



# Differentiating children with Attention-Deficit/Hyperactivity Disorder, Conduct Disorder, Learning Disabilities and Autistic Spectrum Disorders by means of their motor behavior characteristics

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## ABSTRACT

The study was designed to investigate the discriminant validity of the Motor Behavior Checklist (MBC) for distinguishing four groups of children independently classified with Attention-Deficit/Hyperactivity Disorder, (ADHD;  $N = 22$ ), Conduct Disorder (CD;  $N = 17$ ), Learning Disabilities (LD;  $N = 24$ ) and Autistic Spectrum Disorders (ASD;  $N = 20$ ). Physical education teachers used the MBC for children to rate their pupils based on their motor related behaviors. A multivariate analysis revealed significant differences among the groups on different problem scales. The results indicated that the MBC for children may be effective in discriminating children with similar disruptive behaviors (e.g., ADHD, CD) and autistic disorders, based on their motor behavior characteristics, but not children with Learning Disabilities (LD), when used by physical education teachers in school settings.

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## 1. Introduction

### 1.1. Motor behavior characteristics of children

Many children facing symptoms of attentional, emotional, behavioral or developmental problems are placed in public elementary schools without a first screening. These children are “at risk” for school failure, emotional difficulties and significant negative adult outcomes compared to their peers (Eisenberg, Fabes, Guthrie, & Reiser, 2000). Detection efforts are particularly critical during the early educational years, when students are most amenable to change in behavioral, social, and academic arenas and before students with emotional and behavioral disorders (EBD), Learning Disabilities (LD) and Autistic Spectrum Disorder (ASD), experience negative outcomes within and beyond the school setting (Landrum, Tankersley, & Kauffman, 2003; Lane, 2003; Volkmar, Lord, Bailey, Schultz, & Klin, 2004; Wagner, Kutash, Duchnowski, Epstein, & Sumi, 2005).

Among those children who attend school, educational professionals are in a unique position to facilitate adaptive and social behaviors (Waller, Waller, Schramm, & Bresson, 2006; Webster-Stratton, Reid, & Hammond, 2004). Several studies suggest that evidence for the presence of Externalizing and/or Internalizing symptoms can be obtained in multiple active situations, and a number of behavioral symptoms can be observed during physical education classes, team games and during standardised play procedures (Kashani, Allan, Beck, Bledsoe, & Reid, 1997; Mol Lous, Wit, De Bruyn, & Riksen-Walraven,

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2002). Educators who observe different aspects of children's behavior during their lessons are able to identify young children "at risk" for school adjustment problems related to attention, conduct, learning, and mood with a great deal of accuracy (Flanagan, Bierman, & Kam, 2003).

Physical education teachers have the knowledge and the skills to focus on the "warning signs" of abnormal motor related behaviors providing useful information about the development of school-aged children. However, there are only a few instruments that use the physical educators as main source of information about children's development and the majority of them focus on movement and motor coordination problems (Bruininks–Oseretsky Test of Motor Proficiency, Bruininks & Bruininks, 2005; Test of Gross Motor Development, Ulrich, 2000; Movement Assessment Battery for Children, Henderson & Sugden, 2007), or on specific disorders which are highly connected with performance in sports or with class management in school settings (State-Trait Anxiety Inventory for Children, Spielberger, 1973; Physical Education Classroom Instrument, Kulinna, Cothran, & Regualos, 2003). Based on children's motor behavior observed during physical education classes, a new instrument was developed for use by physical education teachers in this study in order to check for differences in motor related behavior characteristics among four clinical groups of children coming from special education settings.

