessed by the researcher in their own school environment. A room was made available and the dates and time of sessions were previously set up by the coordination department. Before getting started on the tasks, the children were told that they would realize one task in the classroom (Experimental Context - EC) and two tasks outside the classroom with another child (Applied Context – AC). In the beginning of the EC task, each child was verbally instructed to pay attention to the material used in the experiment. After the explanations, children were allowed to observe the material one more time if they wanted. The task was initiated after everything was made clear.

In the experimental context (EC), in an adaptation of the study by Piaget (2012) on the succession of perceived events, children were shown a wooden toy that consisted of two yellow ducklings – duckling I and II. The second duckling was marked with a red **d**ot in order to set it apart from the first one. Each duckling was placed at the starting point of two straight, parallel, 48-cm-long lanes at an inclination of 23 degrees to the supporting table.

The ducklings started going down the lane at the same time but, due to their different lengths of step, reached different velocities. Thus, while duckling I (greater velocity) ran the 48 cm of the lane, duckling II would cover only 22 cm. When duckling I reached the final point of its trajectory, duckling II still had 15 cm to go and stopped at the place a double-face tape was placed, thus completing 37 cm of the whole trajectory.

Next, the child was asked the following questions: (1) Did the two ducks stop at the same time? (2) If not, which one stopped first? (3) Which duck ran the longest? (4) Imagine that duckling I stopped at twelve o'clock noon. Did duckling II stop before or after that time? Also, children were asked to explain their answers. The term "noon" was used in order to keep the questions concerning the tasks similar to the ones asked by Piaget (2012).

For the assessment in Applied Context (AC), the concepts of time, velocity, and causality were adapted to a dynamic context. Two activities were developed, in which children of the same group worked in pairs combining one child with TD and another child with DCD.

The first AC task, therefore, consisted of showing the children the two trajectories: the first one was 5 meters long and the second one was 4 meters long. Everything was set up in the school gymnasium. The trajectories were made by means of rows of cones one meter away from each other and a hula hoop placed one meter away from the end of the trajectory.

The children were instructed to run the trajectories zigzag as fast as possible and, at the end of the trajectory, they were supposed to toss a birdie into the hula hoop. And then, the children were individually asked the following questions:

(1) Did you two stop at the same time? (2) Who stopped first? (3) Who spent more time walking? (4) If you were first and stopped at twelve o'clock noon, did your classmate (the runner-up) stop before or after that time?

The second AC task consisted of showing two trajectories, 5 meters long each. In one of the trajectories, hula hoops were positioned so that the children could only step within the hula hoops. There were cones along the other trajectory and the children were supposed to run zigzag. The two children ran each trajectory once. Therefore, the task was distributed into two phases.

The children were instructed to run the two trajectories as fast as possible. At the end of the trajectory they were supposed to kick a ball into a goal. In the end of each phase the children were individually asked the following questions:

(1) Did you two stop at the same time? (2) Who stopped first? (3) Who spent more time running? (4) If you were first and stopped at twelve o'clock noon, did your classmate stop before or after that time? For each pair of children, conducted tasks and activities were recorded in video for later analysis.

Analysis Procedures

The tasks were filmed by means of a Sony *Handycam* DCR-SR42 digital camera, with a sampling rate of 60 Hz. The children's answers were transcribed and the videos were analyzed, in accordance with Piaget's theory on the development of the notion of time, for later categorization of the answers within the phases predicted by the theory (phase 1, sub phase 2A, sub phase 2B and phase 3).

Thus, in the first phase (P1), there are the individuals who presented undifferentiated space and time successions and contradictory answers concerning the duration and the succession of events that made no sense. The children's concepts of time were undifferentiated from space and velocity. The children presented difficulty, for example, to manage the concepts of "before" and "after" in a time-related way. At this stage, duration is assimilated only by means of velocity and trajectory space (Piaget, 2012).

The second phase is divided into two sub phases in accordance with the changes related to the cognitive development of a child. Sub phase *2A* (S2A) concerns the beginning of the differentiation between the order of time, of space, and articulated time intuitions. The children categorized in this phase presented considerable progress. However, some of

them presented a better comprehension of the notion of succession while other children displayed better comprehension of duration. When there is progress in the notion of success, the children explain that the one who spent more time running, ran "faster" or "farther" but they have no difficulty in knowing the difference between who finished "before" and "after". On the other hand, when there is progress in the notion of duration, the children explain without any difficulty that spending "more time" running means that the runner was slower on the trajectory, but understand the relations of "before" and "after" in a special way.

