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

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Abstract

Aim: The study was designed to investigate the discriminant validity of the Motor Behaviour Checklist (MBC; Efstratopoulou, Janssen, & Simons, 2012). **Method:** Four group 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; $N=20$) was used. Physical education teachers used the MBC (Efstratopoulou, Janssen, & Simons, 2012) for children to rate their pupils based on their motor related behaviours. **Results:** A Multivariate Analysis revealed significant differences among the groups on different problem scales. **Conclusions:** The results indicated that the MBC for children may be effective in discriminating children with similar disruptive behaviours (e.g., ADHD, CD) and autistic disorders, based on their motor behaviours characteristics, but not children with learning disabilities (LD), when used by physical education teachers in school settings.

Key words: Discriminant validity, Attention-Deficit/Hyperactivity Disorder, Conduct Disorder,

1. Introduction

1.1 Motor behaviours characteristics of children

Many children facing symptoms of attentional, emotional, behavioural 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 behavioural, social, and academic arenas and before students with emotional and

behavioural disorders (EBD), learning disabilities and autistic spectrum disorder (ASD), experience negative outcomes within and beyond the school setting (Landrum, Tankersley, & Kauffman, 2003, Lane, 2003; Wagner, Kutash, Duchnowski, Epstein, & Sumi, 2005; Volkmar, Lord, Bailey, Schultz, & Klin, 2004).

Among those children who attend school, educational professionals are in a unique position to facilitate adaptive and social behaviours (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 behavioural symptoms can be observed during physical education classes, team games and during standardized play procedures (Kashani, Allan, Beck, Bledsoe, & Reid, 1997; Mol Loïs, Wit, De Bruyn, & Riksen-Walraven, 2002). Educators who observe different aspects of children's behaviours 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 (PE) teachers have the knowledge and the skills to focus on the "warning signs" of abnormal motor related behaviours 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 are focusing 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 & Edwards, 1973; Physical Education Classroom Instrument, Kullina, Cothran, & Regualos, 2003). Based on children's motor behaviours observed during physical education classes, a new developed instrument will be used by physical education teachers in this study in order to check for differences in motor related behaviours characteristics among four clinical groups of children coming from special education settings.

Disruptive behaviours 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 behaviours 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, Hinshaw, Kraemer, Lenora, Newcorn et al., 2001).

During physical activities, children with learning disabilities, display subtle motor difficulties, deficits in balance and spatial awareness (Miyahara, 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 behaviours, impoverished social ties, and

drug or substance abuse in later years (Bassarath, 2001; Patterson, DeGarmo, & Knutson, 2000). Research in psychomotor behaviours in children with behavioural disorders suggested that tension, restlessness psychomotor agitation, and disturbed development of body awareness are often present (Aendekerk & Verheij, 1997). At educational settings, children with conduct problems deviate from school and social principles, rules and regulations; display delinquent behaviours, 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. Spiker, Lotspeich, Dimiceli, Myers, & Risch, 2002; Constantino & Todd, 2003). Problem behaviours observed with autism include physical aggression, self-injury, property destruction, stereotyped behaviours, and tantrums are highly disruptive to classroom, community, and home environments and without intervention, 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, Boisjoli, Hess, & Wilkins, 2010), the Modified Checklist for Autism in Toddlers (MCHAT; 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 PDD like autism.

1.2 Coexisting disorders and overlap of symptoms

Research indicates 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, 2005), 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), conduct disorder, learning disabilities, and other psychiatric conditions such as anxiety disorders and depression (Klassen, Miller, & Fine, 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 behaviours 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 is a growing area of interest to educational research (Kauffman & Landrum, 2009; Lane, 2007; Nelson, Babyak, Gonzalez, & Benner, 2003).

1.3 The Motor Behaviours Checklist (MBC) for Children

In this study, we introduce the Motor Behaviours Checklist for children (MBC) as a screening instrument to measure the motor related behavioural 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, Loney, Sprafkin, Salisbury, Azizian, et al., 2004) and the ability of educators to observe different aspects of children's behaviours during their lessons with accuracy (Flanagan, Bierman, & Kam, 2003), the Motor Behaviours Checklist (MBC) for children was developed to select physical educator's ratings on children's motor related behaviours.

