Research in Developmental Disabilities 110 (2021) 103862

Contents lists available at ScienceDirect

Research in Developmental Disabilities

journal homepage: www.elsevier.com/locate/redevdis

Efficacy of the Cognitive Orientation to daily Occupational Performance (CO-OP) approach with and without parental coaching on activity and participation for children with developmental coordination disorder: A randomized clinical trial

Clarice Ribeiro Soares Araujo [a,b,*], Ana Amélia Cardoso [c,d], Helene J. Polatajko [e], Lívia de Castro Magalhães [a,c]

[a] Rehabilitation Science Graduate Program, Universidade Federal de Minas Gerais (UFMG), Brazil
[b] Occupational Therapy Department, Universidade Federal da Paraíba (UFPB), Health Sciences Center, Cidade Universitária, 58051-900, João Pessoa, PB, Brazil
[c] Occupation Studies Graduate Program, UFMG, Brazil
[d] Occupational Therapy Department, Escola de Educação Física, Fisioterapia e Terapia Ocupacional (UFMG), Av. Antônio Carlos, 6627, Pampulha, 31270-901, Belo Horizonte, MG, Brazil
[e] Occupational Science and Occupational Therapy Department, Rehabilitation Sciences Institute, University of Toronto, 160 – 500 University Avenue, M5G 1V7, Toronto, ON, Canada

ARTICLE INFO

Number of reviews completed is 3

Keywords:
Motor skills disorders
Intervention studies
Family-centered
Occupational therapy

ABSTRACT

Background: Cognitive Orientation to daily Occupational Performance (CO-OP) is recommended for its effectiveness in improving activity performance in children with Developmental Coordination Disorder (DCD). Since parental support is a key element in CO-OP, parental coaching seems relevant to be investigated.
Aims: Compare the efficacy of the CO-OP Approach with and without additional parental coaching to improve activity and participation in children with DCD.
Methods and procedures: Randomized clinical trial with 7–12-years-old children with DCD, randomly assigned to experimental (E-group) or active control (AC-group) groups, with 11 children each. Both groups received traditional CO-OP, E-group received four additional parental group-coaching sessions. Occupational performance and satisfaction on intervention goals were measured at baseline, post-intervention, and follow-up. Participation, motor performance and executive function were assessed at baseline and post-intervention.
Outcomes and results: CO-OP with and without additional parental coaching resulted in improved occupational performance according to children, parents, and external evaluators. Children showed statistically significant gains in motor performance and cognitive flexibility. Participation measures did not change.
Conclusions and implications: As coaching did not add additional gains, parent's required participation in CO-OP might be enough to support children's occupational performance.

* Corresponding author at: Occupational Therapy Department, Universidade Federal da Paraíba (UFPB), Health Sciences Center, Cidade Universitária, 58051-900, João Pessoa, PB, Brazil.
E-mail addresses: clarice.araujo@academico.ufpb.br (C.R.S. Araujo), anaameliacardoso@gmail.com (A.A. Cardoso), h.polatajko@utoronto.ca (H.J. Polatajko), liviacmag@gmail.com (L. de Castro Magalhães).

https://doi.org/10.1016/j.ridd.2021.103862
Received 29 March 2020; Received in revised form 6 December 2020; Accepted 13 January 2021
Available online 25 January 2021

What this paper adds?

CO-OP has been shown as an effective approach to improve children's occupational performance, both in individual and group formats. Although parental participation in therapy is a key element of COOP, very few studies have investigated the influence of the dosage of support given to parents on the children's outcomes. This paper adds evidence to the effectiveness of this approach and shows that additional parental support, by coaching, does not result in gain up above and beyond what is credited to CO-OP. Additionally, we demonstrated that CO-OP improves motor performance and cognitive flexibility in children with DCD.

1. Introduction

Children with developmental coordination disorder (DCD) often have problems performing the childhood activities their peers do with few or no difficulties (American Psychiatric Association, 2013; Blank et al., 2019). Activities like catching ball, bike riding, jumping rope, tying shoelaces or getting dressed present a challenge (Magalhaes, Cardoso, & Missiuna, 2011; Van der Linde et al., 2015), and they might refuse to participate in active play or even physical education due to frustration and repeated failure (Cairney, Kwan, Hay, & Faught, 2012). Emotional problems, low self-esteem, lack of motivation, social isolation and depression bring more concern to their parents (Jasmin, Tétreault, Larivière, & Joly, 2018; Missiuna & Campbell, 2014).

At school, children with DCD frequently struggle with motor-based activities such as handwriting, cutting and pasting and gym activities; at times their difficulties may be interpreted by parents/teachers as a lack of effort. These children are susceptible to poor academic achievement (Blank et al., 2019; Harrowell, Hollén, Lingam, & Emond, 2018), and evidence suggests that their cognitive functions may be altered as well, especially executive functioning (EF) (Leonard, Bernardi, Hill, & Henry, 2015; Wilson et al., 2017). EF are mental processes used by the individual when automated actions are no longer sufficient to perform a task, that includes making changes to complete it, resisting the impulse to do the same acts and to anticipate actions (Diamond, 2013). Cognitive flexibility, inhibitory control and working memory are the foundations of high hierarchical functions, such as reasoning, problem solving and mental planning (Diamond, 2013) conducting cognition and behavior toward a goal (Leonard et al., 2015). Recent research explored the link between motor skills, social and cognitive abilities in children with DCD and found growing evidence that EF is compromised in children with DCD, which may interfere with motor skill acquisition (Bernardi, Leonard, Hill, Botting, & Henry, 2018; Leonard et al., 2015; Wilson et al., 2017). This would suggest that a cognitive approach to motor skill acquisition may be useful for these children.

Evidence supports the use of cognitive-based, activity- or participation-oriented intervention with children with DCD (Blank et al., 2019). The Cognitive Orientation to daily Occupational Performance Approach (CO-OP Approach™) (CO-OP) is such an approach. It is an occupation-centred, goal-oriented intervention that uses metacognitive strategies to promote changes in occupational performance (Polatajko & Mandich, 2004). CO-OP has its foundations in cognitive and motor-learning theories. In CO-OP the focus is on motor skill acquisition through cognitive strategy use; the child learns a problem-solving strategy (Goal-Plan-Do-Check) which elicits the active use of memory, attention and mental planning (Polatajko & Mandich, 2004). The therapist uses mediational techniques and guided discovery to support the child in achieving self-chosen, real-world goals (Goal). Together with the therapist, the child thinks about alternative ways (Plans) to solve identified performance problems, trying out possible solutions (Do) to discover the specific strategies that work best (Check). CO-OP is effective to help children with DCD learn, maintain, and transfer successful strategies (Blank et al., 2019; Smits-Engelsman et al., 2018).

Although CO-OP is highly embedded on higher order cognitive processes like reasoning, problem-solving and mental planning, there are few studies that have examined its effects on EF, none in the area of DCD. This is important to investigate as it would indicate whether CO-OP goes further than task training, and actually promotes changes in cognitive skills.

One of the key elements of CO-OP is to involve significant others (Polatajko & Mandich, 2004). Research shows developing collaborative parent–therapist relationships can promote greater parental self-efficacy, positive parenting, and family well-being, which impacts on children's behavior and functioning (Dunst, Trivette, & Hamby, 2007). CO-OP encourages parents to collaborate with the child on goal setting and, to be present on at least three intervention sessions (Polatajko & Mandich, 2004). However, there is limited evidence regarding parental involvement in CO-OP (Scammell, Bates, Houldin, & Polatajko, 2016), although CO-OP is a client and family-centred approach, there are multiple challenges to parents' engagement in therapy (Power, Russell, Soffer, Blom-Hoffman, & Grim, 2002). Some studies have described limitations to parent's involvement on CO-OP such as restricted areas to practice goals at home, conflicts with the child, difficulties guiding discovery and lack of time to implement strategy use at home (Capistran & Martini, 2016). Nonetheless evidence on better strategies to facilitate parents' involvement is beginning to emerge (Araújo, Cardoso, & Magalhães, 2019; Cameron, Capistran, Edwards, Hunt, & Martini, 2017; Capistran & Martini, 2016; Chan, 2007; Missiuna et al., 2010), but research is still limited (Scammell et al., 2016).

Given the importance of parent involvement we undertook to develop and investigate an approach to build parents' capacity to manage children's occupational performance problems. We drew on Occupational Performance Coaching (OPC) developed by Graham and Rodger (2010). OPC is a coaching approach designed to build parents' capacity to manage children's occupational performance problems. OPC is based on enablement principles, family-centred and occupation-based practices and focuses on three enabling domains: emotional support, information exchange, and structured process (Graham & Rodger, 2010). Evidence about the effectiveness of OPC is beginning to emerge and it shows promising results in improving mothers' and children's occupational performance self-competence (Graham, Rodger, & Ziviani, 2013; Graham & Rodger, 2010). OPC may be a reasonable strategy to boost parents' engagement in their child's occupational therapy. In this study we investigated if the addition of OPC, delivered to groups of parents, would result in greater improvements on primary and secondary outcomes in CO-OP.