Sub phase *2B* (S2B) is characterized by the beginning of operational coordination between articulated intuitions. The most outstanding characteristic of this stage is the fact that the children start discovering the need to connect the relations of succession and duration. Therefore, the children in this group gradually corrected themselves while providing answers to the researcher's questions.

The third phase (P3) consists of the operational succession and duration. Unlike the previous phases, participants in this one respond to procedures by following an operational logic since the very beginning, while considering different factors such as the starting and finishing point of the moving objects. Participants in this phase demonstrated true comprehension of time and space, which produces a command over the capacity of thought decentration (Piaget, 2012).

All assessment procedures with the children, the application of tasks, and the analysis of tasks were realized by the researcher herself. After categorization of the children, results were analyzed quantitatively by means of a percentage, and qualitatively by means of the type and the depth of provided explanations. At last, in order to assess the study premises, Mann-Whitney's U test was used for comparing groups and phases within the same group. The level of significance adopted was p<0,05, in combination with the SPSS statistical package for Windows, version 13.0.

RESULTS

Among the 34 children assessed in this study, 20.59% were categorized in the first phase (P1), 38.24% were categorized in sub phase 2A (S2A), 23.53% in sub phase 2B (S2B) and 17.65% in the third phase (P3). Concerning the groups, it was observed that most of the children with DCD (70.59%) was categorized in phases P1 and S2A. On the other hand, most of the children were categorized in S2A and S2B (Table 2).Concerning the assessment by age, results show that no children with DCD, ages 6-7 years, was categorized in phases S2B and P3. Most of them were concentrated in the first phase of cognitive development. TD children at this age were distributed all over the three phases of development. However, the greatest percentage was classified in phase 2.

Children with DCD, ages 8-9, got classified from Phase S2A (50.0%) to Phase E3 of development (30.0%). On the other hand, the performance of children with TD was more evenly distributed among the phases. However, there was greater frequency in sub phase S2B (37.5%) and P3 (25.0%).

Although data seem to point at different distributions among the DCD and TD groups, the Mann-Whitney U Test did not present any statistically significant difference between them (U=118,5; p=0,375). Thus, the Mann-Whitney U Test was realized between the phases of development within each age group. No significant difference was found in this analysis (U=14,500; p=0,071 in the group of ages 6-7 years and U=40,00; p=1,00 in the group of ages 8-9 years). Finally, when a comparison between the age groups was made, regardless of DCD or TD, a statistical difference was observed. The younger children got classified in the first phases of time notion development whereas the older children got classified in the final phases (U=77,0; p=0,02).

DISCUSSION

The research results were conducive to the conclusion that the children, in the experimental context (EC) as well as in the applied context (AC), adopted the same logical thinking. Children kept the categories they had been assigned to in both the experimental and applied contexts. Thus, we assume that the logic for building the time notion did not change in the transition from the observing position into the function of task performer.

Concerning the established study hypotheses, in which the children with TD would present better notion of time when compared to the children with DCD, the results did not lead to such confirmation. However, the results of the present study demonstrated that the greatest number of children with DCD was categorized in phases P1 and S2A (70.59%) whereas the greatest number of children with TD was categorized in S2A and S2B (64.70%) (Table 2). According to Piaget (2012), the transition from S2B into P3 is much faster than the transition from P1 into S2A. this happens because S2B is a passage from intuitive thought into operational thought, in which operation is constructed in a more elaborate way. This characteristic is evident in the results for age groups 6-7 years, in which children with TD (11.11%) were already in the final phases of development (S2B and E3). On the other hand, none of the children of the DCD group was classified in these phases and remained in the initial phases (P1 and S2A).

These results contradict specified literature and its theory that DCD might associated with cognitive problems (Skinner & Piek, 2001, Okuda, 2015) and with

Table 2. Number of children classified in each phase.