The Motor Behaviours Checklist for children (MBC; Efstratopoulou, Janssen, & Simons, 2012) is a scale designed to be completed by the PE teacher who knows the child well enough to rate his/her motor related behaviours. Responders are asked to observe the child during physical education classes and free play situations and to rate each behaviours on a 5-point Likert scale ranging from "never" (0) to "almost always" (4). The MBC for children consisted of 59 motor related behaviours items included in two broadband factors (Externalizing and Internalizing) and seven problems 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 behaviours' (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 suggest that the MBC for children is an instrument homogenous in content, with high temporal stability and high correlation agreement.

1.3 Hypotheses for the current study

The present study examines the ability of the Motor Behaviours Checklist for children

(MBC; Efstratopoulou, Janssen, & Simons, 2012) to discriminate four samples of children on the basis of their motor related behaviours. Based on motor behaviours 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 were 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 was 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%).

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 details about the assessment procedure and were asked to rate their students on the 59 items of the Motor Behaviours Checklist (MBC; _Efstratopoulou, Janssen, & Simons, 2012) 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 Greek Ministry of Education and was in line with the guidelines given by the research ethics board of the KU Leuven. Background information and permission for release school records (e.g., special education evaluations and psychoeducational testing results) were also required from the parents of the children in order to examine if the child fulfil 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 behaviours profiles and to examine differences 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 behaviours, Lack of Social interaction, and Lack of Self regulation). In addition, the effect of age and gender on MBC means 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 x 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 higher ($F [3, 79] = 11.04, p < .001$) than the other clinical groups on the ten inattention items of the MBC problem scale.

On the contrary, on the 'Stereotyped behaviours' 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 with the children of the LD ($p < .001$). There were no significant differences with regard to the 'Stereotyped behaviours' 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 differ significantly with the children of the CD ($p < .001$), the LD ($p < .001$), and the children of 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 didn't differ significantly with the children of the ADHD group ($p=.471$) with regard to the means scores 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 on these items. 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 didn't 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 'Lack of Attention', 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 behaviours' and 'Lack of Social interaction' items. In addition, none of the four clinical groups (i.e., CD, ADHD, ASD or LD) were significantly differed from each other with regard to 'Low energy' items, and the children of the LD group didn't score significantly higher than the other clinical groups on any problem scale of the MBC for children.

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 is one among very few studies focusing

only on the motor behaviours characteristics of clinical samples of children. The study investigated the discriminant validity of a new screening instrument (Motor Behaviours 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 (Biedermann et al., 2000), indicates that persistence of inattention and coexisting symptoms of the disorder did 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 (Corrigan, 2003; DuPaul & Stoner, 2003; Hutchison, 2004; Jensen et al., 1997; Berkeley, Zittel, Pitney & Nichols, 2001; Piek & Dyck, 2004), it was hypothesized that the presence of a diagnosis would be associated with significant differences in the motor behaviours 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 high coexistence on behavioural symptoms of impulsivity and hyperactivity between ADHD and CD (Hudziak et al., 2000; Mayes et al., 2000; Jensen et al., 1997; Newcorn et al., 2001; Jensen 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, 1999) the similar behavioural 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 behavioural symptoms of disobedience and violation of rules than the other participants. Interestingly, the LD group appeared to exhibit similar behaviours 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 differ 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 behavioural patterns which are met mainly on children with mood disorders (APA, 2000) and in this study no clinical group diagnosed with mood disorders was involved. On the 'Stereotyped behaviours' problem scale, the children of the ASD group scored significantly higher on mean scores than the children of the other groups.

Although there is high coexistence of symptoms between ASD and ADHD (Gadow et al., 2006; Pierre et al., 1999), results from our study indicate that the specific items describing stereotyped motor behaviours 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 in children diagnosed with autism (APA, 2000; Kasari, Chamberlain, & Bauminger, 2001; Bauminger & Kasari, 2000) describing social impairments and problems in communication and cooperation with teachers and peers as core symptoms of the disorder.