Disruptive behavior disorders (DBDs), specifically Attention-Deficit Hyperactivity Disorder (ADHD) and Conduct Disorder (CD), are the most common reasons for referral children and adolescents to mental health clinics. Attention-Deficit Hyperactivity Disorder (ADHD) is characterized by inattention, lack of concentration, and learning difficulties in addition to some degree of hyperactivity and impulsivity (American Psychiatric Association, 2000; Corrigan, 2003). The disorder affects approximately five percent of school aged children (Johnson & Rosén, 2000) which experience difficulties in behaviors crucial to academic success, such as maintaining attention, modulating activity levels, inhibiting impulsive responses, and persisting with academic tasks (DuPaul & Stoner, 2003). Students with ADHD experience persistent and extreme distractibility (Hutchison, 2004), cannot screen out irrelevant stimuli in order to concentrate on tasks long enough to complete them, and does not sustain thought processes long enough to do school work (Bennett, Dworet, & Weber, 2008). The DSM-IV criteria for ADHD (American Psychiatric Association, 2000) include several items that are related to motor characteristics, including fidgeting, running about or excessive climbing (possibly linked to subjective feelings of restlessness), difficulties in playing, and acting as if 'driven by a motor'. During physical activities, children with ADHD exhibit age-inappropriate features of hyperactivity, excessive impulsivity, problems in lateralization, and are often left-handed (Reid & Norvilitis, 2000). In addition, general coordination difficulties and soft neurological signs are frequently reported (Denckla, 2003; Sadock & Sadock, 2003).

Although the diagnostic criteria presents clear distinctions between the core symptoms of ADHD and LD (American Psychiatric Association, 2000), researchers have described a strong link between ADHD and LD. Symptoms similarities between the disorders include problems with inattention and hyperactivity, low frustration tolerance, poor self esteem, low morale, deficits in social skills, impaired academic achievement, increased school dropout and poor vocational achievement (Epstein, Shaywitz, Shaywitz, & Woolston, 1991; Jensen et al., 2001). During physical activities, children with Learning Disabilities, display subtle motor difficulties, deficits in balance and spatial awareness (Miyaraha, 1994), deficits in selective attention and problem solving (Wolfe, 1996), hyperactivity, conceptual rigidity, inappropriate reactions emotional instability (Sherrill, 1998) and sometimes lack social skills and are unable to solve interpersonal problems (Bluehardt & Shephard, 1995).

Conduct Disorder (CD) is marked by a pervasive and persistent violation of rules or rights of others (American Psychiatric Association, 2000) and early-onset of conduct problems in childhood are a major risk factor for the development of delinquency, violence, antisocial behavior, impoverished social ties, and drug or substance abuse in later years (Bassarath, 2001; Patterson, DeGarmo, & Knutson, 2000). Research in psychomotor behavior in children with behavioral disorders suggested that tension, restlessness, psychomotor agitation, and disturbed development of body awareness are often present (Aendekerck & Verheij, 1997). At educational settings, children with conduct problems deviate from school and social principles, rules and regulations; display delinquent behavior, difficulties in social relationships, aggressiveness, combustible disobedience, anger, lack of empathy or concern for others, misperception of the intent of others in ambiguous social situations, lack of guilt or remorse, and low self-esteem (Dodge, 1993).

Educational research indicated that autism may not be an excessively rare disorder (Volkmar et al., 2004), but it could represent the extreme of a quantitative distribution of autistic traits that are present in the general population (e.g. Constantino & Todd, 2003; Spiker, Lotspeich, Dimiceli, Myers, & Risch, 2002). Problem behaviors observed with autism include physical aggression, self-injury, property destruction, stereotyped behaviors, and tantrums are highly disruptive to classroom, community, and home environments and without intervention, they are more likely to increase than improve (Horner, Carr, Strain, Todd, & Reed, 2002). During physical activities, children with ASD, indicate stereotyped and repetitive motor mannerisms, impairments of facial expression, postures, and gestures, and are often characterized as clumsy and as having problems in motor coordination (Berkeley, Zittel, Pitney, & Nichols, 2001; Piek & Dyck, 2004). Autistic traits are widely distributed in the general population, and there are many children unselected by the lack of appropriate screening instruments (Skuse, Mandy, & Scourfield, 2005). Recent surveys of the prevalence of autism in the community indicate not only an increase in the number of cases meeting conventional criteria, but a disproportionate increase in the number of milder cases that fail to reach full criteria (Chakrabarti & Fombonne, 2001; Yeargin-Allsopp et al., 2003).