The aims of this study were to investigate: (1) whether adding parental coaching to CO-OP results in additional improvements in goal achievement, participation, motor performance, and executive functions in children with DCD; (2) whether these children achieve clinically and statistically significant changes on the same outcomes.

2. Method

The study was approved by the Ethics Committee of the Universidade Federal de Minas Gerais/Brazil (UFMG) (Protocol number 1.520.296). The trial was registered (ClinicalTrials.gov-NCT02893852). The study was conducted at the University's Occupational Therapy Clinic (IDEA), a non-for-profit service for children. Prior to entering the study, written consent from parents and assent from the children were obtained. The first author, an experienced occupational therapist trained on CO-OP, was responsible for all intervention procedures.

2.1. Trial design and sample size

A randomized controlled trial (RCT) with an add-on component with allocation ratio 1:1 was conducted. Sample size was estimated with the software G*Power using data from Miller, Polatajko, Missiuna, Mandich, and Macnab (2001). A sample of 11 children per group would be needed to detect clinically relevant differences between intervention and control groups in one of the primary outcome measures (two points on the Canadian Occupational Performance Measure – COPM performance ratings), with an α value of 5% and power of 80 %, accounting for a 20 % dropout rate.

Twenty-two participants were recruited, each participant was randomized into either the active control group (CO-OP-group), which received traditional CO-OP, or to the experimental group (CO-OP + P-group), which received CO-OP with the addition of coaching sessions in groups for parents. It should be noted that the RCT design refers to the addition of parental coaching while the overall effectiveness of CO-OP was investigated with a pre-post design.

2.2. Participants

Inclusion criteria were based on the diagnostic criteria for DCD (American Psychiatric Association, 2013): (1) ages 7–12 years old; (2) motor skills substantially below age expectation, as expressed by scoring below the 15th percentile on the Movement Assessment Battery for Children Second Edition (MABC-2) (Henderson, Sugden, & Barnett, 2007); (3) motor deficits interfering with activities of daily living, or school productivity or play, as reported by parents on the Developmental Coordination Disorder Questionnaire-Brazilian version (DCDQ-Brazil) (Prado, Magalhães, & Wilson, 2009); (4) motor skills problems had been noticed in the early developmental period according to parents report; (5) no evidence of intellectual disability, as expressed by total IQ $\geq$ 70 on the Wechsler Intelligence Scale for Children Fourth Edition - Brazilian Version (WISC-IV) (Wechsler, 2013).

Children with DCD may present associated conditions (Goulardins et al., 2015; Missiuna & Campbell, 2014), thus we conducted screening for attention and emotional problems. We assessed for signs of inattention and/or hyperactivity (ADHD) with the Swanson, Nolan and Phelham (SNAP-IV) - Brazilian version (Mattos, Pinheiro, Rohde, & Pinto, 2006); for behaviour and anxiety/depression issues with the Child Behavior Checklist (CBCL) (Bordin, Mari, & Caeiro, 1995), for self-perception with the Self-Perception Profile for Childre colleaguesn (SPPC) (Valentini, Villwock, Vieira, Vieira, & Barbosa, 2010). It is also essential to know more about parents, as parenting styles influence the way they raise their children (Darling & Steinberg, 1993) and parents' characteristics can plausibly influence treatment outcomes (Kazdin & Nock, 2003). Parents answered the Criteria of Economic Classification (CCEB) (Brasil, 2014) which categorizes families in three classes: high, medium, and low income. The main caregiver answered the Parental Style Inventory (IEP) (Gomide, 2006) to identify positive and/or negative parental practices. IEP consists of 42 statements representing how the parent would react to different situations, with possible answers: "I never (in zero to two out of 10 times; score zero)/ sometimes (in three to seven out of 10 times; score 1)/ always (in eight to ten out of 10 times; score 2) would react like this". Final IEP percentile indicates: 75-99th = optimal parenting style; 55-70th = good above average; 30-50th = good below average; percentile < 25th = vulnerable (risk) parenting style.

Children who had any diagnostic condition interfering with motor performance [e.g. visual impairment, autism spectrum disorder (ASD), neuromuscular conditions] or negatively affecting the child's behavior [co-occurrence with oppositional defiant disorder (ODD)] were excluded. Children with ADHD or signs of the disorder in co-occurrence with DCD were included, as with support, they are able to collaborate with the therapist and these children have been included in other CO-OP studies (Polatajko & Mandich, 2004). Based on the experience of our previous CO-OP study, children with ODD may benefit better from psychological/behavioural approaches.

Children chose therapy goals using the Perceived Efficacy and Goal Setting System (PEGS) (Missiuna, Pollock, & Law, 2004). PEGS is a client-centred interview in which children can talk about their performance competence in a range of daily activities, and then summarize three to four activities they want to be the focus of therapy (Missiuna et al., 2004; Ruggio, Missiuna, Costa, Araújo, & Magalhães, 2018).

2.3. Outcome measures and procedures

Participants were recruited by active search of IDEA's waiting list (children referred due to suspected neurodevelopmental disabilities), e-mails, invitations to primary schools and rehabilitation clinics, advertisements in social medias. Potential participants were

screened for eligibility. Children not included were referred to appropriate treatment facilities.

Following screening and prior to full baseline assessment, participants were randomized to group by a computer random number generator (randomization.com: seed 26513). Children were given a number by the research assistant as they fulfilled inclusion criteria, and they were immediately matched with the randomization sequence sealed and stored in the laboratory. Blinding of subjects and therapist was not possible due to the nature of the treatment.

2.3.1. Primary outcome measures

Perceived occupational performance and satisfaction with performance was measured using the 10-point scoring system of the COPM (1 = not able to do; not at all satisfied to 10 = to do extremely well; extremely satisfied) (Law et al., 2009). COPM's test-retest reliability varies from 0.84 to 0.92 (Law et al., 2009). The final score is the mean of performance on the chosen goals trained in therapy and the mean satisfaction with performance; a 2-point change is considered clinically relevant. COPM was used at baseline (T_1), post-intervention (T_2) and at follow-up (T_3). We adapted the scoring system to make it easier for children (i.e., performance = ladder with steps numbered 1–10 and satisfaction = Graded with sad to happy faces) (Araújo et al., 2019; Law et al., 2009). Children and parents rated performance and satisfaction apart from each other with the main investigator.

Actual occupational performance was measured using the Performance Quality Rating Scale - Generic (PQRS-G) (Polatajko & Mandich, 2004) PQRS-G is a 10-point scale observational measure (1 indicating "can't do the skill at all'' and 10 indicating "does the skill very well'') with moderate inter-rater reliability (ICC 0.71 to 0.77) (Martini, Rios, Polatajko, Wolf, & McEwen, 2015). We used video performances to apply the PQRS. Minimal detectable change or smallest real difference (SRD) with children varies from 2.13 to 2.91, (i.e. three-point change is needed to be 95 % sure that the change is real and not due to a measurement error) (Martini et al., 2015). Five blind external evaluators (occupational therapists) previously trained (ICC = 0.963) scored PQRS-G at T_1, T_2 and T_3, through video analysis of children performing the goals at pre, post and, at 3-month follow-up. The final score is the mean of performance on the goals trained in therapy. Videoclips samples were organized by the research assistants on a random sequence to mask for timeline.

Participation was measured using the Participation and Environment Measure for Children and Youth (PEM-CY) (Coster, Law, Bedell, & Teplicky, 2010), a parent-report measure of participation for 5−17-year-olds, with and without disabilities, embeded in the International Classificaition of Fucntioning - ICF framework (WHO, 2007). PEM-CY measures participation frequency, level of involvement, and desire for change in 25 activities at home (household shores), school (classroom activities), and community (neighborhood outings). Parents can describe environmental factors affecting participation (physical characteristics, relationships, equipment). It has moderate to good psychometric properties (α = 0.59 a 0.91; ICC = 0.58 a 0.95) (Coster et al., 2011). Participation frequency has two summary scores: (1) frequency of engagement in activities in that setting on an 8-point Likert scale (0 = never to 7 = daily) - the sum of all ratings divided by number of ratings, with highest scores representing greater frequency across activities; (2) range of activities the child participates - number of items divided by total number of items rated (Coster et al., 2011). Level of involvement is the extent in which the child is engaged in the activities on a 5-point Likert scale (1 = minimally involved to 5 = very involved) – the average of all items. Summary scores do not considerer items rated 'never' (Coster et al., 2011). Parents answered the home and community domains at T_1 and T_2. In some cases, research assistants did it via interview because parents found PEM-CY difficult to complete. We excluded the school section from the analysis as most of the parents had difficulties to answer about classroom activities like group work and discussions, team sports, getting together with peers, special roles.

