Adaptation of a Developmental Test to Accommodate Young Children with Low Vision

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Structured abstract: *Introduction:* This study analyzed the effects of accommodations for children with low vision in the Griffiths Mental Development Scales–Extended Revised (GMDS-ER). *Methods:* The sample comprised 25 children with low vision and chronological ages between 28 and 76 months. There were two assessment phases: in the first, the Griffiths Scales were administered according to the procedures described in the manual; about two to four weeks later, a second assessment was performed with the same instrument that had been adapted for low vision. *Results:* The results indicated that there were some favorable differences in the use of item accommodations for children with low vision, including statistically significant improvements of scores in subscales A, locomotor; C, language; and E, performance, as well as in the full scale. All children, except one, increased their full scale score; in the subscales, the number of children that increased their scores varied. The combination of different types of accommodations (materials, administration conditions, and success criteria) generated the best results. Still, many children increased their scores with only accommodations to materials (for instance, enhancement of contours and greater visual contrast). *Discussion:* The results demonstrated the importance of adapting developmental standardized tests for children with low vision. Future studies should increase the sample size and control variables related to type of visual impairment. *Implications for practitioners:* Test developers and test users should consider accommodations for young children with low vision. That way, the developmental level could be described more precisely and intervention could be better adjusted to each child's abilities. Furthermore, a more accurate developmental assessment of effective child's competencies and difficulties may be useful in terms of eligibility criteria for special education services.

When children have a specific sensory disability such as visual impairment, they may have more difficulties exploring and understanding the (visual) world around them and may, therefore, be at greater risk of developmental delays (Warren, 1994). Hence, it is very important to assess their development regularly. Furthermore, the assessment of a child's development is a crucial step for the design of an intervention plan, so it should accurately reveal the child's strengths and difficulties. For children with visual impairments, this assumption is no exception.

When information is necessary about a child's level of development in relation to peers, professionals often use individualized, standardized, and norm-referenced developmental assessment instruments. These instruments are designed for children with typical development, and, as a result, the materials, procedures, and instructions do not take into account the specificities of some populations, such as children with low vision. There is, therefore, no guarantee that a developmental assessment conducted with a child who has low vision reflects his or her actual skills, since changing the procedures, instructions, and materials of a particular standardized instrument is not recommended.

Unless accommodations are made in assessment tests, however, assessment practices pose the risk of treating children with disabilities unfairly (Salvia, Ysseldyke, & Bolt, 2013). Children with disabilities may have difficulties on tests if the items are very difficult or impossible to understand due to their disabilities (for example, tests in print or tests with images, lots of visual information, and low contrast may be considered inappropriate for students with severe visual impairments). In addition, children with disabilities may also experience difficulties when trying to carry out the tasks required by the test, and their disability can limit their own ability to respond or renders responses impossible (for example, to fit board pieces in a short period of time or to walk down stairs with one foot on each step, without being allowed to hold the handrail, may be difficult for a young child with visual impairment).

There are tests that take into account the specificity of visual impairment such as the Reynell-Zinkin Scales (Reynell, 1979) and the Oregon Project for Preschool Children who are Blind or Visually Impaired (Andersen, Boigon, Davis, & deWaard, 2007), and that were designed for children with this particular type of impairment. These instruments, however, were originally developed in English and are not always available in other languages and contexts, such as in the case of Portugal. Another solution is to adapt an existing and psychometrically robust instrument that has been designed for the general child population. Accommodations of materials, response possibilities, and procedures may minimize the influence of a disability without changing what the test assesses. As accommodations maintain the item content, norm tables would still be applicable, thus allowing the comparison of the test scores of children with and without disabilities (Visser, Ruiter, van der Meulen, Ruijssenaars, & Timmerman, 2013, 2014).

Although there is a recognized need in the literature for assessment instruments that are specifically adapted to children with visual impairments, there is little empirical research that has demonstrated the reliability and validity of adapted tests for a given country or that has analyzed the effect of such adaptations. For instance, a recent review analyzed contemporary, widely used, and standardized instruments for the developmental assessment of children aged 0–4 years, and concluded that for children with visual impairments no suitable instrument was available (Visser, Ruiter, van der Meulen, Ruijssenaars, & Timmerman, 2012). And only three studies (Ruiter, Nakken, Janssen, Meulen, & Looijestijn, 2011; Visser et al., 2013, 2014) were found that accommodated the procedures, instructions, and materials of a standardized developmental test, namely the Bayley Scales, for the assessment of children with low vision. More specifically, the main accommodations made in these studies included: the extension of time limits so that the child with low vision had enough time to visually and tactually explore materials; the introduction of more color and contrast in the materials (such as vivid and bright colors against a black background); placing objects and pictures closer to the child; the consideration of the child's position in the room (with their back to the window); the lighting in the room; and the additional verbal prompting from the test administrator or parental figure during motor activities. The accommodations were evaluated positively by test administrators and proved to be beneficial for some of the children with visual impairments or motor impairments who participated in the studies (Ruiter et al., 2011; Visser et al., 2013, 2014). Nevertheless, only one of those had a sample totally comprised of children with low vision (Ruiter et al., 2011); the other studies included children with motor impairments (Visser et al., 2013, 2014), visual impairments (Visser et al., 2013), and both visual and motor impairments (Visser et al., 2013, 2014).

