ORIGINAL ARTICLE

Construct validity of The Democritos Movement Screening Tool for preschool children: an examination of the known groups' criterion

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Abstract

The aim of the present study was to examine the construct validity of the DEMOST-PRE©, using the criterion of the known groups. For that purpose, the performance of 18 children with autism spectrum disorders (ASD), aged 48-72 months (M=66.6, SD=8.05 months) and 12 with intellectual disabilities (ID) (M=62, SD=9.42 months) on the nine items of the DEMOST-PRE© was compared to that of 18 typically developing peers (TD) (M=64.9, SD=8.74 months). According to the results, TD children demonstrated significantly higher scores than both the ASD and ID groups of children in all test items except the 'overhead toss to a specific target' (F2,45= 2,659, p =.081), while the performances of ASD and ID groups were similar. The current findings provide support for the construct validity of the DEMOST-PRE© indicating that it can serve as a valuable tool for preschool aged children.

Key Words: DEMOST-PRE, validity, autism spectrum disorder, intellectual disability

In recent decades motor development is studied by many researchers, particularly focused on preschool age, as in this very critical period marked by the beginning of their school life, children should have developed their fundamental movement skills in order to deal with the demands of the school and playground environments (Chambers & Sugden, 2002). Developmental disorders associated with children's motor proficiency, such as Developmental Coordination Disorders (DCD), do not only impede children's participation in physical activity and sports, but they also have significant academic and social impacts (Hendersson & Hall, 1982). These disorders are closely associated with difficulties in writing, copying, and drawing (Barnett & Henderson, 1992), as well as with cognitive, language, social, and emotional problems (Piek, Hands & Licary, 2012), such as low self-esteem (Schoemaker & Kalverboer, 1994) and high levels of anxiety (Skinner & Piek, 2001).

Motor assessment is valuable in indentifying children with developmental disorders and it is the first step in order for the appropriate intervention to be made (Chambers & Sugden, 2002). Thus,

not only children's motor skills will be improved, but also their academic, psychosocial, and health problems associated with reduced motor proficiency will be prevented or reduced (Piek et al., 2012). In recent years, plenty of motor assessment tools have been developed and are currently available. Among the most commonly used are: the Movement Assessment Battery for Children- Second Edition (Henderson, Sugden & Barnett, 2007; [MABC-2]); the Bruininks-Oseretsky Test of Motor Proficiency-2 (Bruininks & Bruininks, 2005; [BOTMP-2]); the Test of Gross Motor Development-2 (Ulrich, 2000; [TGMD-2]); and the Motoriktest für vier- bis sechsjährige Kinder (Zimmer & Volkmaker, 1987; [MOT 4-6]).

Motor assessment tools are needed to be checked for their validity and reliability in order to provide as precise as possible estimation of the examinees' motor development (Brantner, Piek & Smith, 2009; Deitz, Kartin & Kopp, 2007; Sun, Sun, Zhu, Huang & Hsieh, 2011). Such checks are also essential when a tool is to be used in a new context and/or population (Chui, Ng, Fong, Lin & Ng, 2007; Schoemaker, Niemeijer, Flapper & Smits-Engelsman, 2012; Valentini, Ramalho, Oliveira, 2014). In Greece, in recent years, several studies have been carried out in order to evaluate the validity and reliability of the aforesaid tools in Greek population (Ellinoudis et al., 2011; Kambas et al., 2012; Venetsanou, Kambas, Aggelousis, Serbezis & Taxildaris, 2007; Venetsanou, Kambas, Aggelousis, Fatouros & Taxildaris, 2009).

Among the aforementioned movement assessment tools, the MOT 4-6 (Zimmer & Volkmaker, 1987) is the only tool specialized in preschool age. The study of Kambas et al. (2012), in which the suitability of the MOT 4-6 for the Greek population was investigated, showed that the MOT 4-6 is a useful tool for the motor assessment of preschool children. However, both the MOT 4-6 and the other motor assessment tools have some characteristics that cause problems in their use in Greece. Specifically, some of them are quite expensive (BOTMP, M-ABC) or time-consuming (MOT 4-6, BOTMP-LF) (Kambas & Venetsanou, 2014), a characteristic that causes problems in the assessment of preschool children due to the fact that their attention-span is not longer than 15-30 minutes (Werner, 1994). Additionally, excluding the MOT 4-6, the above-mentioned tools cover a wide age range (the BOTMP-2 is aimed at children and youths aged 4-21 years and the MABC-2 relates to an age range from 4 to 16 years). This wide age range gain risks because an evaluation tool should have the sensitivity to distinguish between changes in

motor proficiency associated with the age of the examinees' (Campbell, Kolobe, Osten, Lenke & Girolami, 1995).