Transfer of skills. The term transfer is used in a variety of ways in the literature. Here we use it to refer to prior learning being applied to new skills in different contexts or "*previous learning being applied to new skills, to new contexts or both*" (Houldin, McEwen, Howell, & Polatajko, 2018, p. 2). Children were encouraged to choose an extra goal with PEGS. The same procedure to score occupational performance and satisfaction using COPM 10-point scoring system were applied to children and parents. External evaluators rated occupational performance with PQRS-G through video analysis, a procedure that has been used in other studies (Dawson et al., 2009; McEwen, Polatajko, Huijbregts, & Ryan, 2009).

2.3.2. Secondary outcome measures

Motor performance was measured using the MABC-2 (Henderson et al., 2007). The MABC-2, is a motor performance test in which the child does eight tasks within the domains of manual dexterity, aiming and catching and balance, and higher scores represent better performance. Total test (total impairment), standard scores and percentile ranks are obtained in MABC-2. According to cut-off scores, a percentile ≤ 5 indicate the child is very like to have significant motor difficulties, a percentile between 6th to 15th indicates the child is "at risk of having a movement difficulty" (Henderson et al., 2007). It has evidence of validity, test–retest reliability (r = 0.80) and has been translated to Brazilian Portuguese (α = 0.78; ICC = 0.86 to 0.99) (Valentini, Ramalho, & Oliveira, 2014). In this study, MABC-2 total test scores and percentiles were obtained at T_1 and T_2 by two blind trained external examiners. A change above four on total test score was taken as significant clinical change (Green, Chambers, & Sugden, 2008; Henderson et al., 2007).

Cognitive flexibility and inhibitory control were measured using the Five Digits Test - Brazilian version (FDT) (Sedó, de Paula, & Malloy-Diniz, 2015) which evaluates the processing speed for executive functioning of clients with different ages, educational and cultural backgrounds. It requires minimal linguistic knowledge to evaluate the ability to stop paying attention to some information or to suppress responses (inhibition), and the ability to switch between multiple task sets (flexibility). FDT has four parts: reading, counting, choosing (selective attention), and switching (alternate attention). Parts 1 and 2 involve automatic processes (reading and counting), the child is required to read Arabic algorisms 1–5, and count (quantities from one-to-five) (Paiva, Fialho, Costa, & Paula, 2016). Part 3 (choosing) involves interference control since an automatic numerical transcoding (naming - transform a number in digital to the oral verbal format) has to be inhibited in favor of a controlled one (to count digits that not represent the set cardinality)

(stimulus = "1,1,1" and response ="three"). Part 4 (shifting) involves a set-shift from rules of Part 1 to Part 3 and vice-versa (Paiva et al., 2016). FDT provides executive scores in percentile indexes of inhibition (choosing – reading) and cognitive flexibility (shifting – reading). It has acceptable internal consistency (0.89−0.95) and test-retest reliability (0.59−0.95) (Sedó et al., 2015).

Mental planning was measured using the Tower of London test (TOL) (Anderson, Anderson, & Lajoie, 1996; Shallice, 1982) which measures mental planning and problem-solving skills. The child must move three colored balls according to different to patterns using a minimum number of moves, following pre-determined rules. Each problem solved at the first attempt scores three points, two points at the second try, one point in the third, and zero if not solved. Raw scores and solution time were computed. Clinimetric properties of TOL are still being investigated, but test-retest reliability coefficient of the TOL total move score is within moderate to high range ($r > 0.81$), considering children with and without ADHD (Culbertson & Zillmer, 1998). A psychologist blind to group allocation assessed the children on FDT and TOL at T_1 and T_2. Standard error of measurement was not determined for FDT and TOL.

2.4. Intervention

Each child was encouraged to choose four goals using the PEGS (Missiuna et al., 2004), Brazilian version, (Ruggio et al., 2018) (Additional file 1: Table S1). Three of four goals were trained during the intervention, while the fourth goal (transfer goal) was not. After goal setting, the COPM (Law et al., 2009) 10-point score system was used to rate performance and satisfaction. All children were videotaped performing the chosen tasks to establish baseline data.

2.4.1. Cognitive Orientation to daily Occupational Performance Approach^{TM} (CO-OP)

Children in both groups received 12, 60-minute, CO-OP sessions (10 intervention session and two before and after assessment sessions), one or two sessions weekly. Sessions were videotaped and scored by a clinician with experience on CO-OP, obtaining a fidelity index (McEwen, Polatajko, Wolf, & Baum, 2012) of 4.6 out of 5 points, indicating good fidelity to CO-OP procedures.

In the first session the child learned the global strategy Goal-Plan-Do-Check (GPDC, i.e. global strategy) and then, child, therapist and parents worked on skill acquisition and strategy use to find solutions to performance problems (Polatajko & Mandich, 2004). At the end of each session, we discussed homework (to practice one or more goals at home, school, or community using the global and specific strategies, i.e. bike riding with parents at the square near home, to write a story about her/his favorite cartoon characters, to practice the fourth/transfer goals) to stimulate strategy use at home and other contexts and foster generalization and transfer. Parents were constantly reminded about the transfer goal and encouraged to work on it with their child. They were also asked to send videos or messages about homework completion. Parents of both groups were asked to be present in at least eight out of ten intervention sessions, and they received a booklet with information on how to implement cognitive strategies use and guided discovery at home.

2.4.2. Parental coaching in groups

Parents of children in the CO-OP + P-group received four extra 60 min coaching sessions, in groups with a minimum of four participants, every other week along with CO-OP. The OPC protocol combines performance analysis frameworks of live performance (observation of activities in natural context) with coaching techniques to engage parents in collaborative and goal specific conversations to identify enablers and barriers to their child's successful performance (Graham & Rodger, 2010). Sessions were videotaped and revised for accuracy of the proposed protocol by analysing the adherence to the original protocol (Graham & Rodger, 2010).

2.5. Data analysis

Normality was checked by visual inspection of boxplots. Fisher's exact test (qualitative variables) and Mann-Whitney test (quantitative variables) were used to check for homogeneity between groups regarding demographics, attribute (age, sex, perceived efficacy, signs of ADHDDHA and depression/anxiety, socioeconomic status, parenting style, and parents' education, total IQ, DCDQ) and outcome variables (COPM, PQRS-G, PEM-CY, FDT and TOL) at baseline.

Before conducting the analysis of intervention effects, we opted for creating indexes from (PEM-CY - frequency of participation and level of involvement), FDT (inhibition and cognitive flexibility) and TOL (total score and time of execution). Since each construct has one or more underlying dimensions, indexes can be more statistically manageable (Portney & Watkins, 2015). The indexes were computed using exploratory factor analysis with the method of extracting the main components and varimax rotation (Mingoti, 2005). The use of factor analysis was adequate according to the Kaiser-Meyer-Olki sample adequacy measure (KMO > 0.50). All PEM-CY, FDT and TOL variables were considered relevant in the construction of the indexes, since they had a factor load greater than 0.50 (Hair, Black, Babin, Anderson, & Tatham, 2009). The quality and validity of the indexes (Participation - Home and Community Indexes, FDT Index and TOL Index) were ensured (convergent validation AVE > 0.40), and they had adequate reliability (Cronbach's $\alpha > 0.60$ or C. R. > 0.60).

The effects of the interventions on primary and secondary outcomes within and between-groups were analyzed by Generalized Estimating Equations (GEE) (Liang & Zeger, 1986). GEE is an extension of Generalized Linear Models (GLM) for longitudinal data (McCullagh & Nelder, 1989). GEE accounts for correlation of responses within subject for response variables not normally distributed. The method produces efficient and unbiased regression estimates to be used when analyzing longitudinal or repeated measures research designs with non-normal response variables (Ballinger, 2004). For each outcome variable, we estimated the effect of belonging to either CO-OP + P-group or CO-OP-group, time elapsed since T_1, T_2 and T_3, and the interaction of these two factors, to assess possible differences. All analyses were corrected for age. All the data were analyzed based on the intention-to-treat principle (last observation carried forward) to address drop-out cases.

Cohen's *d* was used to measure effect size (d <0.20 = very small, 0.20 <d> 0.50 = small, 0.50 <d> 0.80 = medium effect size, d> 0.80 = large). Data were analyzed with R (version 3.5.0). Results were described according to CONSORT (Consolidated Standards of Reporting Trials) statement (Schulz, Altman, & Moher, 2010).