In this context, the present study takes as its starting point the Portuguese version of the Griffiths Mental Development Scales–Extended Revised: 2 to 8 years (GMDS-ER 2–8) (Ferreira, Carvalhão, Gil, Ulrich, & Fernandes, 2007a, 2007b). This instrument was created by Griffiths (1984) in the United Kingdom, but it is widely used in Portugal as well as in other countries (such as South Africa—Luiz, Foxcroft, & Stewart, 2001; the Philippines—Reyes et al., 2010; and Greece—Giagazoglou et al., 2006). The GMDS-ER 2–8 assesses the areas of cognition, language, fine and gross motor development, and social-emotional development. Regarding the scales' psychometric properties, it has been demonstrated that they have construct validity across cultures and over time (Luiz et al., 2001: Reyes et al., 2010), and there is other favorable evidence of their validity and accuracy (Ferreira et al., 2007a, 2007b; Griffiths, 1984). In Portugal, the GMDS-ER is one of the few standardized developmental assessment instruments available, and is also one of the most used with young children.

The GMDS-ER has not been adapted for children with low vision in any country. In the current study, the GMDS-ER was adapted to assure its suitability for use with children with low vision and, in particular, to enhance the children's opportunities to show their skills. Items were accommodated in terms of materials, administration conditions, and success criteria in order to minimize the influence of visual impairments in the children's performance. The item time limits were also extended because children with visual impairments generally need more time to complete the tasks. Thus, this study has the following purposes:

1. To determine whether children with low vision would perform differently in each subscale of the GMDS-ER with and without accommodations and to define what types of accommodations were more and less effective. Results will be analyzed quantitatively and qualitatively.
2. To obtain information concerning the development of Portuguese young

children with low vision. The research available about the development of children with visual impairments is restricted, mainly to North America (Celeste, 2006, 2007; Hatton, Bailey, Burchinal, & Ferrel, 1997; Lewis & Iselin, 2002) and focused on blindness (Brambring, 2001, 2006, 2007; Celeste, 2006, 2007; Warren, 1994).

Methods

Study design

This study used a within-subject design and included, first, the administration of the GMDS-ER 2–8 to children with low vision according to the procedures described in the manual (standard version). Next, the authors identified the accommodations that were to be introduced into several items that might reduce the impact of the visual impairment on the children's performance, in the various developmental areas assessed. Two to four weeks later (*M* = 22.2 days; *SD* = 4.1 days; *Min.* = 16 days; *Max.* = 34 days), a second assessment was performed with the same instrument, now adapted for low vision (the accommodated version).

At the second assessment, only those items that the child had previously failed and those that required timing were administered. This procedure was implemented for the following reasons: to reduce the GMDS-ER 2–8 administration time, which is usually long, since it includes six subscales and a maximum of 228 items; and to avoid fatigue in the children since they were being retested shortly after having completed the first assessment. Loss of acquired skills was not expected. In addition, the decision to re-administer all the items that required timing ensured that the children with low vision had the time they needed for exploring the materials and completing the tasks. In short, this procedure seemed unlikely to affect children's scores.

Participants

The sample comprised children monitored by the Support Centre to Early Intervention in Visual Impairment (Centro de Apoio à Intervenção Precoce na Deficiência Visual [CAIPDV]), a part of the National Association of Early Intervention (Associação Nacional de Intervenção Precoce [ANIP]). The CAIPDV monitors visually impaired children from birth to age 6 years who live in the center of Portugal. The criteria for sample selection were: age (between 2 and 6 years); the type of visual impairment, including only low vision due to "potentially simple" congenital peripheral visual pathologies (cerebral visual etiologies were excluded); and a severe level of visual impairment, that is, form (spatial) vision or awareness of visual targets that do not reflect light. These criteria are consistent with the ones proposed by Sonksen and Dale (2002) concerning the categorization of children with visual impairments who participate in developmental studies, as well as with the need to control for confounding variables.

Thus, the sample included 25 children with low vision, of which 18 were boys and 7 were girls, aged between 28 and 76 months (*M* = 56 months, *SD* = 15.3). To grade the level of visual impairment, the Near Detection Vision Scale was applied (Sonksen & Dale, 2002).