Due to the effectiveness of early intervention on the outcome of individuals with ASD, there is a race to identify children with ASD at younger ages (Matson, Boisjoli, Hess, & Wilkins, 2010). For this reason, a top priority in the field of autism is the development of precise early diagnostic tools that are designed to assess symptoms of ASD in young children. The Baby and

Infant Screen for Children with aUtism Traits-Part 1 (BISCUIT-Part 1; [Matson et al., 2010](#)), the Modified Checklist for Autism in Toddlers (M-CHAT; [Robins, Fein, & Barton, 1999](#)) and the Childhood Autism Rating Scale (CARS; [Schopler, Reichler, & Renner, 1988](#)) are among the most popular screening instruments designed to screen for ASD in young children. The instruments consider examiner's observations and parents' responses concerning children's social development, attention and ability to use imaginative play skills in order to determine whether the child in question appears to be at risk for a Pervasive Developmental Disorder (PDD) like autism.

### 1.2. Coexisting disorders and overlap of symptoms

Researchers indicate that high coexistence among disorders and children with comorbid conditions experience greater symptom severity and persistence ([Gadow, DeVincent, & Pomeroy, 2006](#)) and there is evidence that the greater the number of coexisting disorders the poorer the child's psychosocial health-related quality of life ([Klassen, Miller, & Fine, 2004](#)).

Autism spectrum disorder and ADHD are excellent examples of two syndromes that evidence high heritability, commonly co-occur with each other, share similar biologic and environmental features that are assumed to be associated with their pathogenesis ([Gadow et al., 2006](#)). ADHD is relatively common in children with ASD ([Gadow, DeVincent, Pomeroy, & Azizian, 2004](#); [Gadow, DeVincent, Pomeroy, & Azizian, 2005](#); [Gadow, Drabick, et al., 2004](#)), who exhibit higher rates and greater severity of co-occurring aggression, anxiety, and depression ([Gadow et al., 2006](#)). Reported studies show that children with ASD may display significant degree of ADHD-like symptoms as well as ADHD subtypes and it commonly occurs in association with oppositional defiant disorder (ODD), CD, LD, and other psychiatric conditions such as anxiety disorders and depression ([Klassen et al., 2004](#)).

Moreover, epidemiological studies have found considerable coexistence of ADHD and CD, and differences in ADHD symptomatology as a function of coexisting disorders have been reported ([Neuman et al., 2001](#); [Newcorn et al., 2001](#)). Data suggest that children who evidence early neuro-regulatory problems such as impulsivity and inattention are at increased risk for early onset and persisting conduct problems ([Moffit, 2003](#); [Moffit, Caspi, Rutter, & Silva, 2001](#)). High correlations between disruptive behavior disorders and variables relating to aggression have been also documented ([Hudziak, Rudiger, Neale, Heath, & Todd, 2000](#); [Mayes, Calhoun, & Crowell, 2000](#)).

Early identification and early intervention are important influences upon the outcome for children and can help to minimize the long-term harm of mental disorders and reduce the overall healthcare burden and costs ([Aos, Lieb, Mayfield, Miller, & Pennucci, 2004](#)). Short measures with known reliability and validity are necessary to ensure that all children succeed in school ([DiStefano & Kamphaus, 2007](#)).

Given the costs associated with children's disorders, to students themselves, their families, and society as a whole, it is not surprising that systematic screening and comprehensive intervention efforts are a growing area of interest to educational research ([Kauffman & Landrum, 2009](#); [Lane, 2007](#); [Nelson, Babyak, Gonzalez, & Benner, 2003](#)).