	Phase 1		Phase 2				Phase 3		Total	
			Sub Phase 2 A		Sub Phase 2 B					
	N	%	N	%	N	%	N	%	N	%
TD	3	17.65%	5	29.41%	6	35.29%	3	17.65%	17	100%
DCD	4	23.53%	8	47.06%	2	11.76%	3	17.65%	17	100%
Total	7	20.59%	13	38.24%	8	23.53%	6	17.65%	34	100%

Source: the author.

low memory capacity (Wilson, Green, Caeyenberghs, & Steenbergen, 2016). It is important to emphasize that children with DCD tend to avoid the practice of activities involving motor skills and social interaction with other children. These children are aware of their own limitations and that can be an aggravating factor in their development process. Thus, although the study hypothesis was not confirmed, more studies must be realized in order to investigate the construction of that notion, especially for children with DCD.

Concerning the age groups analyzed in the present study, the results were similar to the ones produced by the researches of Piaget (2012), in which 15% of the six-year-old children reached the stage of operational thought while 85% of the children ages 7-8 years reached that stage. In the results found here, considering the two groups (DCD and TD), only 11.11% of the children ages 6-7 years were classified into the third phase, while 55.00% of the children ages 8-9 years reached that level of cognitive development. Thus, corroborating the studies by Piaget, most the children of the age group 6-7 years were classified into lower phases in comparison to older children.

It was possible to observe that a greater number of children with DCD ages 6-7 years was categorized into phase P1 (Table 3) when compared to the TD group, which is a sign that the children with TD reach phases of the cognitive development at a faster pace than the children in the DCD group. However, the 8-9-year age group is not a developmental milestone in the transformations of the knowledge scheme. A small percentage (12.50%) of children with TD in this age group was classified into P1. The fact that the children sometimes do not reach developmental stages at the expected age is a variable aspect and is connected to not only maturation components but also to the internal and external mechanisms that influence every individual in their social interactions and in their acquired experiences with actions on objects (Piaget & Inhelder, 1986; Piaget, 2012). In this same perspective, Manoel (2000) explains that the routes of development, which lead the system from one state to another, are diverse and result from the interaction between the restrictions of the environment, of the individual, and of the task.

Also, it was observed that, although most of the children with DCD did not reach the operational thought stage at the expected age, 6-7 years, part of the children in the age group 8-9 years reached that stage (30% of the DCD age group 8-9 years). It was also noticed that a great number of children with DCD, in the age group 8-9 years, was classified into P3 when compared to the TD group of the same age (Table 3). However, there was no statistically significant difference between the two groups.

These results are different from the ones found in a similar study by Campos, Goldberg, Capellini and Padula (2007), realized with six children at ages between 8 and 12 years who had been diagnosed with Attention Deficit

Table 3. Number of children by group in each phase.

	Phase 1		Phase 2				Phase 3		Total	
			Sub phase 2A		Sub phase 2B					
	N	%	N	%	N	%	N	%	N	%
TD 6-7	2	22.22%	3	33.33%	3	33.33%	1	11.11%	9	100%
TD 8-9	1	12.50%	2	25.00%	3	37.50%	2	25.00%	8	100%
DCD 6-7	4	57.14%	3	42.86%	0	0.00	0	0.00	7	100%
DCD 8-9	0	0.00	5	50.00%	2	20.00%	3	30.00%	10	100%
Total	7	20.59%	13	38.24%	8	23.53%	6	17.65%	34	100%

Source: the author.

and Hyperactivity Disorder (ADHD), in which the children took operational tests of continuous and discontinuous quantity conservation. The authors verified that the children with ADHD were concentrated in a period of logical developmental of inner thought which was less advanced than what was expected for their age. In order to explain the results, the authors mention that agitation, impulsiveness, and lack of concentration in children with ADHD are barriers to the interpretation of problem and compromise learning.

However, it is a good idea to remember that he children with DCD are part of a heterogeneous group in which each child might present a different assortment of problems (Okuda, 2015; Yu, Sit, & Burnett, 2018). Also, although we have not answered all questions related to the DCD problem (Dantas & Manoel, 2009), studies indicate that the children with this disorder are more likely to have academic difficulties (Michel, Roethlisberger, Neuenscwander, & Roebers, 2011). In addition, children who go through constant failure generally quit trying on new tasks and are more likely to give up their academic careers (Santos et al., 2015).

In this aspect, according to the study by Medina, Rosa and Marques (2006), in which there was an investigation of the development of time organization in children with learning difficulties ages between 8 and 10 years, it was possible to observe that children with difficulty at school also presented difficulty on tasks involving motor skills and time management. The authors verified that only the 8-year-old children presented results in accordance to what was expected for children at that age while demonstrating deficit in the different tasks used in the evaluation. Such results indicate that, as children grow older, there seems to be a relative increase in deficit for aspects that compose time organization. In view of this difference between the present study and the study by Medina et al. (2006), we emphasize the necessity to realize other studies that attempt to understand the learning of school aspects by children with difficulties, especially studies with longitudinal characteristics.