This is a 0-to-9–point functional scale that grades degrees of impairment and levels of vision lower than the limits of other scales—Snellen size 60 at 1 meter (about 3.3 feet), logMAR 1.8 at 1 meter, grating acuity 0.18 cycles/degree at 38 centimeters (about 15 inches)—and is used with children who have already been identified as having visual impairments. A functional scale seems essential for preschool children with visual impairments whose visual acuity cannot be recorded using optotypes. The Near Detection Vision Scale assesses fixation or tracking of stationary or moving targets (easily performed by typically sighted children); 0 points corresponds to sunlight perception (profound visual impairment) and 2 or more points to form vision (severe visual impairment) (Sonksen & Dale, 2002). Approximately 96% of the children obtained a score of 9 points (fixation on a stable object of 0.12 centimeters [0.05 inches] diameter), and 4% of the children had a score of 8 points (fixation on a stable object of 0.25 centimeters [0.1 inches] diameter). Both objects were presented at 30 cm [11.8 inches] distance and contrasted against a dark-green cloth on a table surface. Hence, the sample included children with severe visual impairments and, therefore, form (spatial) vision, since all children achieved scores equal to or higher than 2 points. Furthermore, the severe visual impairment had very diverse causes, with high myopia ($n = 7$), nystagmus ($n = 3$), ocular albinism ($n = 3$), and glaucoma ($n = 3$) being the most frequent pathologies.

Approximately 56% of the children belonged to a low socioeconomic level, 24% to a medium one, and 20% to a high one. Socioeconomic level was determined according to a classification system created and used with the Portuguese population in the national standardization of tests (Simões, 2000). This system takes into account the main occupation, job situation, and school level of the child's parents or caregivers. The information was collected by interviewing the children's parents (usually the mother). The parents of all children participating in the study gave their informed consent.

Instrument

The GMDS-ER 2–8 consists of six subscales: A, locomotor, which measures gross motor skills, including balance, coordination, and movement control; B, personal-social, measuring the proficiency of the child's autonomy in daily activities, as well as the ability to interact with peers; C, language, which assesses receptive and expressive language; D, eye and hand coordination, measuring the child's fine motor skills, manual dexterity, and visual-motor skills; E, performance, which assesses visual-spatial skills, including speed of working and precision; and F, practical reasoning, which measures the child's ability to solve practical problems, sort sequences, and understand basic mathematical concepts and moral issues (such as understanding right and wrong). It is possible to calculate scores for each of these subscales and for the full scale, which encompasses all subscales.

Griffiths Mental Development Scales —Accommodated Version

The first step in the process of adapting the GMDS-ER for children with low vision was to research the accommodations performed in other studies reported in the literature (Ruiter et al., 2011; Visser et al., 2013, 2014). In addition, all GMDS-ER 2–8 items were explored to assess which accommodations would be necessary. Observations of how each child performed the tasks proposed in the first assessment (without accommodations) also provided clues on the accommodations necessary. The long experience of the first author in working with children with low vision was also a factor taken into account when defining the accommodations necessary for each item. The accommodations were also developed in close cooperation with assessment experts and practitioners working with children with visual impairments.

Accommodations were made to the materials, administration conditions, and success criteria (response and time). These accommodations included the enhancement of contours (such as images using a black marker); image magnification (for instance, block patterns or images); the use of the reading stand; isolation of visual stimulus (for instance, for copying figures or for describing a big image); and contrast enhancement (such as the use of yellow cubes instead of brown ones, providing greater contrast with the black box).

The accommodations to administration conditions comprised better lighting in the work area; the substitution of the mandatory visual demonstration of the task (such as cutting with scissors) as it was performed by the examiner, by having the examiner and child performing the task together; and the tactile exploration of the material before performing the task (for example, puzzle pieces, blocks, or boxes). These accommodations took place, mainly, in items that required eye and hand coordination. Visual demonstration of the task is mandatory in several items of the GMDS-ER, so the examiner demonstrated the task before asking the child to perform it. This procedure could be inaccessible to a child with low vision (for instance, the child may not see how the examiner had cut a piece of paper with scissors), so if the child failed the item, the visual demonstration was replaced by a demonstration with the physical assistance of the examiner (by the examiner holding the paper and giving the scissors to the child). After the demonstration, the child performed the task by herself.

The accommodations related to success criteria involved determining a performance conducted with a little assistance (such as holding the handrail while going up stairs) as successful. These accommodations were used with a small number of items of the locomotor subscale: while going up or down stairs the child could hold the handrail; while running up or down stairs the child could also hold the handrail; the child could ride a bicycle or a tricycle in the presence of an adult or in familiar places. These accommodations were intended to ensure that the children with low vision could show their skills with safety.