Although research (Jensen et al., 1997; Bluehardt & Shephard, 1995), indicates that children with learning disabilities 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 didn't face 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 behaviours patterns with regard to the 'Lack of Self-regulation' items, as there weren't 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 behaviours which are included in the 'Internalizing' problem scales of the instrument (Stereotyped behaviour, 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; MCHAT; Robins et al., 2001; CARS; Schopler et al., 1988), the MBC for children doesn't focus on a specific disorder but based on children's motor behaviours characteristics, gives the educators the ability to asses an array of problematic behaviours 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-efficacy instrument for assessing student's deviant motor related behaviours. 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 behavioural 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 teaching procedure for 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 research 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 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 research in order to examine the ability of the MBC to differentiate with accuracy children with emotional and behavioural disorders from typical school-aged population.

References

Aendekerck, E., W., C., & Verheij, F. (1997). The psychodynamics of psychomotor therapeutic process of children with conduct disorders. In A. Vermeer, R., J. Bosscher, & G., D. Broadhead (Eds). *Movement Therapy across the Lifespan*. Amsterdam: VU University Press, 76–96.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Aos, S., Lieb, R., Mayfield, J., Miller, M., & Penucci, A. (2004). *Benefits and costs of prevention and early intervention programs for youth*. Olympia, WA: Washington State Institute for Public Policy.

Bassarath L. (2001). Conduct disorder: a biopsychosocial review. *Canadian Journal of Psychiatry*, 46, 609–616.

Bauminger, N., & Kasari, C. (2000). Loneliness and friendship in high-functioning children with autism. *Child Development*, 71, 447–456.

Bennett, S., Dworet, D., & Weber, K. (2008). *Special Education in Ontario Schools (Sixth Edition)*. Highland Press: St. David's.

Berkeley S. L., Zittel L. L., Pitney L. V., & Nichols S. E. (2001). Locomotor and object control skills of children diagnosed with autism. *Adapted Physical Activity Quarterly*, *18*, 405–16.

Biederman, J., Mick, E., & Faraone, S. V. (2000). Age dependent decline of symptoms of attention deficit hyperactivity disorder: Impact of remission definition and symptom type. *American Journal of Psychiatry*, *157*, 816-818.

Bluehardt, M., & Shephard, R. (1995). Using an extracurricular physical activity program to enhance social skills. *Journal of Learning Disabilities*, *28*, 160-169.

Brown, T. (Ed.). (2000). *Attention-deficit disorders and comorbidities in children, adolescents and adults*. Washington, DC: American Psychiatric Press.

Bruininks, R., & Bruininks, B. (2005). *Bruininks-Oseretsky Test of Motor Proficiency-2nd edition manual*. Minneapolis, MN: NCS Pearson.

Chakrabarti, S. & Fombonne, E. (2001). Pervasive developmental disorders in preschool children. *JAMA*, *285*, 3093-3099.

Constantino, J. N., & Todd, R. D. (2003). Autistic traits in the general population: a twin study. *Archives of General Psychiatry*, *60*, 524-530.

Corrigan, B. (2003). Attention Deficit Hyperactivity Disorder in Sport: A Review. *International Journal of Sports Medicine*, *24*, 535-40.

Denckla, M. B. (2003). ADHD: topic update. *Brain Development*, *25*, 383–89.

DiStefano, C., & Kamphaus, R. W. (2007). Development and Validation of a Behavioural Screener for Preschool-Age Children. *Journal of Emotional and Behavioural Disorders*, *15*, 93-102.

Dodge K, (1993). Social-cognitive mechanisms in the development of conduct disorder and depression. *Annual Review of Psychology*, *44*, 559-584.

DuPaul, G., & Stoner, G. (2003). *ADHD in the schools: Assessment and practice*. New York: Guilford.

Eisenberg, N., Fabes, R. A., Guthrie, I. K., & Reiser, M. (2000). Dispositional Emotionality and regulation: Their role in predicting quality of social functioning. *Journal of Personality and Social Psychology*, 78, 136-157.