### 1.3. The Motor Behavior Checklist (MBC) for children

In this study, we introduce the Motor Behavior Checklist for children (MBC) as a screening instrument to measure the motor related behavioral symptoms of elementary school-aged children. Taking into consideration the importance of early diagnosis, the differences in parent and teacher perceptions of psychiatric symptom severity (e.g., [Gadow et al., 2006](#); [Gadow, Drabick, et al., 2004](#)) and the ability of educators to observe different aspects of children's behavior during their lessons with accuracy ([Flanagan et al., 2003](#)), the Motor Behavior Checklist (MBC) for children was developed to select physical educator's ratings on.

The Motor Behavior Checklist for children (MBC) is a scale designed to be completed by a physical educator teacher who knows the child well enough to rate his/her motor related behavior. Responders are asked to observe the child during physical education classes and free play situations and to rate each behavior on a 5-point Likert scale ranging from "never" (0) to "almost always" (4). The MBC for children consisted of 59 motor related behavior items included in two broadband factors (Externalizing and Internalizing) and seven problem scales. The Externalizing factor includes three problem scales: Rules Breaking (7 items), Hyperactivity/Impulsivity (14 items) and Lack of Attention (10 items), and the Internalizing factor includes four problem scales: Low Energy (4 items), Stereotyped Behaviors (2 items), Lack of Social Interaction (10 items), and Lack of Self-Regulation (12 items). The mean result for each of the seven scales and the two factors can be calculated. The internal consistency (ranging from  $\alpha = .82$  to  $\alpha = .95$ ), the reproducibility (ranging from ICC = .85 to ICC = .90) and the interrater agreement (ranging from ICC = .75 to ICC = .91), were excellent suggesting that the MBC for children is an instrument homogenous in content, with high temporal stability and high correlation agreement.

### 1.4. Hypotheses for the current study

The present study examines the ability of the Motor Behavior Checklist for children (MBC) to discriminate four samples of children on the basis of their motor related behavior. Based on motor behavior characteristics of the disorders examined it was hypothesized that the problem scales of the MBC would reveal significant differences between groups with regard to the mean scores on each problem scale. More specifically:

- (i) Children with ADHD will have significantly higher mean scores on the Hyperactivity/Impulsivity and Lack of Attention Problem scales than the children of the other groups.
- (ii) Children with CD will differ significantly on the Rules Breaking Problem scale in comparison to the other groups.
- (iii) Children with ASD are expected to have significantly higher mean scores than the children of the other groups on the Lack of Social Interaction scale.
- (iv) Finally, the children with LD, is hypothesized that they will score high on inattention and disobedience items as most of the students in this group were reported as having learning and adjustment problems mainly connected with problems in concentration and violation of rules.

## 2. Method

### 2.1. Participant's characteristics and selection criteria

Data used in present study were collected from two educational settings in Greece. The first data were derived from students attending special elementary schools and the second data obtained from students attending special classes in typical elementary schools. Students in both settings were referred for further assessment and had a diagnosis according to APA (*American Psychiatric Association, 2000*) criteria by a multidisciplinary diagnostic team. Students who had a primary diagnosis of ADHD, CD, LD or ASD, were eligible for inclusion in the present study. Whether a child had a neuromuscular disorder, visual impairment, or hearing impairment was determined through consultation with the classroom teacher. If any one of these conditions were present, the child was excluded from the study. Students who were under medication during the research period were also excluded from the study. In addition, students with mild mental retardation, according to their educational files, were not participated in this study.

The total sample consisted of four groups. The ADHD group comprised of 22 children (mean age = 7.9 years), male participants made up 73% of the ADHD group and 18 (80%) had the Greek nationality. The CD group included 17 children (mean age = 9.2). Seventy-five percent of the CD group was male, 75% had the Greek nationality and 11 (68%) were attending special elementary schools. The LD group included 24 students (mean age = 8.7) from which 11 were boys (56%), 13 were girls (54%), 19 (79%) had the Greek nationality and 14 (58%) were attending special elementary schools. Finally, the ASD group included 20 students all coming from elementary schools specialized in children diagnosed with autism, and all of them (100%) had Greek nationality. The children of the ASD sample had mean age = 8.2 years and consisted of 13 boys (65%) and 7 girls (35%). Children's characteristics by group are in [Table 1](#).