The accommodated items were organized into three mutually exclusive categories: items included in category 1 that required accommodation of the materials or administration conditions; category 2 included the items requiring accommodation of the success criteria; and category 3 comprised those items that required two or more of the aforementioned accommodations, particularly in terms of materials, administration conditions, and success criteria. In the specific case of this category, accommodations could also include extension of time limits, which we decided to extend by one-third, as proposed by Ruiter et al. (2011).

The largest number of accommodations occurred in motor or visual-motor

Table 1
Raw scores and developmental ages in the standard and accommodated versions.

Subscales	Raw scores M	Raw scores SD	t^a/W^b	Developmental ages M	Developmental ages SD	t^a/W^b
A. Locomotor	57.74	21.68	-3.12^{*a}	49.08	17.14	-3.08^{*a}
A. Locomotor, with accommodations	58.70	21.63		49.94	17.27	
B. Personal-social	63.81	18.20	-1.00^{b}	53.18	15.61	-1.00^{b}
B. Personal-social, with accommodations	63.89	18.21		53.26	15.61	
C. Language	62.23	23.19	-2.82^{*a}	50.80	18.73	-2.85^{*a}
C. Language, with accommodations	63.91	22.71		51.94	18.34	
D. Eye-hand coordination	56.15	22.30	-2.90^{*a}	49.64	16.29	-1.87^{a}
D. Eye-hand coordination, with accommodations	57.24	22.45		50.78	17.35	
E. Performance	56.50	20.68	-8.44^{*a}	52.42	24.83	-3.83^{*b}
E. Performance, with accommodations	64.49	21.99		61.84	26.18	
F. Practical reasoning	57.36	23.03	-1.45^{a}	47.82	15.29	-1.45^{a}
F. Practical reasoning, with accommodations	57.52	23.02		47.94	15.27	
Full scale	58.90	20.42	-7.49^{*a}	50.04	16.63	-5.99^{*a}
Full scale, with accommodations	61.09	20.63		52.40	17.67	

* $p < .05$.
[a] Paired samples *t* test.
[b] Wilcoxon signed-ranks test.

subscales, specifically in the locomotor (22 items accommodated), eye and hand coordination (27 items accommodated), and performance (38 items accommodated) subscales. Of a total of 228 items, 108 items were accommodated as follows: 68 items with category-1 accommodations; 7 items with category-2 accommodations; and 33 items with category-3 accommodations.

Results

Preliminary data analysis indicated three outliers in developmental ages (one in subscale D with accommodations; one in subscale F; and one in subscale F with accommodations). These extreme values were Winsorized (Wilcox, 2005).

Developmental ages were derived through reference tables of the normative sample. Concerning the accommodated version, all the items passed on the first administration were scored as passed on the second administration. The items administered (previously failed and those that required timing) were scored again. Table 1 shows the raw scores and developmental ages obtained.

The raw scores and developmental ages of each of the subscales and of the full scale (see Table 1) with and without accommodations for low vision indicated the existence of differences between the standard and the accommodated versions. This was evident in the means, which were slightly higher for the accommodated version, especially in subscale E (performance), which displayed the largest differences.

In order to test these differences, the distribution of all the variables was examined with the Shapiro-Wilk test, which is considered suitable for small samples (Field, 2000). All the variables showed a normal distribution ($p > 0.05$), except the

Table 2
Score increases from the first to the second assessment.

Subscale	Category accommodations 1	2	3	Score increase	*n*	%
A. Locomotor (38 items)	15	7	0	Yes	9	36
				No	16	64
B. Personal-social (38 items)	5	0	0	Yes	1	4
				No	24	96
C. Language (38 items)	7	0	0	Yes	9	36
				No	16	64
D. Eye-hand coordination (38 items)	26	0	1	Yes	8	32
				No	17	68
E. Performance (38 items)	6	0	32	Yes	22	88
				No	3	12
F. Practical reasoning (38 items)	9	0	0	Yes	2	8
				No	23	92
Full scale	68	7	33	Yes	24	96
				No	1	4

following ones: raw scores of subscale B with (p = .004) and without (p = .006) accommodations; developmental ages of subscale B with (p = .014) and without (p = .019) accommodations; and developmental ages of subscale E with (p = .005) and without (p = .005) accommodations. Data were compared with the paired samples t test when the distributions were normal, and with the Wilcoxon signed-ranks test when the distributions were not normal. There were significant differences ($p < .05$) in the raw scores and developmental ages in subscale D (eye and hand coordination) between the standard and the accommodated versions. In addition, at both the raw score and developmental age levels, there were significant differences in subscale A (locomotor), subscale C (language), subscale E (performance), and the full scale.