3. Results

Participants were 22 children (4 girls, 2 in each group) mean age 8.96 (±1.09), randomized into two intervention groups, as shown in Fig. 1. Sixteen children had signs of ADHD (8 per group), 10 children had signs of anxiety/depression (5 per group). Nineteen parents had either completed high school, were attending university, or had graduated from university. There was a statistically significant between-group difference for age (p = .03) (Table 1). Recruitment ran from May/2016 to April/2017, intervention started on October/2016, finished August/2017, with last follow-up in November/2017. In the CO-OP+P-group, one child dropped out during intervention and another one was lost to follow-up. In the CO-OP-group one child was lost to follow-up (Fig.1).

3.1. Within-group differences at T_2 and T_3

At T_2, CO-OP + P-group and CO-OP-group presented statistically significant differences on occupational performance (COPM-P children and parents and PQRS-G), satisfaction (COPM-S children and parents) and motor performance (MABC-2) on both trained and transfer goals. Additionally, large effect sizes were detected for occupational performance and satisfaction, and medium effect size for motor performance. The CO-OP-group achieved a statistically significant difference in FDT index (p = .001; d = .67). No within-group differences were found in participation Home and Community indexes and in TOL index (Table 2).

At T_3, CO-OP-group achieved statistically significant changes on COPM-Performance scores when compared to T_2 (p = .001 d = .79) on trained goals. On transfer goals, the CO-OP-group also had statistically significant changes on COPM-Performance for parents

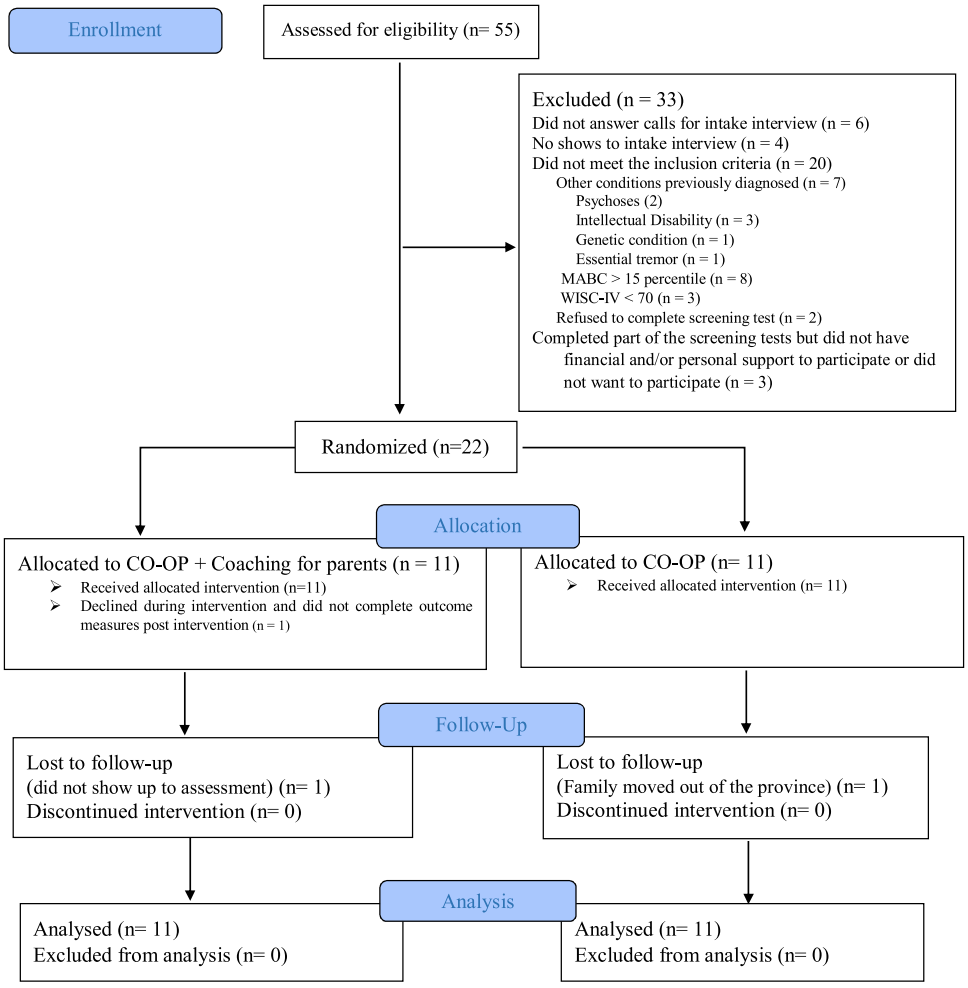

Fig. 1. CONSORT flow diagram displaying participants' recruitment and analysis (Schulz et al., 2010).

Table 1
Participant characteristics at baseline.

Variables / Group	CO-OP + P-group *mean* (SD)	CO-OP-group *mean* (SD)	p[1]
Age (years)	8.46 (1.04)	9.46 (.93)	**.03***
Socioeconomic status			
High	2	1	
Middle	5	8	.48
Low	4	2	
Parenting Style			
Vulnerable	3	2	
Regular	1	4	.49
Good	5	2	
Ótimo	2	3	
Perceived efficacy (PEGS)	75.18 (12.34)	73.55 (9.74)	.66
WISC-IV (Total IQ)	103.09 (11.89)	91.82 (15.37)	.07
DCDQ (Total score)	37.55 (9.85)	42.64 (17.19)	.53
MABC-2 (Percentile)	3.96 (2.55)	2.91 (2.73)	.32
MABC-2 (Total score)	48.46 (7.82)	45.73 (8.13)	.39
FDT Inhibition	45 (26.46)	33.18 (36.83)	.21
FDT Flexibility	56.5 (32.58)	35.46 (33.05)	.14
TOL (Total score)	31 (2.06)	30.09 (2.07)	.41
TOL (Execution time in seconds)	301.2 (91.68)	315.73 (107.62)	.72
COPM–Performance *Trained Goals*			
Children	3.08 (.98)	3.46 (1.32)	.42
Parents	3.21 (1.13)	3.71 (1.52)	.50
COPM–Performance *Transfer Goals*			
Children	3.1 (1.66)	3.2 (1.55)	.93
Parents	3.9 (1.97)	4.0 (1.94)	.93
COPM–Satisfaction *Trained Goals*			
Children	4.16 (1.62)	3.89 (1.29)	.76
Parents	2.96 (1.51)	3.45 (1.93)	.66
COPM–Satisfaction *Transfer Goals*			
Children	3.4 (2.37)	3.3 (1.83)	1.0
Parents	3.6 (2.12)	3.5 (2.68)	.75
PQRS-G *Trained goals*	5.32 (1.72)	6.1 (1.54)	.27
PQRS-G *Transfer goals*	6.2 (3.01)	6.3 (2.67)	.78
PEM-CY (Home)			
Frequency	87.28 (7.07)	84.79 (7.37)	.34
Number of activities (%)	92.73 (6.47)	96.36 (6.74)	.15
Involvement	4.15 (.89)	3.64 (.78)	.35
PEM-CY (Community)			
Frequency	56.77 (10.53)	57.65 (10.52)	.66
Number of activities (%)	63.64 (12.86)	68.18 (16.01)	.40
Involvement	3.99 (.73)	3.9 (.76)	.79

[1] Mann-Whitney test except for Socioeconomic status and Parenting Style (Fisher's Exact test). PEGS: Perceived Efficacy and Goal Setting System; WISC-IV: Wechsler Intelligence Scale for Children Fourth Edition; DCDQ: Developmental Coordination Disorder Questionnaire; MABC-2: Movement Assessment Battery for Children Second Edition; Five Digits Test; Tower of London test; COPM: Canadian Occupational Performance Measure; PQRS-G: Performance Quality Rating Scale-Generic; PEM-CY: Participation and Environment Measure-child and youth; SD: standard deviation.
* $p < .05$.

($p = .005$ $d = .64$), and on PQRS-G ($p = .001$ $d = 1.23$). Overall, the two groups maintained improvements on occupational performance and satisfaction on T_3 (Table 2).

Regarding clinically relevant changes at T_2, CO-OP-group and CO-OP + P-group achieved clinically relevant changes for trained and transfer goals on COPM (performance and satisfaction for children and parents). CO-OP + P-group achieved the smallest real difference (SRD) on PQRS-G score (3.52-point difference) for transfer goals. Both groups achieved clinically relevant changes on motor performance (CO-OP-group = 6.64; CO-OP + P-group = 7.78) (Table 2).

3.2. Between-group differences at T_2 and T_3

There was not a statistically significant difference between groups on primary and secondary outcomes for the trained goals at T_2, except for children's satisfaction (COPM-S) in favor of CO-OP + P-group ($p = .01$; $d = .79$). There was a statistically significant difference between groups on PQRS-G ($p = .02$; $d = 1.15$) for transfer goals at T_3 in favor of the CO-OP-group (Table 3).