### 2.2. Assessment procedure

The research team informed the school personnel about the aims of the research and after accepting to participate, the physical educators of the schools were informed in detail about the assessment procedure and were asked to rate their students on the 59 items of the Motor Behavior Checklist (MBC) for children. Before contacting the assessment, appropriate consent/assent from each of the participant's physical educators was obtained. Children were recruited after approval from the university Human Subjects Committee and parent(s) of each child received and signed a copy of the Human Consent Form. The research was approved by the Ethics board of the Pedagogy Department of the Greek Ministry of Education and was in line with the guidelines given by the research ethics board of the K.U. Leuven. Background information and permission for release of school records (e.g., special education evaluations and psycho-educational testing results) were also required from the parents of the children in order to examine if the child fulfilled the selection criteria. Parents were asked to complete and return the consent forms to the school. In most cases (>90%), information and permission files were completed by the child's mother.

### 2.3. Statistical analysis

Statistical analysis of the data was conducted using the Statistical Package for Social Sciences (*SPSS 15.0, 2006*). A multivariate analysis of variance (MANOVA) was conducted to compare motor behavior profiles and to examine differences

**Table 1**  
Participant's characteristics by group.

Variable		ADHD (N = 22)	CD (N = 17)	LD (N = 24)	ASD (N = 20)	Overall (N = 83)
Age (years)	Mean (SD)	7.9 (1.3)	9.5 (1.2)	8.7 (1.5)	8.2 (1.7)	8.5 (1.6)
Gender (%)	Male	16 (73%)	12 (75%)	11 (46%)	13 (65%)	52 (63%)
	Female	6 (27%)	5 (25%)	13 (54%)	7 (35%)	31 (37%)
Nationality	Greek	18 (80%)	13 (75%)	19 (79%)	20 (100%)	70 (84%)
	Other	4 (20%)	4 (25%)	5 (21%)		13 (16%)
Special education	School	15 (69%)	11 (68%)	14 (58%)	20 (100%)	60 (72%)
	Class	7 (31%)	6 (32%)	10 (42%)		23 (28%)

CD, Conduct Disorder; ADHD, Attention Deficit/Hyperactivity Disorder; LD, Learning Disabilities; ASD, Autistic Spectrum Disorder.

**Table 2**  
Scores on MBC problem scales by clinical group.

MBC factors	Problem scales	Items	ADHD (N = 23) M (SD)	CD (N = 16) M (SD)	LD (N = 24) M (SD)	ASD (N = 20) M (SD)	F-values	p-Values	Group contrasts <sup>a</sup>
Externalizing		31	2.8 (0.7)	2.4 (0.7)	1.2 (0.4)	1.1 (0.3)	17.56**	<.001	ADHD > CD, LD, ASD
	Rules breaking	7	1.7 (0.7)	3.1 (0.5)	1.5 (0.9)	1.1 (0.8)	19.42**	<.001	CD > ADHD, LD, ASD
	Hyperactivity/Impulsivity	14	3.1 (0.5)	2.2 (0.3)	0.7 (0.2)	1.2 (0.5)	14.71**	<.001	ADHD > CD, LD, ASD
	Lack of Attention	10	3.4 (0.8)	1.2 (0.6)	1.8 (0.8)	1.6 (0.4)	11.14**	<.001	ADHD > LD, CD, ASD
Internalizing		28	1.5 (0.7)	1.2 (0.2)	1.1 (0.7)	2.1 (0.6)	14.35**	<.001	ASD > ADHD, LD, CD
	Low energy	4	0.6 (0.5)	0.6 (0.2)	0.7 (0.5)	1.1 (0.3)	2.71	.048	
	Stereotyped behaviors	2	0.8 (0.3)	0.7 (0.4)	1.2 (0.6)	2.7 (0.6)	13.58**	<.001	ASD > ADHD, LD, CD
	Lack of Social interaction	10	1.1 (0.4)	0.7 (0.6)	1.3 (0.7)	2.8 (0.8)	11.25**	<.001	ASD > ADHD, LD, CD
	Lack of Self regulation	12	1.4 (0.5)	1.2 (0.3)	1.3 (0.8)	2.1 (0.6)	10.13**	<.001	ASD > ADHD, LD, CD