Regarding the score increase from the first to the second assessment, in terms of the raw scores in each of the subscales and the full scale, Table 2 shows that the scores of 96% of the children increased on the full scale. Analyzing each of the subscales separately, the greatest number of children (88%) increased their score in subscale E (performance). By contrast, subscale B (personal-social) and subscale F (practical reasoning) were those in which the greatest number of children (96% and 92%, respectively) maintained their original scores. These scores are consistent with the number of items accommodated in each of the subscales. All items of subscale E were accommodated, while only five and nine items were accommodated in subscales B and F, respectively.

In regard to the accommodation categories, the score increase was higher in items with category-3 accommodations (88% of the sample), followed by category 1 (56% of the sample), and category 2 (20% of the sample). Table 3 shows the number of children who increased their score per accommodation category.

Table 3
Number of children who increased their score according to accommodation category.

Children who	Items of category 1		Items of category 2		Items of category 3	
	n	%	*n*	%	*n*	%
Did not increase their score	11	44	20	80	3	12
Increased their score by 1 point	5	20	5	20	0	—
Increased their score by 2 points	4	16	0	—	2	8
Increased their score by 3 points	1	4	0	—	4	16
Increased their score by 4 points	1	4	0	—	5	20
Increased their score by 5 points	1	4	0	—	6	24
Increased their score by 6 points	0	—	0	—	1	4
Increased their score by 7 points	2	8	0	—	2	8
Increased their score by 8 points	0	—	0	—	1	4
Increased their score by 9 points	0	—	0	—	1	4
Total	25	100	25	100	25	100

A wide variability in individual performances was observed for each of the accommodation categories when analyzing each participant separately. In particular, the scores of participants 2, 11, and 18 did not improve or improved only slightly, and improvements were most evident in the scores of participants 3, 9, 10, 12, 13, 15, 22, and 24 (see Table 4). The remaining participants showed some improvement in one or more of the accommodations categories.

Table 4
Variability in individual performances.

Participants	Score increase		
	Category 1	Category 2	Category 3
2	0	0	0
3	1	1	6
9	7	0	5
10	5	0	5
11	1	0	2
12	7	0	9
13	2	0	7
15	0	1	7
18	1	0	0
22	4	0	8
24	1	0	5

Discussion

Effects of the accommodations —quantitative analysis

The main objective of this study was to determine what adaptations should be introduced to the GMDS-ER and to analyze the effect of item accommodations on the performance of children with low vision.

Significant differences were found in the raw scores and developmental ages between the standard and the accommodated versions in subscales A (locomotor), C (language) and E (performance), as well as in the full scale. By analyzing the differences between the standard and the accommodated versions, both in raw scores and developmental ages, it was possible to verify that in subscale E (performance), there was an increase of approximately nine months in developmental age, equivalent to 8 raw score points, and that the full scale score increased by a few months. It should be noted that between the administration of the standard and accommodated versions only two to four weeks had elapsed. Regarding the score increases from the original version to the accommodated version, all children except one increased their scores. In each of the subscales, the number of children with increased scores varied.

It is interesting to note that it is in subscale E (performance) that the most significant differences were found. This subscale had the largest number of items with accommodations, especially category-3 accommodations, and was the most effective in terms of the score increases of the participants.

A lack of effectiveness in score increases in items with category-2 accommodations (success criteria) was observed. A possible explanation is that there were only seven items with category-2 accommodations, mainly in subscale A (locomotor). Moreover, taking into account the qualitative observations made during the assessments, if the child had difficulty performing a certain task in the first assessment, having changed only the success criteria did not seem to have an effect on the score (for example, in items related to stairs, the accommodation introduced was the permission to hold the handrail; if the child had difficulty going up and down stairs, holding the handrail did not eliminate this difficulty, although it may have minimized it).

The combination of different types of accommodations (materials, administration conditions, success criteria, and extension of time limits)—that is, category 3—generated the best results. Nonetheless, many subjects increased their scores only with accommodations of the materials (category 1), which means that these accommodations may be sufficient for children with low vision to perform better in accordance with their effective abilities.

Effects of the accommodations—qualitative analysis

In regard to the score increases in each item's accommodation category, the analysis of the individual performance of each of the participants revealed a wide variability that is important to explore (see Table 4). Participants 2, 11, and 18 did not show improvements, while subjects 3, 9, 10, 12, 13, 15, 22, and 24 did show clear improvements. By analyzing the individual characteristics of each child, it is possible to propose some explanations for these results.

Participants 2 and 11, in the assessment with the original scales, already revealed a developmental age within what would be expected for their age, and they had difficulties in seeing faraway objects. Thus, without any concerns about their development and because their type of vision impairment did not greatly interfere in the performance of the assessment tasks, it was somewhat expected that the accommodations would have no effect on their scores. The contrary was observed for participant 18, who was also nearsighted but for whom the assessment with the original scales revealed a developmental delay. Hence, the fact that the accommodations did not have a significant effect on the performance of this child may be explained by the existence of developmental, rather than visual, impairments.