Kambas, Venetsanou and Gavriilidou (2013), taking into consideration both the unique characteristics of preschool aged children and the conditions in Greek preschool settings, constructed the Democritos Movement Screening Tool for preschool children (DEMOST-PRE©), an assessment tool that aspires to be used for motor detection of children aged 4-6 years. The DEMOST-PRE© has several characteristics that render it promising: a) it is cost effective, requiring only few specialized materials, b) its administration requires only 15 minutes, c) its items are presented to the examinees through a fairytale motivating them to participate, d) it can be easily administered by any preschool professional. The authors have examined the criteria of content and face validity, and, according to their results, the initial evidence that the items included represent the fundamental areas of motor proficiency providing a brief overview of motor development level in preschool children is offered (Kambas & Venetsanou, 2014). In addition, the DEMOST-PRE© factorial validity was examined in 435 children and has given satisfactory results (Kambas & Venetsanou, 2014). Finally, the DEMOST-PRE© has been found to differentiate the performance of different age groups and present adequate concurrent validity with the BOTMP-LF (Kambas & Venetsanou, 2016); however, further research is needed in order to enhance the validity of the battery.

One of the criteria used in order for construct validity to be examined is that of known groups. Using this method, the performances of two groups of individuals who would be expected to differ on the construct measured by a test are compared. According to the literature, children with developmental disorders, such as autism spectrum disorders (ASD) and intellectual disabilities (ID), demonstrate significantly poorer motor proficiency than their typically developing peers (Hartman, Houwen, Scherder & Visscher, 2010; Hilton et al., 2007; Liu & Breslin, 2013; Liu, Hamilton, Davis & ElGarhy, 2014; Rintala & Loovis, 2013; Siaperas et al., 2012; Westendorp, Houwen, Hartman & Visscher, 2011).

Evidence for the examination of the known group validity criterion is provided in the manuals of several standardized motor assessment tools. For example, comparisons between children with ASD and their typically developing peers are demonstrated in the manual of MABC-2

(Henderson et al., 2007). These data reveal significant differences in their motor competence with the autistic ones to be significantly motor impaired. Also, Henderson et al. (2007) provide information about children with cognitive impairments that obtained lower scores, with particular problems on manual dexterity and dynamic balance tasks, than the typically developing ones. Moreover, data are also presented in the manual of the BOTMP (Bruininks, 1978) concerning participants with intellectual disability (mildly retarded and moderately-to-severely retarded) and learning disability, confirming the hypothesis that typically developing participants performed significantly better than the intellectual and learning disabled on the BOTMP. In addition, examinations on individuals with high-function autism/Asperger syndrome and with mild to moderate mental retardation are also presented in the manual of BOT-2 (Bruininks & Bruininks, 2005), demonstrating that their differences from their typically developing peers were statistically significant.

The aim of the present study was to investigate the construct validity of the DEMOST-PRE$^{©}$ (Kambas et al., 2013) using the criterion of known groups. For that purpose, the DEMOST-PRE$^{©}$ was administered to three groups of preschool aged children known to have different levels of motor proficiency (namely, children with ASD; ID and typically developing ones) in order the competence of the battery to differentiate their performance to be examined.

Method

Participants

A total of 48 children participated in the present study. Among them 30 (25 boys and 5 girls), aged from 48 to 72 months, had been diagnosed with neurodevelopmental disorders [18 with ASD (M=66.6, SD=8.05 months) and 12 with ID (M=62, SD=9.42 months)]. Moreover, 18 typically developing children (TD) (15 boys and 3 girls) (M=64.9, SD=8.74 months) participated too.

Children with ASD and ID attended special schools or integration classes in the main stream of the Greek educational system, being supported by a special education teacher, and were randomly selected from the regions of Komotini, Kavala, Xanthi, and Larissa, Greece. The inclusion criteria used for the participants with developmental disorders were (1) able to understand and communicate with the examiner, (2) capable to follow instructions, and (3)

willing to participate in the measurement.   The typically developing participants were selected from schools in the same regions with the ASD and ID participants and they were matched on age and gender. Parents were informed of their rights and the nature of the study, and were asked to sign a consent form prior to their child's participation.

Measurements

The DEMOST-PRE© (Kambas et al., 2013) consists of nine items which are presented to the children through a fairytale. The items included are: Tapping, Jumping repeatedly sideways, Running, carrying and placing a ball in a box, Toe-to-heel walking in a backward direction, Overhead toss to a specific target, Pick up coins and placing them in a box, Stepping through three vertical hoops, Catching a bean bag, Standing jump over a stick. A hand preference test is performed before the administration. The total test time needed for each participant is about 15 minutes. The performance of the examinees' in each item (time needed to complete tasks in seconds, number of dots, number of jumps, etc) is recorded and then converted to a point scale where according to the specific item it can range from 1 to 4, 1 to 9, 1 to 18, etc. The higher the score, the better the performance. Scores on nine items are then added, giving the final score of the instrument.