3.2.1. Compliance to treatment

Parents participated in eight traditional CO-OP intervention sessions on average (minimum = 3; maximum = 10). Parents of 10 children participated in all 10 intervention sessions, parents of 8 children participated in 6–8 sessions, and four parents were present in

Table 2
Within-group differences at T_2 and T_3 – Intention-to-treat GEE intervention effects.

	CO-OP-group				CO-OP + P-group			
Outcome measure	β (E.P.β)	I.C.−95%	p	Cohen's d	β (E.P.β)	I.C.−95%	p	Cohen's d
Trained goals								
COPM-P children								
T2-T1	4.91 (0.45)	[4.02; 5.8]	**.001***	3.97	5.68 (0.47)	[4.76; 6.6]	**.001***	6.15
T3-T2	.79 (0.21)	[.38; 1.21]	**.001***	.79	−.04 (0.31)	[−.65; .56]	.884	.01
COPM-P parents								
T2-T1	4.2 (.6)	[3.03; 5.37]	**.001***	2.64	4.61 (.34)	[3.95; 5.27]	**.001***	4.06
T3-T2	.23 (.31)	[−.37; .83]	.461	.12	.01 (.30)	[−.59; .61]	.975	.09
COPM-S children								
T2-T1	5.05 (.35)	[4.37; 5.72]	**.001***	4.92	5.32 (0.54)	[4.27; 6.37]	**.001***	4.06
T3-T2	.35 (.24)	[.13; .82]	.149	.52	−.01 (0.26)	[−.53; .51]	.962	.05
COPM-S parents								
T2-T1	5.07 (.59)	[3.92; 6.22]	**.001***	3.00	5.5 (.53)	[4.47; 6.53]	**.001***	3.63
T3-T2	−0.08 (.43)	[−.93; .77]	.856	.05	.01 (.34)	[−.66; .68]	.981	.03
PQRS-G								
T2-T1	2.65 (.55)	[1.59; 3.72]	**.001***	2.16	3.52 (0.51)	[2.52; 4.52]	**.001***	2.78
T3-T2	0.26 (.28)	[−.28; 0.8]	.340	.31	.21 (0.16)	[−.1; 0.52]	.178	.36
Transfer goals								
COPM-P children								
T2-T1	5.20 (.51)	[4.21; 6.19]	**.001***	3.49	5.03 (0.79)	[3.49; 6.58]	**.001***	2.76
T3-T2	.56 (.45)	[−.33; 1.45]	.216	.35	.26 (0.45)	[−.63; 1.15]	.569	.16
COPM-P parents								
T2-T1	3.00 (.63)	[1.76; 4.24]	**.001***	1.46	3.55 (.44)	[2.7; 4.4]	**.001***	1.87
T3-T2	1.39 (.5)	[.41; 2.37]	**.005***	.64	.40 (.26)	[−.11; .92]	.126	.1
COPM-S children								
T2-T1	5.00 (0.6)	[3.82; 6.18]	**.001***	2.83	5.54 (.9)	[3.77; 7.31]	**.001***	2.79
T3-T2	.75 (0.46)	[−.16; 1.65]	.106	.44	.21 (.51)	[−.79; 1.22]	.678	.2
COPM-S parents								
T2-T1	4.80 (1.02)	[2.81; 6.79]	**.001***	2.12	4.71 (.60)	[3.53; 5.89]	**.001***	2.4
T3-T2	.57 (.51)	[−.42; 1.56]	.261	.24	−.08 (.37)	[−.81; .66]	.833	.12
PQRS-G								
T2-T1	2.7 (.88)	[.97; 4.43]	**.002***	1.35	2.78 (.78)	[1.25; 4.3]	**.001***	1.19
T3-T2	.83 (.26)	[.33; 1.33]	**.001***	1.23	.05 (.3)	[−.53; .63]	.863	.00
PEM-CY								
Home Index								
T2-T1	1.6 (.99)	[−.33; 3.54]	.104	.38	.44 (.74)	[−1.02; 1.89]	.557	.32
Community Index								
T2-T1	.87 (1.47)	[−2.01; 3.76]	.552	.12	−1.26 (2.22)	[−5.62; 3.09]	.569	.22
MABC-2 Total								
T2-T1	6.64 (3.2)	[.37; 12.9]	**.038***	.57	7.78 (3.25)	[1.41; 14.15]	**.017***	.75
FDT Index								
T2-T1	21.4 (4.61)	[12.36; 30.44]	**.001***	.67	8.5 (9.7)	[−10.51; 27.51]	.381	.31
TOL Index								
T2-T1	9.41 (20.90)	[−31.55; 50.37]	.652	.20	9.2 (13.5)	[−17.26; 35.66]	.496	.22

GEE = Generalized Estimating Equations; COPM-P: Canadian Occupational Performance Measure performance score; COPM-S: Canadian Occupational Performance Measure satisfaction score; PQRS-G: Performance Quality Rating Scale-Generic; PEM-CY: Participation and Environment Measure-child and youth; MABC-2: Movement Assessment Battery for children Second Edition; FDT: Five Digits Test; TOL: Tower of London.
* $p < .05$.

five sessions or less. Parents in CO-OP + P-group (n = 11) participated on average in three out of four extra coaching sessions (one mother attended only one session; while six parents - mother, father, or both - were present in all).

Children collaborated during all procedures, except for one child with signs of disruptive behavior (CO-OP + P-group). He refused to complete the intervention protocol and to complete final assessments. In the meantime, he was diagnosed with oppositional deviant disorder (ODD) by a physician.

4. Discussion

This study was the first randomized controlled trial that investigated whether a coaching group for parents in addition to traditional CO-OP would result in better outcomes for children with DCD. This study also aimed to investigate changes on cognitive flexibility, inhibition, and mental planning after an occupation-based intervention. Additional parental coaching in groups did not result in superior gains in occupational performance, participation, motor performance and executive functioning and mental planning for children with DCD. Our study suggests that the addition of coaching groups to CO-OP is not necessary if parents are sufficiently engaged and willing to cooperate. It must be noted that most parents were characterized as having good to optimal parenting style, i.e., they have positive parental practices, possibly influencing their involvement in their child's therapy process (Kazdin & Nock, 2003).

Table 3
Time-Group interaction -Intention-to-treat GEE intervention effects.

CO-OP + P-group - CO-OP-group					
	β	E.P.(β)	I.C.−95%	*p*	Cohen's *d*
COPM-P Children					
T_1	−.23	.45	[−1.11; .65]	.6	.17
T_2	.54	.43	[−.3; 1.38]	.2	.53
T_3	−.3	.33	[−.94; .35]	.36	.25
COPM-P Parents					
T_1	−.77	.4	[−1.55; .01]	.05	.37
T_2	−.36	.44	[−1.22; .49]	.40	.07
T_3	−.58	.37	[−1.31; .15]	.12	.14
COPM-S Children					
T_1	.33	.57	[−.78; 1.45]	.55	.19
T_2	.61	.26	[.11; 1.11]	**.01***	.79
T_3	.25	.26	[−.27; .76]	.34	.30
COPM-S Parents					
T_1	−.5	.57	[−1.61; .61]	.37	.23
T_2	−.07	.36	[−.78; .63]	.83	.01
T_3	.01	.37	[−.71; .74]	.97	.03
PQRS-G					
T_1	−.85	.56	[−1.95; .26]	.13	.4
T_2	.02	.28	[−.52; .56]	.94	.34
T_3	−.03	.36	[−.74; .67]	.93	.21
COPM-P Children transfer goals					
T_1	−.1	.68	[−1.44; 1.24]	.88	.06
T_2	−.27	.78	[−1.79; 1.26]	.73	.1
T_3	−.57	.62	[−1.78; .64]	.35	.28
COPM-P Parents transfer goals					
T_1	−.1	.83	[−1.73; 1.53]	.9	.05
T_2	.45	.84	[−1.2; 2.1]	.59	.22
T_3	−.54	.74	[−2; .92]	.47	.36
COPM-S Children transfer goals					
T_1	.10	.9	[−1.66; 1.86]	.91	.05
T_2	.64	.7	[−.73; 2.01]	.35	.43
T_3	.11	.53	[−.93; 1.15]	.83	.21
COPM-S Parents transfer goals					
T_1	.1	1.02	[−1.91; 2.11]	.92	.04
T_2	.01	.77	[−1.49; 1.51]	.99	.02
T_3	−.64	.83	[−2.27; 0.99]	.44	.34
PQRS-G transfer goals					
T_1	−.1	1.21	[−2.47; 2.27]	.93	.04
T_2	−.02	.47	[−,95;, 9]	.95	.0
T_3	−.81	.36	[−152; -,1]	**.02***	1.15
PEM-CY Home					
T_1	.26	1.41	[−2.51; 3.02]	.85	.07
T_2	−.91	1.36	[−3.58; 1.75]	.5	.2
PEM-CY Community					
T_1	−1.74	2.71	[−7.05; 3.57]	.52	.26
T_2	−3.88	3.33	[−10.41; 2.65]	.24	.53
MABC-2					
T_1	1.29	2.91	[−4.42; 7]	.65	.34
T_2	2.43	3.69	[−4.8; 9.66]	.51	.33
FDT Index					
T_1	5.61	9.42	[−12.85; 24.07]	.55	.54
T_2	−7.25	9.8	[−26.46; 11.96]	.46	.12
TOL Index					
T_1	7.72	20.9	[−33.24; 48.68]	.71	.15
T_2	7.51	15.6	[−23.07; 38.09]	.63	.20

GEE = Generalized Estimating Equations; COPM-P: Canadian Occupational Performance Measure performance score; COPM-S: Canadian Occupational Performance Measure satisfaction score; PQRS-G: Performance Quality Rating Scale-Generic; PEM-CY: Participation and Environment Measure-child and youth; MABC-2: Movement Assessment Battery for children Second Edition; FDT: Five Digits Test; TOL: Tower of London.