Participants 9, 10, and 12 reached higher scores on items with category-1 accommodations (materials), and their visual performance seemed to be consistent with the type of accommodations made in materials, such as contour enhancement, contrast enhancement, image magnification, and isolation of visual stimulus. Both participants 9 and 10 had nystagmus, which implied difficulty in seeing distant objects but also difficulty in seeing an image clearly (affecting distance vision). As a result, by enhancing the contrast of images, enlarging their details, and isolating the visual stimuli to be copied, it was possible to facilitate a clearer perception of stimuli, which translated into an increased score in items with adapted materials (category 1). As for participant 12, the same hypothesis can be proposed but for different reasons. It turned out that at the time of assessment, this child was under occlusion therapy (the eye with better sight was covered with a patch) to correct an amblyopia, which meant that the child's vision impairment was increased. In this situation, the accommodations introduced in the materials could have improved the ability to perceive visual stimuli.

The scores of participants 3, 13, 15, and 24—and, particularly, of participants 12 and 22—increased in category-3 items (materials, administration conditions, success criteria, and extension of time limits). What these children seemed to have in common was their relatively short concentration or attention span, which cannot be attributed to their visual difficulties or other issues. Thus, as several accommodations were made, they may have facilitated these children's adherence to the assessment. Furthermore, the second assessment was shorter than the first one because the children only performed previously failed items and those that required timing, and this may also explain why the scores of these participants increased markedly.

Development of Portuguese children with low vision

Another objective of this study was to obtain information concerning the development of children with low vision and thus to expand the restricted empirical evidence available. In this context, both in the standard and accommodated versions, lower means in raw scores and developmental ages were observed in subscales A (locomotor), D (eye and hand coordination), and F (practical reasoning), which is consistent with findings in the literature. Subscale A (locomotor) assesses gross motor skills, including balance, coordination, and movement control (Ferreira et al., 2007a, 2007b), and lower scores in this area are not uncommon for the population of children with visual impairments, as demonstrated by studies by Hatton and colleagues (1997) and Brambring (2001, 2006). Regarding subscale D (eye and hand coordination), which evaluates fine motor skills, manual dexterity, and visual-motor skills (Ferreira et al., 2007a, 2007b), the low scores observed are in accordance with the scores found by Brambring (2007). In the case of subscale F (practical reasoning), which assesses the ability to solve practical problems, sort sequences, and understand basic mathematical concepts and moral issues, several authors reported difficulties with visually impaired children at this level (Hatton et al., 1997; Randò et al., 2005). Specifically, Bals, Gringhuis, Moonen, and Woundenberg (2002) reported that some aspects of the cognitive development of children with visual impairments can be more vulnerable, leading to the difficulty in ordering events, inadequate inference of cause and effect, and inadequate conceptualization, because of the fragmented way in which visual information is received. In addition, children with visual impairments must perform mental operations based on very limited sensory information, which leads to a different understanding of their environment and the effects of their actions in their environment (Lueck, Chen, & Kekelis, 1997).

In contrast, and in comparison with the other subscales, higher scores were observed in subscale B (personal-social), which assesses the proficiency of the child's autonomy in daily activities, level of independence, and ability to interact with peers, indicating that there are no important difficulties in the activities of everyday life. The subscales language and performance also showed higher scores, and in the case of performance especially when accommodations were provided. Indeed, the mean developmental ages of the children with low vision in the personal-social (M = 53.18), language (M = 50.80), and performance (M = 52.42) subscales were close to their mean chronological age (M = 56 months). This indicates that language, visual-spatial skills, and processing speed, at least at this point in time and in this sample, are not necessarily vulnerable areas in low vision.

Limitations

The results demonstrated the importance of accommodating developmental assessments for children with low vision; nevertheless, since the children were assessed twice with versions of the same instrument, it is not possible to rule out the influence of maturation or familiarity with the instrument. This limitation could be addressed if there was a control group of children with low vision who were assessed twice with the standard version; that is, under the same conditions as the first administration.

It is important to indicate, however, that the time interval between the first and the second assessment moments was carefully considered in order to allow the comparison of the data collected in the two different moments while trying to minimize maturation or learning effects. Thus, a two- to four-week period between the first and second assessment is usual in dynamic assessment studies (Swanson & Lussier, 2001). A shorter interval, as chosen in other, similar, studies (Ruiter et al., 2011; Visser et al, 2014), would be more sensitive to learning or practice effects. Also, and as shown previously, the children who participated in this study presented some difficulties in certain developmental domains. These difficulties may have attenuated maturation effects since, as stated by Visser et al. (2014), the combination of impaired development of children with relatively older chronological age (M = 56 months) should result in no great difference in developmental level being expected within two to four weeks.