Epstein, M. A., Shaywitz, S. E., Shaywitz, B. A., & Woolston, J. L. (1991). The boundaries of attention deficit disorder. *Journal of Learning Disabilities*, 24, 78-87.

Flanagan, K. S., Bierman, K. L., & Kam, C. M. (2003). Identifying at-risk children at school entry: The usefulness of multibehavioural problem profiles. *Journal of Clinical Child and Adolescent Psychology*, 32, 396-407.

Gadow, K. D., DeVincent, C. J., Pomeroy, J., & Azizian, A. (2004). Psychiatric symptoms in preschool children with PDD and clinic and comparison samples. *Journal of Autism and Developmental Disorders*, 34, 379-393.

Gadow, K. D., Drabick, D. A. G., Loney, J., Sprafkin, J., Salisbury, H., Azizian, A., et al. (2004). Comparison of ADHD symptom subtypes as source-specific syndromes. *Journal of Child Psychology and Psychiatry*, 45, 1135-1149.

Gadow, K. D., DeVincent, C. J., Pomeroy, J., & Azizian, A. (2005). Comparison of DSM-IV symptoms in elementary school-aged children with PDD versus clinic and community samples. *Autism*, 9, 392-415.

Gadow, K. D., DeVincent, C. J., & Pomeroy, J. (2006). ADHD symptom subtypes in children with pervasive developmental disorder. *Journal of Autism and Developmental Disorders*, 36, 271-283.

Henderson, S. E., & Sugden, D. A. (2007). *Movement Assessment Battery for Children*. Second Edition. London, the Psychological Corporation.

Horner, R., Carr, E., Strain, P., Todd, A., & Reed, H. (2002). Problem behaviours interventions for young children. *Journal of Autism and Developmental Disorders*, 32, 423–446.

Hudziak, J. J., Derks, E. M., Althoff, R. R., Copeland, W., & Boomsma, D. I. (2005). The genetic and environmental contributions to oppositional defiant behaviours: A multiinformant twin study. *Journal of the American Academy of Child & Adolescent Psychiatry*, 44, 907-914.

Hudziak, J. J., Rudiger, L. P., Neale, M. C., Heath, A. C., & Todd, R. D. (2000). A twin study of inattentive, aggressive, and anxious/ depressed behaviours. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 469-476.

Hutchison, N. L. (2004). *Teaching Exception Children and Adolescents*. Toronto: Pearson Prentice Hall.

Jensen, P. S., Hinshaw, S. P., Kraemer, H. C., Lenora, N., Newcorn, J. H., Abikoff, H. B., et al. (2001). ADHD comorbidity findings from the MTA study: Comparing co morbid subgroups. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 147-158.

Jensen, P. S., Martin, D., & Cantwell, D. P. (1997). Comorbidity in ADHD: Implications for research, practice, and DSM-V. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36, 1065-1080.

Johnson, R. C., & Rosén, L. A. (2000). Sports behaviours of ADHD children. *Journal of Attention Disorders*, 4, 150-160.

Kasari, C., Chamberlain, B., & Bauminger, N. (2001). Social emotions and social relationships in autism: can children with autism compensate? In J. Burack, T. Charman, N.

Yirmiya, & P. Zelazo (Eds.), *Development and autism: Perspectives from theory and research*. Hillsdale, NJ: Erlbaum Press.

Kashani, J. H., Allan, W. D., Beck, N. C., Bledsoe, Y., & Reid, J. C. (1997). Dysthymic disorder in clinically referred preschool children. *Journal of the American Academy of Child and Adolescents Psychiatry*, *36*, 1426-1433.

Kauffman, J. M., & Landrum, T. (2009). *Characteristics of emotional and behavioural disorders of children and youth* (8th ed.). Columbus, OH: Merrill.

Klassen, A., Miller, A., & Fine, S. (2004). Health-Related Quality of life in children and adolescents who have a diagnosis of Attention-Deficit/Hyperactivity Disorder. *Pediatrics*, *114*, 541-547.