* $p < .05$.

Parental and significant other involvement is one of the key features of CO-OP, but the original protocol suggests that parents or caregivers participate in at least three sessions, while in this study, all parents participated on average in eight CO-OP intervention sessions. They also had additional information on how to implement cognitive strategy use and guided discovery at home. All parents had more opportunities to participate with their children and the therapist. They received the booklet with more information and they had more opportunities to collaborate with the therapist. However, even though parents of the CO-OP + P-group had four extra

sessions, overall, this addition did not result in better outcomes for their children.

The detailed description of limitations to parent's involvement on CO-OP and to the implementation of cognitive strategies at home (Capistran & Martini, 2016) are documented more consistently (Cameron et al., 2017) and can help clinicians and researchers to overcome barriers and to propose strategies to improve participation. Based on our previous studies in Brazil, we noticed that parents needed more information about family-centred practices, occupation-based approaches, and guided discovery (Araújo et al., 2019).

In the present study, the following strategies seemed to have contributed to parents' engagement: (1) to keep in constant touch with families (using technology, apps), (2) to share ideas and possibilities for homework on how, where, and when to do different kinds of homework, fitting into the family's routine. Parents were constantly reminded about the booklet (3) and how it could help manage strategy use and guided discovery in other contexts; (4) we also shared videos and messages to remember about homework's completion.

The CO-OP + P-group had higher satisfaction with their changes on trained goals post-intervention a fact that shed light on OPC components that focus on emotional support and collaborative performance analysis with parents, which could possibly influenced the way they perceived their child's and their own occupational issues and challenges. In previous studies with OPC, mothers reported experiencing changes in the way they generally interacted with their children as they gain a calmer internal state in themselves (Graham, Rodger, & Ziviani, 2014). In a study about the perceptions of the impact of OPC, mothers referred to insights gained about themselves and their children that went beyond the learning of skills and strategies, which reflected in changes in their attitudes, beliefs, and assumptions about their support for their children (Graham et al., 2014; Graham & Rodger, 2010). In the present study, coaching sessions based on OPC might provide insights on how parents could deal with their children and their own, reflecting in increased motivation, self-perception, and satisfaction in their children about how they perform everyday activities.

Evidence supports that collaborative interventions are central to family-centred service delivery (An et al., 2019), though multiple challenges can interfere on how parents engage in the process (Power et al., 2002). Families values and routines must be considered when planning interventions and expecting parents to become engaged. Engagement is an important construct that need to be understood as a component of effective service delivery i.e., "*engagement is not simply a state of participation, it is a fluid internal state influenced by individual and contextual factors*" (D'Arigo, Ziviani, Poulsen, Copley, & King, 2017), p. 3). Therapist need to be aware that engagement involves affective (emotional connection), behavioral (in-session participation, collaboration, and self-efficacy) and cognitive (beliefs, perceived need and effectiveness for therapy) elements (D'Arigo et al., 2017). Future studies on CO-OP should consider parents' or significant others *engagement*, not only presence, to find strategies to keep improving its effectiveness with diverse people in diverse contexts.

The CO-OP-group had better occupational performance on transfer goals (PQRS-G) at T_3 compared to CO-OP + P-group according to external evaluation. We expected changes for both groups. We may speculate that given the CO-OP-group results on within-group analysis on the same outcome, and that also CO-OP-group had better outcomes on FDT index, improved cognitive flexibility and inhibition influenced performance at T_3. This is a possibility that must be further investigated with caution.

Because CO-OP is strongly based on cognitive elements, it was important to investigate effects on cognitive flexibility, inhibitory control, and mental planning of children with DCD. Although there were no changes on TOL index, FDT index demonstrated statistically significant differences in cognitive flexibility and inhibitory control on the CO-OP-group at T_2. One study investigated the effects of a ball skill intervention for children with seven to eleven years old with learning disabilities on executive functioning (cognitive flexibility and mental planning using TOL) and they found no effects on the cognitive parameters but they reported a correlation between the changes in ball skills and the changes on the TOL performance (Westendorp et al., 2014). There is a need for more studies to investigate the mechanisms of change in cognitive-based interventions for children with DCD.

Overall, the analysis of within-group differences showed clinically relevant and statistically significant changes on occupational performance for all goals, and motor performance, in both groups at T_2. For children and parents, changes on occupational performance and satisfaction were statistically significant and clinically relevant, and gains were maintained at T_3. As in other studies, children with DCD were able to use global strategies to solve performance problems and to select specific strategies that would lead to success in the activity performance (Miller et al., 2001; Thornton et al., 2016; Zwicker et al., 2015). This study advances by showing significant gains in motor performance (MABC-2) in children with DCD after intervention with the CO-OP approach.

We found no changes within-group and no differences between-group on participation. In recent studies of the effectiveness of CO-OP, researchers used different instruments to assess participation pre-post intervention. Thornton et al. (2016) used COPM and Goal Attainment Scale (GAS) as participation measures. Thornton et al. (2016) documented clinically relevant changes on COPM scored by children and parents, and on GAS scores, but they did not clearly detail the operational definitions used to measure participation as an outcome captured by GAS (Thornton et al., 2016). Zwicker et al. (2015) used the Children's Assessment of Participation and Enjoyment (CAPE) (King et al., 2004) but they did not find differences post-CO-OP. Some questions remain for further investigation: did improvements on occupational performance lead to better participation patterns? Is PEM-CY responsive enough to detect changes on participation of children with DCD?

While all children and most parents observed relevant clinical improvement, for trained and transfer (COPM) goals, for external evaluators (PQRS-G), only children on CO-OP + P-group achieved clinically relevant changes on trained goals at T_2. This inconsistency may reflect the difference between perceived and real-time observation of progress made by parents and children and the observation of videos by examiners. Another study found divergences between these measures (Martini et al., 2015).

Our study has limitations, we had a small sample size, even though consistent with similar trials in clinical populations of children with DCD. Due to randomization, the CO-OP + P-group was younger, but we adjusted all analysis for age. We did not measure the type, quality, and time of interaction between parents, child, and therapist, that was not controlled for. This could inform us more about the absence of differences between groups, although it could still be analyzed through video analysis in a future study. Future studies

should include measures of parental engagement as this is a key feature of CO-OP Approach.

5. Conclusion

This parallel randomized controlled trial investigated the efficacy of including additional coaching sessions for parents. There were no significant differences in children's outcomes when traditional CO-OP Approach was compared to the same approach with an add-on component of four OPC sessions in groups for parents, except for children's satisfaction on the CO-OP + P-group and for occupational performance on transfer goals of the CO-OP-group at follow-up. Additional support might not be needed when parents receive adequate information and support while participating on a client-centered, occupation-based intervention for their children. The effects of the CO-OP approach were tested by comparing pre/post intervention outcomes and follow-up scores. CO-OP showed statistically and clinically relevant improvements on occupational performance, satisfaction from both children, parents and external evaluators' perspectives, and gains in motor performance and cognitive flexibility.

Funding sources

This study was supported by the Universidade Federal da Paraín the Fundação de Amparo à Pesquisa do Estado de Minas Gerais – FAPEMIG [APQ-02469-16 Edital Universal 01/2016], by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES), and by the Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq.

Data statement

The datasets generated during and/or analyzed during the study are available from the corresponding author on reasonable request.

CRediT authorship contribution statement

Clarice Ribeiro Soares Araujo: Conceptualization, Methodology, Investigation, Writing - original draft, Project administration. **Ana Amélia Cardoso:** Resources, Supervision, Writing - review & editing. **Helene J. Polatajko:** Methodology, Supervision, Writing - review & editing. **Lívia de Castro Magalhães:** Methodology, Resources, Writing - review & editing, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors report no declarations of interest.