Another limitation of this study is related to the sample size. The fact that the sample was small did not allow for a definitive demonstration of the effectiveness of the accommodations of the GMDS-ER made for low vision.

Future research

A suggestion for further study is the existence of a control group, with sighted children, in order to verify whether the accommodations made preserved the construct validity. If the scales' scores of sighted children on both versions did not differ significantly, then item difficulty would remain the same and it would be possible to rule out learning effects. This control group would also allow the comparison of the performance among children with and without low vision.

Future studies should also increase the sample size and control variables related to the type of visual impairment and the presence of developmental delays. Nevertheless, it must be acknowledged that the children who participated in this study had low vision due to "potentially simple" congenital peripheral visual pathologies. According to Sonksen and Dale (2002), these cases of low vision have the lowest potential for confounding variables, which strengthens the validity of the research and of the results obtained. However, these cases are very rare in western countries (Sonksen & Dale, 2002), and especially so in a country with a low population, such as Portugal. It is worth remembering that the sample was collected in only the central region of Portugal, comprising six districts.

Another suggestion for future study is related to the sample characteristics, specifically with respect to the type of visual impairment. It would be important to control this variable and use a sample in which the children are primarily farsighted or in which there is a balance between near- and farsighted children.

In terms of the accommodations introduced, we sought, as much as possible, to maintain the characteristics of the original scales regarding materials, procedures, and instructions. The need for more radical accommodations that are farther from what is mentioned in the manual should be investigated. Nonetheless, it may be difficult to introduce accommodations that "serve" all children with low vision, even those who are farsighted, because for some it may be useful to enlarge the image but, for others, especially those who have a reduced field of vision, it may not. In future studies, the accommodations should also be analyzed individually in order to identify the ones that generate the best results.

Implications for practitioners

Regarding the implications for practice of professionals working with children with low vision, test developers and test users should consider accommodations for young children with low vision. Both the accommodations and the scores obtained should be shared with parents, preschool teachers, and other professionals so that a developmental level could be described more precisely and information could be gained about how the child manifests a particular skill, the barriers to successful performance, and the conditions and type of materials that tended to prove most helpful. Thus, intervention can be better adjusted to the abilities of each child. Furthermore, a more accurate developmental assessment of a child's effective competencies and difficulties may be useful in terms of eligibility criteria for special education services.

References

Andersen, S., Boigon, S., Davis, K., & deWaard, C. (2007). *The Oregon Project for Preschool Children Who Are Blind or Visually Impaired* (6th ed.). Medford, OR: Southern Oregon Education Service District.

Bals, I., Gringhuis, D., Moonen, J., & Woundenberg, P. (2002). Cognitive development. In D. Gringhuis, J. Moonen, & P. von Woudenberg (Eds.), *Children with partial sight: Development, parenting, education and support* (pp. 55–72). Doorn, Netherlands: Bartiméus.

Brambring, M. (2001). Motor activity in children who are blind or partially sighted. *Visual Impairment Research, 3*(1), 41–51. doi: 10.1076/vimr.3.1.41.4415

Brambring, M. (2006). Divergent development of gross motor skills in children who are blind or sighted. *Journal of Visual Impairment & Blindness, 100*(10), 620–634.

Brambring, M. (2007). Divergent development of manual skills in children who are blind or sighted. *Journal of Visual Impairment & Blindness, 101*(4), 212–225.

Celeste, M. (2006). Play behaviors and social interactions of a child who is blind: In theory and practice. *Journal of Visual Impairment & Blindness*, *100*(2), 75–90.

Celeste, M. (2007). Social skills intervention for a child who is blind. *Journal of Visual Impairment & Blindness*, *101*(9), 521–533.

Ferreira, C., Carvalhão, I., Gil, I., Ulrich, M., & Fernandes, S. (2007a). *Escala de Desenvolvimento Mental de Griffiths—Extensão revista (dos 2 aos 8 anos): Manual de Administração* (1ª ed. Portuguesa). [*The Griffiths Mental Development Scales—Extended Revision (2 to 8 years): Administration Manual* (Portuguese 1st Ed.).] Lisboa: CEGOC-TEA.

Ferreira, C., Carvalhão, I., Gil, I., Ulrich, M., & Fernandes, S. (2007b). *Escala de Desenvolvimento Mental de Griffiths—Extensão revista (dos 2 aos 8 anos): Manual Técnico* (1ª ed. Portuguesa). [*The Griffiths Mental Development Scales—Extended Revision (2 to 8 years): Technical Manual* (Portuguese 1st Ed.).] Lisboa: CEGOC-TEA.

Field, A. (2000). *Discovering statistics using SPSS for Windows. Advanced techniques for the beginner.* London: Sage.