ADHD, Attention Deficit/Hyperactivity Disorder; CD, Conduct Disorder; LD, Learning Disabilities; ASD, Autistic Spectrum Disorder.

<sup>a</sup> Tukey HSD,  $p < .001$ .

\*\*  $p < .001$

among the children of the four groups (ADHD, CD, LD, and ASD), on the two factors (Externalizing, Internalizing) and the seven problem scales of MBC (Rules Breaking, Hyperactivity/Impulsivity, Lack of Attention, Low Energy, Stereotyped Behaviors, Lack of Social Interaction, and Lack of Self Regulation). In addition, the effect of age and gender on the MBC Scores was also examined. Post hoc Tukey tests (equal variances) were performed to localize differences between groups in terms of mean MBC scores.

### 3. Results

#### 3.1. Differences on MBC problem scales

Significant test results for the MANOVA procedure were based on  $F$  statistics derived from Wilks' lambda. Means and standard deviations for the four clinical groups and group's comparisons are summarized in Table 2.

The MANOVA's results revealed a significant main effect of age ( $F[5, 71] = 2.72, p < .001$ ), but no significant effect of gender ( $F[1, 71] = 1.28, p = .59$ ) and no significant interaction for age  $\times$  gender ( $F[5, 71] = 1.41, p = .67$ ). For the Externalizing factor the differences found between the mean scores on each problem scale were significant for the four groups. More specifically, the children of the CD group scored significantly higher ( $F[3, 79] = 19.41, p < .001$ ) than the children of the other groups on the items of the Rules Breaking problem scale of the MBC for children. No significant differences were observed on disobedience items between the children of the ADHD, ASD and the LD groups. On the Hyperactivity/Impulsivity problem scale, results indicated that the children of the ADHD group differed significantly with the children of the LD group ( $p < .001$ ) and with the children of the ASD group ( $p < .001$ ), but not with the children of the CD group ( $p = .074$ ). For the Lack of Attention problem scale the children of the ADHD group scored significantly higher ( $F[3, 79] = 11.04, p < .001$ ) than the other clinical groups on the ten inattention items of the MBC problem scale.

With regard to the Internalizing domain the differences found on the four problems scales (Low energy, Stereotyped Behaviors, Lack of Social Interaction and Lack of Self Regulation) were significant for only three of the four groups. More specifically, for the Low Energy scale there was not any significant difference on scores between the four groups ( $F[3, 79] = 2.74, p = .078$ ). On the contrary, on the Stereotyped Behavior items the differences found were significant between all groups ( $F[3, 79] = 13.48, p < .001$ ). The children of the ASD group differed significantly with the children of the ADHD ( $p < .001$ ), CD ( $p < .001$ ), and LD ( $p < .001$ ) group. There were no significant differences with regard to the Stereotyped Behaviors between the children of the LD group, the children of the ADHD group ( $p = .841$ ) and the children of the CD group ( $p = .420$ ). For the Lack of Social Interaction problem scale the children of the ASD group differed significantly with the children of the CD ( $p < .001$ ), the LD ( $p < .001$ ), and the ADHD group ( $p < .001$ ). The differences found between the children of the LD group and the children of the CD group ( $p = .681$ ), and the children of the ADHD group ( $p = .749$ ) on the Social Interaction items were not significant. In addition, the children of the CD group did not differ significantly with the children of the ADHD group ( $p = .471$ ) with regard to the means on the Lack of Social Interaction scale.