Acknowledgements

We are especially thankful to all the children and families who participated in the study. We would like to thank Universidade Federal da Paraíba for the leave of absence granted to the principal investigator to conduct the study, to all the external evaluators who contributed enormously to this work. We are thankful to our funders: Fundação de Amparo à Pesquisa do Estado de Minas Gerais, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Conselho Nacional de Desenvolvimento Científico e Tecnológico. We are also thankful to the Occupational Therapy Department from UFMG and to the Occupational Therapy and Occupational Science Department of the Rehabilitation Sciences Institute from the University of Toronto, for all support given to the principal investigator during the research period.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ridd.2021.103862.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorder* (5th ed.). Washington (DC): American Psychiatric Association.

Anderson, P., Anderson, V., & Lajoie, G. (1996). The tower of London test: Validation and standardization for pediatric populations. *The Clinical Neuropsychologist, 10*(1), 54–65. https://doi.org/10.1080/13854049608406663.

An, M., Palisano, R. J., Yi, C., Chiarello, L. A., Dunst, C. J., & Gracely, E. J. (2019). Effects of a collaborative intervention process on parent–therapist interaction: a randomized controlled trial. *Physical & Occupational Therapy In Pediatrics, 39*(3). https://doi.org/10.1080/01942638.2018.1496965.

Araújo, C. R. S., Cardoso, A. A., & Magalhães, L. C. (2019). Efficacy of the cognitive orientation to daily occupational performance with Brazilian children with developmental coordination disorder. *Scandinavian Journal of Occupational Therapy, 26*(1). https://doi.org/10.1080/11038128.2017.1417476.

Ballinger, G. A. (2004). Using generalized estimating equations for longitudinal data analysis. *Organizational research methods, 7*(2). https://doi.org/10.1177/1094428104263672.

Bernardi, M., Leonard, H. C., Hill, E. L., Botting, N., & Henry, L. A. (2018). Executive functions in children with developmental coordination disorder: A 2-year follow-up study. *Developmental Medicine and Child Neurology, 60*(3), 306–313. https://doi.org/10.1111/dmcn.13640.

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 and Child Neurology*. https://doi.org/10.1111/dmcn.14132.

Bordin, I. A. S., Mari, J. J., & Caeiro, M. F. (1995). Validação da versão brasileira do "child behavior checklist"(CBCL): Dados preliminares. *Revista da ABP-APAL, 17*(2), 55–66.

Brasil, C. D. C. (2014). *Critério de classificação econômica Brasil*. Associação Brasileira de Empresas de Pesquisa (ABEP).

Cairney, J., Kwan, M. Y., Hay, J. A., & Faught, B. E. (2012). Developmental coordination disorder, gender, and body weight: Examining the impact of participation in active play. *Research in Developmental Disabilities, 33*(5), 1566–1573. https://doi.org/10.1016/j.ridd.2012.02.026.

Cameron, C., Capistran, J., Edwards, B., Hunt, A., & Martini, R. (2017). Using the CO-OP approach: Involving parents and others in the process. In D. R. Dawson, S. E. McEwen, & H. J. Polatajko (Eds.), *Cognitive Orientation to daily Occupational performance in Occupational Therapy: using the CO-OP Approach™ to enable participation across the lifespan* (pp. 161–175). Bethesda: AOTA Press.

Capistran, J., & Martini, R. (2016). Exploring inter-task transfer following a CO-OP approach with four children with DCD: A single subject multiple baseline design. *Human Movement Science, 49*, 277–290. https://doi.org/10.1016/j.humov.2016.07.004.

Chan, D. Y. (2007). The application of cognitive orientation to daily occupational performance (CO-OP) in children with developmental coordination disorder (DCD) in Hong Kong: A pilot study. *Hong Kong Journal of Occupational Therapy, 17*(2), 39–44. https://doi.org/10.1016/S1569-1861(08)70002-0.

Coster, W., Bedell, G., Law, M., Khetani, M. A., Teplicky, R., Liljenquist, K., … Kao, Y. C. (2011). Psychometric evaluation of the Participation and Environment Measure for Children and Youth. *Developmental Medicine and Child Neurology, 53*(11), 1030–1037. https://doi.org/10.1111/j.1469-8749.2011.04094.x.

Coster, W. J., Law, M. C., Bedell, G. M., & Teplicky, R. (2010). *Participation and environment measure for children and youth (PEM-CY)*. Trustees of Boston University Secção Comunidade da PEM-CY.

Culbertson, W. C., & Zillmer, E. A. (1998). The Tower of LondonDX: A standardized approach to assessing executive functioning in children. *Archives of Clinical Neuropsychology, 13*(3), 285–301.

Darling, N., & Steinberg, L. (1993). Parenting style as context: An integrative model. *Psychological Bulletin, 113*(3), 487. https://doi.org/10.1037/0033-2909.113.3.487.

Dawson, D. R., Gaya, A., Hunt, A., Levine, B., Lemsky, C., & Polatajko, H. J. (2009). Using the cognitive orientation to occupational performance (CO-OP) with adults with executive dysfunction following traumatic brain injury. *Canadian Journal of Occupational Therapy, 76*(2), 115–127. https://doi.org/10.1177/000841740907600209.

D'Arigo, R., Ziviani, J., Poulsen, A. A., Copley, J., & King, G. (2017). Child and parent engagement in therapy: What is the key? *Australian Occupational Therapy Journal, 64*(4). https://doi.org/10.1111/1440-1630.12279.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750.

Dunst, C. J., Trivette, C. M., & Hamby, D. W. (2007). Meta-analysis of family-centered helpgiving practices research. *Mental Retardation and Developmental Disabilities Research Reviews, 13*(4), 370–378. https://doi.org/10.1002/mrdd.20176.

Gomide, P. I. C. (2006). *Inventário de estilos parentais: modelo teórico, manual de aplicação, apuração e interpretação*. Petrópolis: Editora Vozes.

Goulardins, J. B., Rigoli, D., Licari, M., Piek, J. P., Hasue, R. H., Oosterlaan, J., & Oliveira, J. A. (2015). Attention deficit hyperactivity disorder and developmental coordination disorder: Two separate disorders or do they share a common etiology. *Behavioural Brain Research, 292*, 484–492. https://doi.org/10.1016/j.bbr.2015.07.009.

Graham, F., & Rodger, S. (2010). Occupational performance coaching: Enabling parents' and children's occupational performance. *Occupation-centred practice with children: A practical guide for occupational therapists* (pp. 203–226). https://doi.org/10.1002/9781444319699.ch10.

Graham, F., Rodger, S., & Ziviani, J. (2013). Effectiveness of occupational performance coaching in improving children's and mothers' performance and mothers' self-competence. *American Journal of Occupational Therapy, 67*(1), 10–18. https://doi.org/10.5014/ajot.2013.004648.

Graham, F., Rodger, S., & Ziviani, J. (2014). Mothers' experiences of engaging in occupational performance coaching. *The British Journal of Occupational Therapy, 77*(4), 189–197. https://doi.org/10.4276/030802214X13968769798791.

Green, D., Chambers, M. E., & Sugden, D. A. (2008). Does subtype of developmental coordination disorder count: Is there a differential effect on outcome following intervention? *Human Movement Science, 27*(2), 363–382. https://doi.org/10.1016/j.humov.2008.02.009.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2009). *Análise multivariada de dados*. Bookman editora.

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. https://doi.org/10.1016/j.ridd.2017.10.014.

Henderson, S. E., Sugden, D., & Barnett, A. (2007). *Movement assessment battery for children-2: Examiner's manual*. Pearson.

Houldin, A., McEwen, S. E., Howell, M. W., & Polatajko, H. J. (2018). The cognitive orientation to daily occupational performance approach and transfer: A scoping review. *OTJR: Occupation Participation Health, 38*(3), 157–172. https://doi.org/10.1177/1539449217736059.

Jasmin, E., Tétreault, S., Larivière, N., & Joly, J. (2018). Participation and needs of children with developmental coordination disorder at home and in the community: Perceptions of children and parents. *Research in Developmental Disabilities, 73*, 1–13. https://doi.org/10.1016/j.ridd.2017.12.011.

Kazdin, A. E., & Nock, M. K. (2003). Delineating mechanisms of change in child and adolescent therapy: Methodological issues and research recommendations. *Journal of Child Psychology and Psychiatry, 44*(8), 1116–1129. https://doi.org/10.1111/1469-7610.00195.

King, G., Law, M., King, S., Hurley, P., Hanna, S., Kertoy, M., … Young, N. (2004). *Children's assessment of participation and enjoyment (CAPE) and preferences for activities of children (PAC)*. San Antonio, TX: Harcourt Assessment, Inc.

Law, M., Baptiste, S., Carswell, A., McColl, M. A., Polatajko, H., & Pollock, N. (2009). *Medida canadense de desempenho ocupacional (COPM)*. Belo Horizonte: Editora UFMG.