Giagazoglou, P., Tsimaras, V., Fotaidou, E., Evaggelinou, C., Tsikoulas, J., & Angelopoulou, N. (2006). Standardization of the motor scales of the Griffiths Test II on children aged 3 to 6 years in Greece. *Child: Care, Health and Development*, *31*(3), 321–330.

Griffiths, R. (1984). *The abilities of young children*. Amersham, UK: ARICD.

Hatton, D., Bailey, D., Burchinal, M., & Ferrel, K. (1997). Developmental growth curves of preschool children with vision impairments. *Child Development*, *68*, 788–806.

Lewis, S., & Iselin, S. A. (2002). A comparison of the independent living skills of primary students with visual impairments and their sighted peers: A pilot study. *Journal of Visual Impairment & Blindness*, *96*(5), 335–344.

Lueck, A., Chen, D., & Kekelis, L. (1997). *Developmental guidelines for infants with visual impairment*. Louisville, KY: American Printing House for the Blind.

Luiz, D. M., Foxcroft, C. D., & Stewart, R. (2001). The construct validity of the Griffiths Scales of Mental Development. *Child: Care, Health and Development*, *27*(1), 73–83.

Randò, T., Baranello, G., Ricci, D., Guzzetta, A., Tinella, F., Biagioni, E.,. . . & Guzzetta, F. (2005). Cognitive competence at the onset of West syndrome: Correlation with EEG patterns and visual function. *Developmental Medicine and Child Neurology, 47*(11), 760–765. doi: 10.1111/j.1469-8749.2005.tb01074.x

Reyes, A., Pacifico, R., Benitez, B., Villanueva-Uy, E., Lam, H., & Ostrea Jr., E. M. (2010). Use of the Griffiths Mental Development Scales in an agro-industrial province in the Philippines. *Child: Care, Health and Development*, *36*(3), 354–360. doi: 10.1111/j.1365-2214.2010.01080.x

Reynell, J. (1979). *Manual for the Reynell-Zinkin Scales, developmental scales for young visually handicapped children—Part 1, mental development*. Windsor, ON, Canada: NFER-Nelson Publishing Company.

Ruiter, S., Nakken, H., Janssen, M., Meulen, B., & Looijestijn, P. (2011). Adaptive assessment of young children with visual impairment. *British Journal of Visual Impairment, 29(2)*, 93–112. doi: 10.1177/0264619611402766

Salvia, J., Ysseldyke, J., & Bolt, S. (2013). *Assessment in special and inclusive* *education* (12th ed.). Belmont, WA: Wadsworth, Cengage Learning.

Simões, M. (2000). *Investigações no âmbito da aferição nacional do teste das Matrizes Progressivas Coloridas de Raven (M.P.C.R.)* [*Investigations in the context of the national standardization of the Raven Colored Progressive Matrices test (RCPM).*]. Coimbra: Fundação Calouste Gulbenkian, Fundação para a Ciência e a Tecnologia, Ministério da Ciência e da Tecnologia [ ].

Sonksen, P., & Dale, N. (2002). Visual impairment in infancy: Impact on neurodevelopmental and neurobiological processes. *Developmental Medicine & Child Neurology, 44*, 782–791. doi: 10.1111/j.1469-8749.2002.tb00287.x

Swanson, H. L., & Lussier, C. M. (2001). A selective synthesis of the experimental literature on dynamic assessment. *Review of Educational Research, 71,* 321–363.

Visser, L., Ruiter, S. A. J., van der Meulen, B. F., Ruijssenaars, W. A. J. J. M., & Timmerman, M. E. (2012). A review of standardized developmental assessment instruments for young children and their applicability for children with special needs. *Journal of Cognitive Education and Psychology*, *11*(2), 103–127. Retrieved from http://dx.doi.org/10.1891/1945-8959.11.2.102

Visser, L., Ruiter, S. A. J., van der Meulen, B. F., Ruijssenaars, W. A. J. J. M., & Timmerman, M. E. (2013). Validity and suitability of the Bayley-III low motor/vision impairment: A comparative study among young children with and without motor and/or visual impairments. *Research in Developmental Disabilities*, *34*, 3736–3745. Retrieved from http://dx.doi.org/10.1016/j.ridd.2013.07.027

Visser, L., Ruiter, S. A. J., van der Meulen, B. F., Ruijssenaars, W. A. J. J. M., & Timmerman, M. E. (2014). Accommodating the Bayley-III for motor and/or visual impairment: A comparative pilot study. *Pediatric Physical Therapy*, *26*, 57–67. doi: 10.1097/PEP.0000000000000004

Warren, D. H. (1994). *Blindness and children: An individual differences approach*. New York: Cambridge Press.

Wilcox, R. R. (2005). *Introduction to robust estimation and hypothesis testing* (2nd ed.). San Diego, CA: Elsevier Academic Press.

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