On the other hand, despite the absence of studies that seek to understand these aspects, we see the necessity to start some type of intervention with this population as soon as possible in collaboration with families and, most importantly, teachers. It is in the school context that children develop most of their cognitive and motor skills (Santos et al., 2015; Pellegrini & Hiraga, 2008). In this perspective, intervention studies have had a positive influence on the development of these children's motor skills (Yu et al., 2018, Ferreira, Barros, Bruzi, Santos, & Freudenhein, 2015). These results suggest that education professionals must be aware of DCD and the development of these notions because this is a process of reconstruction of previous structures on a new plan with the objective to promote re-structuring throughout an individual's life (Piaget, 2012). Thus, knowledge on this process becomes fundamental for the planning of tasks that respond to students' different needs.

The analysis and interpretations of the information in this study led us to thee conclusions. First, concerning the notion of time, results showed that the participating children used the same thought construction logic when they took the test by observing the materials (EC) and when they realized the movements with their own bodies as active elements in the test (AC). Second, the children with DCD as well as the children with TD, reached the stages of operational thought at different ages. Third, although literature points out that children reach the stage of operational thought around the ages of 7 or 8, it was possible to observe that not even the children with TD reached that stage.

One of the limitations of this study was the small number of participants in each group (at most 10 children per group). This was due to difficulty in the identification and classification of a larger sample of children with DCD. Despite this limitation, all criteria proposed by the literature for the identification of this contingent were observed. Thus, we recommend the production of more studies with a larger number of children in order to obtain more solid results concerning cognitive development and how the development of the notion of time happens to these children.

We also recommend that the interventions in education do not restrict themselves to practices involving motor skills per se and evolve towards interventions with cognitive and motor skills. The intention is to help children create their own personal strategies for the solution of problems and develop their more robust knowledge schemes, which will certainly mitigate many secondary problems of adult life.

REFERENCES

Associação Psiquiátrica Americana. (2014). *Manual diagnóstico e estatístico de transtornos mentais* (5a. ed.). Porto Alegre: Artmed.

Campos, L. G. A.; Goldberg, T. B. L.; Capellini, A. S.; Padula, N. A. M. R. (2007). Caracterização do desempenho de crianças com transtorno de défict de atenção e hiperatividade (TDAH) em provas operatórias: estudos de casos. *Revista Psicopedagogia, 24*, 218-28.

Cleaton, M. A. M.; Lorgelly, P. K.; Kirby, A. (2019). Developmental coordination disorder: the impact on the family. *Quality of Life Research*, *28*(4): 925-934. DOI:10.1007/s11136-018-2075-1

Dantas, L. E. B. P. T.; Manoel, E. J. (2009). Crianças com dificuldades motoras: questões para conceituação do transtorno do desenvolvimento da coordenação. *Movimento, 15*(3), 293-313.

Estil, L. B.; Ingvaldsen, R. P.; Whiting, H. T. A. (2002). Spatial and temporal constraints on performance in children with movement co-ordination problems. *Experimental brain research, 147*, 153-161.

Ferreira, L. F.; Barros, J. L. C.; Bruzi, A. T.; Santos, J. O. L.; Freudenhein, A. M. (2015). Transtorno do desenvolvimento da coordenação: discutindo sobre intervenção e seus efeitos. *Amazônida, 1*, 89-108.

Gimenez, R.; Manoel, E. J.; Oliveira, D. L.; Dantas, L.; Marques, I. (2012). Integrating fundamental movement skills in late childhood. *Perceptual and Motor Skills, 114*(2), 563-583.

Henderson, S.; Sugden, D. A.; Barnett, A. (2007). *Movement Assessment Battery for Children* (2. ed.). San Antonio: Harcourt Assessment.

Manoel, E. J. (1994). Desenvolvimento motor: implicações para a educação física escolar I. *Revista Paulista de Educação Física, 8*(1), 129-147.

Manoel, E. J. (2000). Desenvolvimento motor: padrões em mudança, complexidade crescente. *Revista Paulista de Educação Física, 3*, 35-54.