Procedure

All the measurements took place at the participants' schools during school time in specially modified indoor areas. Each child was measured individually, without the presence of other children. All the measurements were managed by the same examiner, who has been trained in the DEMOST-PRE© (Kambas, et al., 2013) administration and scoring system.

Statistical analysis

All data were analyzed using SPSS 20. One-way analysis variance was performed on the nine item scores, setting as independent variable the factor "group" which had three levels: a) TD population, b) ASD, c) ID. Children's performance in the nine items of the DEMOST-PRE© was defined as dependent variable. Post hoc comparisons were made using the Bonferroni test, with alpha set at .05.

Results

Means and standard deviations of the performance of children with ASD, ID, and typically developing ones are depicted in Table 1. The Anova showed that the factor "group" had a statistically significant effect on children's scores in all test items, except the 'overhead toss to a specific target' ($F_{2,45}$= 2,659, p =.081) (Table 1). According to the results of Bonferroni test, typically developing children had significantly higher scores than both the ASD and ID groups of children, while the performance of the latter two groups does not demonstrated statistically significant differences.

Table 1. Means, Standard Deviations and F Ratios for each item of the DEMOST-PRE by contrast group

*p< .001

DEMOST-PRE items	Typical		Autism		ID		$F_{2,45}$
	Mean	SD	Mean	SD	Mean	SD	
TAPPING	51,94	11,159	5,22	3,703	8,00	4,369	206,185*
JUMPING REPEATIDLY SIDEWAYS	6,78	2,942	1,00	1,612	,64	,924	35,883*
RUNNING/D PLACING A BALL IN A BOX	13,61	4,539	23,43	6,183	24,95	6,516	19,002*
WALKING IN A BACKWARD DIRRECTION	12,67	7,799	1,86	3,325	,20	,632	22,719*
OVERHEAD TOSS TO A TARGET	2,83	2,936	1,11	1,779	1,33	2,270	2,659
PICK UP COINS/PLACING IN A BOX	22,44	8,501	8,00	4,561	7,20	4,638	23,561*
STEPPING THROUGH VERTICAL HOOPS	1,94	,236	,33	,594	,42	,669	53,220*
CATCHING A BEAN BAG	2,56	1,294	,28	,958	,25	,452	28,641*
STANDING JUMP OVER A STICK	3,06	1,434	1,00	1,348	,00	,000	22,839*

Discussion

The aim of the present study was to examine the construct validity of a new motor screening tool for 4 to 6-year-old children, the DEMOST-PRE[©] (Kambas et al., 2013), using the known groups method. A huge number of studies indicates that children with developmental disorders have poor motor proficiency (Hartman et al., 2010; Hilton et al., 2007; Liu & Breslin, 2013; Liu et al., 2014; Pan, 2014; Rintala & Loovis, 2013; Siaperas et al., 2012). That is why the comparison of their performance with that of their typically developing peers is usually a part of the technical

adequacy examination of known motor assessment instruments, such as the BOTMP (Bruininks, 1978) the BOT-2 (Bruininks & Bruininks, 2005) or the MABC 2 (Henderson et al., 2007).

The results of the present study showed that there was a significant difference between the performance of the TD group and that of the ASD and ID ones. Specifically, the TD children demonstrated significantly higher scores on the DEMOST-PRE[©] items, except of the "overhead toss to a specific target", than both the ASD and ID groups, while the performances of children with ASD and ID children were similar. The above findings are in close agreement with previous studies investigating the motor proficiency of children with developmental disorders compared with TD children, using standardized motor assessment tools. More specifically, Hilton et al. (2007) found that children with Asperger syndrome (AS) (n=51) had statistically lower performance on the MABC (Henderson & Sugden, 1992) compared with TD peers (n=56). Additionally, in Liu and Breslin's study (2013), in which the MABC-2 (Henderson et al., 2007) was utilized, children diagnosed with ASD (n=30) demonstrated significant motor delays when compared with their TD peers (n=30). In accordance to this were also the results of Siaperas et al. (2012) who compared the performance of 50 children with AS with that of 50 TD ones on the MABC-2 (Henderson et al., 2007). Similar were the results of studies in which the skills performance was qualitatively assessed, using the TGMD-2 (Ulrich, 2000). Liu et al., (2014) focused on assessing FMS of children with ASD (n=21) with their aged-matched TD (n=21) children and they also found that the ASD group was considered developmentally delayed when compared to their TD peers.

Research focusing on children with ID provides analogous results. Hartman et al. (2010) found that the motor skills of children with borderline ID (n=61, IQ range=71-79) and mild ID (n=36, IQ range= 54-70), as they were measured by the TGMD-2 (Ulrich, 2000), were poor compared to those of TD children (n=97). Similar were the results of Rintala and Loovis (2013) who compared the FMS of children with ID (n=20) with those of TD children (n=20).