On the Lack of Self Regulation problem scale, the physical education teachers rated the children of the ASD group as having more severe problems than the other three clinical groups. The children of the ASD group scored significantly higher than the children of the CD group ( $p < .001$ ) and the children of the ADHD group ( $p < .001$ ). The differences found between the children the ASD group and the LD group ( $p = .381$ ) were not significant. In addition, the children of the ADHD group did not differ significantly with the CD group ( $p = .361$ ), and the differences found between the children of the LD group and the CD group ( $p = .383$ ) with regard to the mean scores on the Lack of Self Regulation problem scale were also not significant.

Summarizing, the physical education teachers rated the children of the ADHD group as having more severe problems on Hyperactivity/Impulsivity scale and the Lack of Attention scale, the children of the CD group as having more severe problems on Rules Breaking items and the children of the ASD as having more severe problems on both Stereotyped Behaviors and Lack of Social Interaction items. In addition, none of the four clinical groups (i.e., CD, ADHD, ASD or LD) were significantly different from each other with regard to Low Energy items, and the children of the LD group did not score significantly higher than the other clinical groups on any problem scale of the MBC for children.

### 4. Discussion

#### 4.1. Interpretation of the findings, progress of knowledge

The transition from home and family to school and peer ecologies entails exposure to a new set of opportunities, demands, rules and relationships that complement and elaborate social experiences with parents and siblings. Unskilled, aggressive hyperkinetic and impulsive children are quickly rejected and ostracized in the formation of a new peer group, and become frequent targets of counter-coercive harassment by peers (Snyder, 2004).

The current study provides novel data because it is one among very few studies focusing only on the motor behavior characteristics of clinical samples of children. The study investigated the discriminant validity of a new screening instrument (Motor Behavior Checklist for children) using data from four clinical samples of elementary school-aged children. The children of the ADHD group were significantly younger than the children from the other clinical groups. Although literature involving clinical populations (Biederman, Mick, & Faraone, 2000) indicates that persistence of inattention and coexisting symptoms of the disorder does not change drastically by age and there is only a slight decrease with age (Lee & Ousley, 2006).

Based on the diagnostic criteria (APA, 2000) and the existing literature (Berkeley et al., 2001; Corrigan, 2003; DuPaul & Stoner, 2003; Hutchison, 2004; Jensen, Martin, & Cantwell, 1997; Piek & Dyck, 2004), it was hypothesized that the presence of a diagnosis would be associated with significant differences in the motor behavior profiles of the children and these differences on the mean scores would be associated with the MBC problem scales. With regard to the Externalizing scales of the MBC the results of the study confirmed the initial hypotheses.

More specifically, on the Hyperactivity/Impulsivity items, the children of the ADHD group differ significantly with the children of the ASD and the children of the LD group but not with the children of CD group. This is maybe due to the high coexistence on behavioral symptoms of impulsivity and hyperactivity between ADHD and CD (Hudziak et al., 2000; Jensen et al., 1997, 2001; Mayes et al., 2000; Newcorn et al., 2001). Concerning the problems in attention, the children of the ADHD group were, as expected, rated to have more severe problems in concentration items than the children of the other clinical groups. The differences found on mean scores were significant for the ASD and CD group but not for the LD group. Consistent with the literature indicating coexistence of symptoms between ADHD and LD (Brown, 2000; Pliszka, Carlson, & Swanson, 1999) the similar behavioral patterns of inattention between the children of the ADHD group and the children of the LD group were also expected. According to their educational files many of the children of the LD group were classified as having learning disabilities due to attention problems which were present but not at the intensity and severity that could justify an ADHD diagnosis for these children.

Consistent to the core symptoms of the conduct disorder (APA, 2000), the physical education teachers rated the children of the CD group as having more severe behavioral symptoms of disobedience and violation of rules than the other participants. Interestingly, the LD group appeared to exhibit similar behavior patterns with the children of the ADHD and the ASD group with regard to the Rules Breaking scale.