Kulinna, P. H., Cothran, D. J., & Regualos, R. (2003). Development of an instrument to measure student disruptive behaviours. *Measurement in Physical Education and Exercise Science*, *7*, 25–41.

Landrum, T. J., Tankersley, M., & Kauffman, J. M. (2003). What is special about special education for students with emotional and behavioural disorders? *Journal of Special Education*, *37*, 148–156.

Lane, K. L. (2003). Identifying young students at risk for antisocial behaviours: The utility of “teachers as tests.” *Behavioural Disorders*, *28*, 360–389.

Lane, K. L. (2007). Identifying and supporting students at risk for emotional and behavioural disorders within multi-level models: Data driven approaches to conducting secondary interventions with an academic emphasis. *Education and Treatment of Children*, *30*, 135–164.

Lee, D. O., & Ousley, O. Y. (2006). Attention-deficit hyperactivity disorder symptoms in a clinic sample of children and adolescents with pervasive developmental disorders. *Journal of Child & Adolescent Psychopharmacology*, *16*, 737-746.

Matson, J. L., Boisjoli, J. A., Hess, J. A., & Wilkins, J. (2010). Factor structure and diagnostic fidelity of the Baby and Infant Screen for Children with aUtIsm Traits-Part 1 (BISCUIT-part 1). *Developmental Neurorehabilitation*, *13*, 72-79.

- Mayes, S. D., Calhoun, S. L., & Crowell, E. W. (2000). Learning disabilities and ADHD: Overlapping spectrum disorders. *Journal of Learning Disabilities, 33*, 417-424.
- Moffit, T. E. (2003). Life-course persistent and adolescence-limited antisocial behaviours. In B. B. Lahey, T. E. Moffit, & A. Caspi (Eds.), *Causes of conduct disorder juvenile delinquency* (pp.49-75). New York: Guilford.
- Moffit, T. E., Caspi, A., Rutter, M., & Silva, P. A. (2001). *Sex differences in antisocial behaviour: Conduct disorder, delinquency, and violence in the Dunedin longitudinal study*. New York: Cambridge University Press.
- Mol Lous, A., Wit, C. A. M., De Bruyn, E. J., & Riksen-Walraven, J. M. (2002). Depression markers in young children's play: a comparison between depressed and non depressed 3 to 6 years old in various play situations. *Journal of Child Psychology and Psychiatry, 43*, 1029-1038.
- Miyaraha, M. (1994). Subtypes of students with learning disabilities based upon gross motor functions. *Adapted Physical Activity Quarterly, 11*, 368-382.
- Nelson, N. J., Babyak, A., Gonzalez, J., & Benner, G. J. (2003). An investigation of the types of problem behaviours exhibited by K-12 students with emotional or behavioural disorders in public school settings. *Behavioural Disorders, 28*, 348-359.
- Neuman, R. J., Heath, A., Reich, W., Bucholz, K. K., Madden, P. A. F., Sun, L., et al. (2001). Latent class analysis of ADHD and comorbid symptoms in a population sample of adolescent female twins. *Journal of Child Psychology and Psychiatry, 42*, 933-942.
- Newcorn, J. H., Halperin, J. M., Jensen, P. S., Abikoff, H. B., Arnold, L. E., Cantwell, D. P., et al. (2001). Symptom profiles in children with ADHD: Effects of comorbidity and gender. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*, 137-146.
- Patterson, G. R., DeGarmo, D. S., & Knutson, N. (2000). Hyperactive and antisocial behaviours Comorbid or two points in the same process? *Development and Psychopathology,*

12, 91–106.

Piek, J. P., & Dyck, M. J. (2004). Sensory-motor deficits in children with developmental coordination disorder, attention deficit hyperactivity disorder and autistic disorder. *Human Movement Sciences*, 23, 475–88.

Pierre, C. B., Nolan, E. E., Gadow, K. D., Sverd, J., & Sprafkin, J. (1999). Comparison of internalizing and externalizing symptoms in children with attention-deficit hyperactivity disorder with and without co morbid tic disorder. *Journal of Developmental and Behavioural Pediatrics*, 20, 170-176.