A closer look at the individual item scores of the ASD and ID groups can reveal specific impairment areas. The DEMOST-PRE[©] items that are similar to those of other assessment tools seem to provide comparable results with previous studies. For example, ASD and ID children in the present study presented poor scores in "tapping dots" and "transferring pennies" two items that assess manual dexterity. Similar were the results of Pan's study (2014) in which the

participants with ASD demonstrated significant lower scores in manual dexterity tasks, including "tapping dots" and "transferring coins" items, than the non ASD participants.

The items "toss to a specific target" and "catching a bean bag" are similar to tasks included in the object control subtests of TGMD-2 and the ball skills of MABC, where a ball is used instead of a beanbag. The present results on the "catching a beanbag" item are similar to those of studies having used the MABC (Green et al., 2002; Hilton et al. 2007) or the MABC-2 (Siaperas et al. 2012), as well as the TGMD-2 (Rintala & Loovis, 2013; Simons et al. 2008) and reported that children with ASD and ID demonstrated significantly lower scores on catching tasks. As for the item "toss to a specific target", in the present study, children with ASD and ID demonstrated better performance than the catching one task, which is confirmed by the studies of Whyatt and Craig, (2012), and Green et al. (2009). Whyatt and Craig (2012) highlight the lower level of catching performance in ball skill items, specifically in ASD children which "*act 'surprised' or ''startled'' when a ball is thrown towards them*" (pp. 1807). Also in the study of Green et al. (2009), the authors concluded that ball-catching impairment scores were higher than ball-throwing.

Additionally, the balance item of the DEMOST-PRE$^©$, "toe-to-heel walking in a backward direction" is also presented in the BOT-2 as "walking forward heal to toe" and in the dynamic balance subtest of the MABC-2. Our results are in accordance with the study of Green et al. (2009) and Whyatt and Craig (2012), indicating that the higher impairment scores were demonstrated in the balance tasks for children with ASD. The above results are also confirmed for children with ID by the findings of Vuijk, Hartman, Scherder, and Visser (2010). The only study with contradicting findings is that of Stins, Emck, de Vries, Doop, and Beek (2015), in which children with ASD showed no significant differences compared to TD children on the balance subscale of the MABC-2.

The item "running, carrying and placing a ball in a box" of the DEMOST-PRE$^©$ is partially similar to the "speed and agility" item of the BOT. Children with ASD and ID, participating in the present study, demonstrated significantly lower scores on the specific item than their TD peers. This result is in accordance with other studies that used the BOT-2 in children with ASD. More specifically, in the study of Pan (2014), it was demonstrated that the strength and agility mean score of the ASD participants was significantly lower than the TD ones'. Concerning

children with ID the above results are partially supported. According to Wuang, Wang, Huang, and Su (2008) only 1.3% of the ID participating in their study demonstrated impaired scores on the running speed item of the BOT-2

Concerning the remaining three items of the DEMOST-PRE[©], "stepping through three vertical hoops", "jumping repeatedly sideways", and "standing jump over a stick", similar tasks are encountered in the MOT 4-6, but due to the absence of data relating to children with ASD or ID using the MOT 4-6, the results for the specific items cannot be verified.

The results of the present study confirm the ability of the DEMOST-PRE[©] to distinguish children with ASD and ID from their typically developing peers, enhancing in that way the construct validity of the instrument. However, there are a couple of limitations in this study that have to be taken into account. To begin with, the participants come from specific regions (Komotini, Kavala, Xanthi and Larissa) so the results cannot be assured for the rest of Greece. Future work is needed in order to affirm the results for the whole Greek region. Moreover, the small sample of children with developmental disorders (n=30) used in order to establish construct validity is an acknowledged limitation. Additional work with a larger sample is required.

Conclusion

The results of the current study provide sufficient evidence for the construct validity of the DEMOST-PRE[©], depicting its ability to differentiate the performance of children with ASD and ID from their TD peers. Taking into consideration both the current and previous findings about its psychomotor properties (Kambas & Venetsanou, 2014; 2016), it can be concluded that the DEMOST-PRE[©] can serve as a valuable tool for children aged 4 to 6 years. Moreover, apart from offering information about the DEMOST-PRE[©] validity, the present results indicated that children with ASD and ID demonstrate significantly poorer motor proficiency than their TD peers, as it is reported in previous studies (Hartman, et al., 2010; Hilton et al., 2007; Liu & Breslin, 2013; Liu, et al., 2014; Rintala & Loovis, 2013; Siaperas et al., 2012; Westendorp, et al., 2011). The early identification of motor deficits demonstrated in children with ASD and ID will contribute significantly to the design of appropriate intervention programs for the improvement of their motor proficiency.

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