With regard to the Internalizing scales, the children of the four groups differed significantly on the problem scales with the exception of the Low Energy scale in which the differences found among the groups were not significant. One possible explanation is that the specific items in this problem scale are behavioral patterns which are met mainly by children with mood disorders (APA, 2000) and in this study no clinical group diagnosed with mood disorders was involved. On the Stereotyped Behaviors problem scale, the children of the ASD group scored significantly higher than the children of the other groups. Although there is high coexistence of symptoms between ASD and ADHD (Gadow et al., 2006; Pierre, Nolan, Gadow, Sverd, & Sprafkin, 1999), results from our study indicate that the specific items describing stereotyped motor behaviors were observed mainly on the children of the ASD group.

With regard to the items describing Lack of Social Interaction, the physical education teachers rated the children of the ASD group as having more severe problems in comparison to the other clinical groups. This finding is in line with research on children diagnosed with autism (APA, 2000; Bauminger & Kasari, 2000; Kasari, Chamberlain, & Bauminger, 2001) describing social impairments and problems in communication and cooperation with teachers and peers as core symptoms of the disorder. Although researchers (Bluehardt & Shephard, 1995; Jensen et al., 1997) indicate that children with LD sometimes lack social skills, have poor self esteem and are unable to solve interpersonal problems, there were no significant differences on social interaction items between the children of the LD group and the children of the ADHD and the CD group. Physical educators rated their students with Learning Disabilities as not facing more severe social problems than the children of the ADHD or the CD group.

Finally, with regard to the Lack of Self Regulation items, the children of the ASD group were rated by their physical educators as having more severe problems in self regulation and significant differences were observed among the children of the ASD group and the children of the other groups. On the contrary, children of the ADHD, CD and LD groups were rated as having similar behavior patterns with regard to the Lack of Self-Regulation items, as there were not any significant differences among them.

The results indicated that although the MBC for children is not a screening instrument specialized only in children with developmental disabilities, the motor related behaviors which are included in the Internalizing problem scales of the instrument (Stereotyped behavior, Lack of Social Interaction and Lack of Self-Regulation), can discriminate children with ASD and help educators identify if a child acts like a child with autism. In general, unlike screeners designed especially for children with ASD (BISCUIT-1; Matson et al., 2010; M-CHAT; Robins et al., 1999; CARS; Schopler et al., 1988), the MBC for children does not focus on a specific disorder but is based on motor behavior characteristics, and gives the educators the ability to assess an array of problematic behaviors providing separate scores on different problem scales and stretching the attention to the warning signs of the most problematic domains.

#### 4.2. *Implications, limitations and recommendations for future research*

The main purpose of the MBC for children is to provide a practical, valid, reliable and cost-efficient instrument for assessing student's deviant motor related behaviors. Although there is high co-occurrence of disorders and overlap of symptoms, results from the present study indicated that MBC for children can be a useful tool for discriminating the core symptoms of ADHD, CD and ASD through observation during physical education and free play situations, and indicate children with emotional and behavioral disorders and children with autistic symptoms.

A further and more in depth accurate psychological assessment must follow this initial "screening" as the aim of MBC is not to provide a clinical diagnosis but to facilitate the teaching process of physical education teachers in school settings and help them in their important decision to refer these students for further clinical evaluation.

One potential weakness of the study which could limit somewhat the generalizability of the results is the fact that the participants were diagnosed by different clinicians and by different diagnostic teams. It is possible that differences in the conceptualization of ADHD, CD, ASD and LD by different clinicians may have confounded the results. It is argued however that the fact that the diagnoses were given based on APA criteria by experienced educators and clinicians would reduce diagnostic unreliability to a point that it is unlikely to be a significant weakness in our findings. Future research could involve investigations with other clinical groups (i.e., depression or anxiety) and focus on the discriminant validity of the new instrument. In addition, a community control sample of typical elementary school-aged children could be involved in a future study in order to examine the ability of the MBC to differentiate with accuracy children with emotional and behavioral disorders from a typical school-aged population.

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