Pliszka S. R., Carlson, C. L., Swanson, J. M., (1999). *ADHD with Co morbid Disorders: Clinical Assessment and Management*. New York: Guilford.

Reid, H. M., & Norvilitis, J. M. (2000). Evidence for anomalous lateralization across domains in ADHD children as well as adults identified with the Wender Utah rating scale. *Journal of Psychiatric Research*, 34, 311–316.

Robins, D. L., Fein, D., & Barton, M. L. (1999). *The Modified Checklist for Autism in Toddlers(M-CHAT)*. Storrs, CT: Self published.

Sadock, B. J., Sadock, V. A. (2003). *Kaplan and Sadock's Synopsis of Psychiatry*, 9th ed. Philadelphia: Lippincott Williams & Wilkins.

Schopler, E., Reichler, R., & Renner, B. (1988). *The Childhood Autism Rating Scale (CARS)*. Los Angeles: Western Psychological Services.

Sherrill, C. (1998). *Adapted Physical Activity, Recreation, and Sport: Cross disciplinary and Lifespan*, 5th edition. Dubuque, IA: MCB/McGraw-Hill.

Skuse, H. D., Mandy, L. P. W., & Scourfield, J. (2005). Measuring autistic traits: heritability, reliability and validity of the Social and Communication Disorders Checklist. *British Journal of Psychiatry*, 187, 568-572.

Smith, S. R., Wingenfeld, S. A., Hilsenroth, M. J., Reddy, L. A., & LeBuffe, P. A. (2000). Use of the Devereux Scales of Mental Disorders in the Assessment of Attention-Deficit/Hyperactivity Disorder and Conduct Disorder. *Journal of Psychopathology and Behavioural Assessment*, 22, 237-255.

Snyder, J. (2004). Child impulsiveness-inattention, early peer experiences, and the development of early onset conduct problems. *Journal of Abnormal Child Psychology*, 32, 579-594.

Spielberger, C. D. (1973). *Manual for the State-Trait Anxiety Inventory for Children*. Palo Alto, CA: Consulting Psychologists Press.

Spiker, D., Lotspeich, L. J., Dimiceli, S., Myers, R., & Risch, N. (2002). Behavioural phenotypic variation in autism multiplex families: evidence for a continuous severity gradient. *American Journal of Medical Genetics*, 114, 129-136.

SPSS 15.0. (2006). *Statistical Package for the Social Sciences. Command Syntax Reference*. SPSS Inc., Chicago III.

Ulrich, D. (2000). *Test of gross motor development. Examiner's manual (2nd ed.)*. Austin, Texas: PRO-ED.

Volkmar, F. R., Lord, C., Bailey, A., Schultz, R. T. & Klin, A. (2004). Autism and pervasive developmental disorders. *Journal of Child Psychology and Psychiatry*, 45, 135-170.

Wagner, M., Kutash, K., Duchnowski, A. J., Epstein, M. H., & Sumi, W. C. (2005). The children and youth we serve: A national picture of the characteristics of students with emotional disturbance receiving special education services. *Journal of Emotional and Behavioural Disorders*, 13, 79-96.

Waller, R. J., Waller, K. S., Schramm, M. L., & Bresson, D. J. (2006). Conduct disorder. In R. J. Waller (Ed.), *Educator's Guide to Child and Adolescent Mental Health*. Thousand Oaks, CA: Sage.

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Webster-Stratton, C., Reid, J. M., & Hammond, M. (2004). Treating children with early-onset conduct problems: intervention outcomes for parent, child, and teacher training. *Journal of Clinical Child and Adolescent Psychology, 33*, 105–124.

Wolfe, J. (1996). Relations of cognitive functions associated with the frontal lobes and learning disorders in children. *Psychological Reports, 79*, 323-333.

Yeargin-Allsopp, M., Rice, C., Karapurkar, T., Doernberg N., Boyle, C., & Murphy, C. (2003). Prevalence of autism in a US metropolitan area. *JAMA, 289*, 49-55.