Leonard, H. C., Bernardi, M., Hill, E. L., & Henry, L. A. (2015). Executive functioning, motor difficulties, and developmental coordination disorder. *Developmental Neuropsychology, 40*(4), 201–215. https://doi.org/10.1080/87565641.2014.997933.

Liang, K. Y., & Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika, 73*(1), 13–22. https://doi.org/10.1093/biomet/73.1.13.

Magalhaes, L. C., Cardoso, A. A., & Missiuna, C. (2011). Activities and participation in children with developmental coordination disorder: A systematic review. *Research in Developmental Disabilities, 32*(4), 1309–1316. https://doi.org/10.1016/j.ridd.2011.01.029.

Martini, R., Rios, J., Polatajko, H., Wolf, T., & McEwen, S. (2015). The performance quality rating scale (PQRS): Reliability, convergent validity, and internal responsiveness for two scoring systems. *Disability and Rehabilitation, 37*(3), 231–238. https://doi.org/10.3109/09638288.2014.913702.

Mattos, P., Pinheiro, M. A., Rohde, L. A. P., & Pinto, D. (2006). Apresentação de uma versão em português para uso no Brasil do instrumento MTA-SNAP-IV de avaliação de sintomas de transtorno do déficit de atenção/hiperatividade e sintomas de transtorno desafiador e de oposição. In *Revista de psiquiatria do Rio Grande do Sul. Porto Alegre.* (Vol. 28, pp. 290–297). https://doi.org/10.1590/S0101-81082006000300008. n. 3 (set./dez. 2006).

McCullagh, P., & Nelder, J. A. (1989). *Generalized linear models* (2nd edition). London, UK: Chapman and Hall.

McEwen, S., Polatajko, H., Wolf, T. J., & Baum, C. (2012). *CO-OP fidelity checklist*. CO-OP Academy. Available from: http://co-opacademy.ca/wpcontent/uploads/2018/04/CO-OP-Fidelity-Checklist-Apr-4-2018.pdf (Accessed 23 June 2015).

McEwen, S. E., Polatajko, H. J., Huijbregts, M. P., & Ryan, J. D. (2009). Exploring a cognitive-based treatment approach to improve motor-based skill performance in chronic stroke: Results of three single case experiments. *Brain Injury, 23*(13–14), 1041–1053. https://doi.org/10.3109/02699050903421107.

Miller, L. T., Polatajko, H. J., Missiuna, C., Mandich, A. D., & Macnab, J. J. (2001). A pilot trial of a cognitive treatment for children with developmental coordination disorder. *Human Movement Science, 20*(1–2), 183–210.

Mingoti, S. A. (2005). *Análise de dados através de métodos de estatística multivariada: uma abordagem aplicada*. Editora UFMG.

Missiuna, C., & Campbell, W. N. (2014). Psychological aspects of developmental coordination disorder: can we establish causality? *Current Developmental Disorders Reports, 1*(2), 125–131. https://doi.org/10.1007/s40474-014-0012-8.

Missiuna, C., DeMatteo, C., Hanna, S., Mandich, A., Law, M., Mahoney, W., & Scott, L. (2010). Exploring the use of cognitive intervention for children with acquired brain injury. *Physical & Occupational Therapy in Pediatrics, 30*(3), 205–219.

Missiuna, C., Pollock, N., & Law, M. (2004). *Perceived efficacy and goal setting system (PEGS)*. San Antonio, TX: Psychological Corporation.

Paiva, G. C. D. C., Fialho, M. B., Costa, D. D. S., & Paula, J. J. D. (2016). Ecological validity of the five digit test and the oral trails test. *Arquivos de Neuro-Psiquiatria, 74*(1). https://doi.org/10.1590/0004-282X20150184.

Polatajko, H. J., & Mandich, A. (2004). *Enabling occupation in children: The cognitive orientation to daily occupational performance (CO-OP) approach*. Ottawa, ON: CAOT Publications ACE.

Portney, L. G., & Watkins, M. (2015). *Foundations of clinical research: Applications to pratice*. FA Davis Company.

Power, T. J., Russell, H. F., Soffer, S. L., Blom-Hoffman, J., & Grim, S. M. (2002). Role of parent training in the effective management of attention-deficit/hyperactivity disorder. *Disease Management and Health Outcomes, 10*, 117–126. https://doi.org/10.2165/00115677-200210020-00007.

Prado, M., Magalhães, L. C., & Wilson, B. N. (2009). Cross-cultural adaptation of the developmental coordination disorder questionnaire for Brazilian children. *Brazilian Journal of Physical Therapy, 13*(3), 236–243. https://doi.org/10.1590/S1413-35552009005000024.

Ruggio, C. I. B., Missiuna, C., Costa, S. D. A., Araújo, C. R. S., & Magalhães, L. D. C. (2018). Validity and reliability of the perceived efficacy and goal setting system (PEGS) for Brazilian children. *Cadernos Brasileiros de Terapia Ocupacional, 26*(4), 828–836. https://doi.org/10.4322/2526-8910.ctoAO1702.

Scammell, E. M., Bates, S. V., Houldin, A., & Polatajko, H. J. (2016). The Cognitive Orientation to daily Occupational Performance (CO-OP): A scoping review: L'approche CO-OP (Cognitive Orientation to daily Occupational Performance): examen de la portée. *Canadian Journal of Occupational Therapy, 83*(4), 216–225. https://doi.org/10.1177/0008417416651277.

Schulz, K. F., Altman, D. G., & Moher, D. (2010). CONSORT 2010 statement: Updated guidelines for reporting parallel group randomized trials. *BMC Medicine, 8*(1), 18. https://doi.org/10.1136/bmj.c33.

Sedó, M., de Paula, J., & Malloy-Diniz, L. (2015). *O Teste dos Cinco Dígitos*. Hogrefe.

Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society of London B Biological Sciences, 298*(1089), 199–209. https://doi.org/10.1098/rstb.1982.0082.

Smits-Engelsman, B., Vincon, S., Blank, R., Quadrado, V. H., Polatajko, H., & Wilson, P. H. (2018). Evaluating the evidence for motor-based interventions in developmental coordination disorder: A systematic review and meta-analysis. *Research in Developmental Disabilities, 74*, 72–102. https://doi.org/10.1016/j.ridd.2018.01.002.

Thornton, A., Licari, M., Reid, S., Armstrong, J., Fallows, R., & Elliott, C. (2016). Cognitive orientation to (daily) occupational performance intervention leads to improvements in impairments, activity and participation in children with Developmental Coordination Disorder. *Disability and Rehabilitation, 38*(10), 979–986. https://doi.org/10.3109/09638288.2015.1070298.

Valentini, N. C., Ramalho, M. H., & Oliveira, M. A. (2014). Movement assessment battery for children-2: Translation, reliability, and validity for Brazilian children. *Research in Developmental Disabilities, 35*(3), 733–740. https://doi.org/10.1016/j.ridd.2013.10.028.

Valentini, N. C., Villwock, G. D. M. C., Vieira, L. F., Vieira, J. L. L., & Barbosa, M. L. L. (2010). Validação brasileira da escala de autopercepção de Harter para crianças. *Psicologia: reflexão e crítica, 23*(3), 411–419. https://doi.org/10.1590/S0102-79722010000300001 (2010).

Van der Linde, B. W., van Netten, J. J., Otten, B., Postema, K., Geuze, R. H., & Schoemaker, M. M. (2015). Activities of daily living in children with developmental coordination disorder: Performance, learning, and participation. *Physical Therapy, 95*(11), 1496–1506. https://doi.org/10.2522/ptj.20140211.

Wechsler, D. (2013). Escala de Inteligência Wechsler para crianças. *Quarta Edição*. São Paulo: Casa do Psicólogo.

Westendorp, M., Houwen, S., Hartman, E., Mombarg, R., Smith, J., & Visscher, C. (2014). Effect of a ball skill intervention on children's ball skills and cognitive functions. *Medicine and Science in Sports and Exercise, 46*, 414–422. https://doi.org/10.1249/MSS.0b013e3182a532b3.

WHO. (2007). *International classification of functioning, disability and health: Children and youth version: ICF-CY*. Geneva: WHO.

Wilson, P. H., Smits-Engelsman, B., Caeyenberghs, K., Steenbergen, B., Sugden, D., Clark, J., … Blank, R. (2017). Cognitive and neuroimaging findings in developmental coordination disorder: New insights from a systematic review of recent research. *Developmental Medicine and Child Neurology, 59*(11), 1117–1129. https://doi.org/10.1111/dmcn.13530.

Zwicker, J. G., Rehal, H., Sodhi, S., Karkling, M., Paul, A., Hilliard, M., & Jarus, T. (2015). Effectiveness of a summer camp intervention for children with developmental coordination disorder. *Physical & Occupational Therapy in Pediatrics, 35*(2), 163–177. https://doi.org/10.3109/01942638.2014.957431.