Medina, J.; Rosa, G. K. B.; Marques, I. (2006). Desenvolvimento da organização temporal de crianças com dificuldades aprendizagem. *Revista da Educação Física/UEM, 17*(1), 107-116.

Michel, E.; Roethlisberger, M.; Neuenscwander, R.; Roebers, C. M. (2011). Development of cognitive skills in children with motor coordination impairments at 12-month follow-up. *Child Neuropsychology, 17*(2), 151-172.

Okuda, P. M. M. (2015). *Intervenção e identificação precoce do Transtorno do Desenvolvimento da coordenação em escolares no inicio da alfabetização* (Dissertação de mestrado). Universidade Estadual Paulista Julio de Mesquita Filho, Marília, SP, Brasil.

Omer, S.; Jijon, A. M.; Leonard, H. C. (2018). Internalising symptoms in developmental coordination disorder: a systematic review and meta-analysis. *Journal of Child Psychology and Psychiatry*, 60 (6), 606–621. doi: 10.1111/jcpp.13001

Pellegrini, A. M.; Hiraga, C. Y. (2008). A intervenção no contexto do comportamento motor: integrando teoria e prática. In Corrêa, U. C. (Ed.), *Comportamento motor: a intervenção profissional em perspectiva* (116-129). São Paulo: EFP/EEFEUSP.

Piaget, J. (1958). *Psicologia da inteligência* (E. de Alencar, trad.). Rio de Janeiro: Fundo de Cultura.

Piaget, J. (1978). *Seis estudos de psicologia* (24a ed., M. A. M. D'Amorim & P. S. L. Silva, trad.) Rio de Janeiro: Forense Universitária.

Piaget, J. (2012). *A noção de tempo na criança* (3a ed., R. Fiúza, trad.) Rio de Janeiro: Civilização Brasileira.

Piaget, J.; Inhelder, B. (1986). *A Psicologia da criança* (9a ed., O. M. Cajado, trad.) São Paulo: DIFEL S.A.

Poulsen, A. A.; Ziviani J. M.; Johnson H.; Cuskelly M. (2008). Loneliness and life satisfaction of boys with developmental coordination disorder: The impact of leisure participation and perceived freedom in leisure. *Human Movement Science*, *27*(2), 325-43.

Roebers, C. M.; Kauer, M. (2009). Motor and cognitive control in a normative sample of 7-year-olds. *Developmental Science, 12*, 175-181.

Rosa Neto, F. (2002). *Manual de avaliação motora.* Porto Alegre: Artmed.

Santos, J. O. L.; Ferreira, L. F.; Souza, M. L.; Branco Junior, A. C.; Oliveira, P. B.; Bruzi, A. T. (2015). Transtorno do desenvolvimento da coordenação: um desafio oculto no cotidiano escolar manauara. *Amazônida, 2*, 1-15.

Skinner, R. A.; Piek, J.P. (2001). Psychosocial implications of poor motor coordination in children and adolescents. *Human Movement Science, 20*, 73-94.

Tani, G.; Basso, L.; Corrêa, U.C. (2012). O ensino do esporte para crianças e jovens: considerações sobre uma fase do processo de desenvolvimento motor esquecida. *Revista brasileira de Educaçao* Física e Esporte, 26(2), 339-50.

Thomas, J. R.; Nelson, J. K.; Silverman, S. J. (2012). *Métodos de pesquisa em Atividade Física* (6ª ed.). Porto Alegre: Artmed.

Wilson, P.; Green, D.; Caeyenberghs, K.; Steenbergen, B. (2016). Integrating New Technologies into the Treatment of CP and DCD. *Current developmental disorders reports, 3*(2), 138-151.

Yu J. J.; Burnett. A. F.; Sit, C. H. (2018). Motor Skill Interventions in Children with Developmental Coordination Disorder: A Systematic Review and Meta-Analysis. *Archives of physical medicine and rehabilitation, 99*(10), 2076-2099. doi: 10.1016/j.apmr.2017.12.009

Yu J.; Sit, C. H.; Capio C. M.; Burnett A.; Ha A. S.; Huang W. Y. (2016). Fundamental movement skills proficiency in children with developmental coordination disorder: Does physical self-concept matter? *Disability and Rehabilitation*, *38*(1), 45-51.

This paper was translated from Portuguese by Régis Lima.

Received: July 20, 2018

Approved: January 08, 2020