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Accommodating the Bayley-III with regard to motor and/or visual impairment: a comparative pilot study

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ABSTRACT

Purpose: This study aimed at assessing the validity and usefulness of the Bayley-III Low Motor/Vision accommodated version. Accommodations are adaptations to minimize impairment bias, without altering what the test measures. Of the items, 66% have Low motor accommodations like enlarged materials; 62% have Low vision accommodations. **Method:** Using a within-subject design, we tested 19 children with the accommodated and standard Bayley-III, in randomly counterbalanced order. The children had motor and/or visual impairment and a calendar age between 22 and 90 months. The test administrators completed an evaluation form. **Results:** A subgroup of children benefitted from the accommodations; 2 children obtained a large raw score difference. Test administrators considered the accommodations as practicable, and advantageous for a majority of children. **Conclusion:** The Low Motor/Vision accommodated version seems to validly assess the development of this target population. Future, larger-scale research should study whether the accommodations improve the construct validity of the Bayley-III.

INTRODUCTION

Estimates of the prevalence of special needs in young children (0-3 years) vary, generally ranging from 5% to 10% of the population in the United States and the Netherlands.[1,2] Professionals use standardized instruments to objectively assess the development of children with special needs. This is in conformity with national regulations in, for example, Europe and the United States.[3,4] Substantial numbers of the children with special needs have a motor and/or visual impairment.[5] It is essential that appropriate and fair instruments are available for this group.[6-8] This group is especially in need of developmental assessment, and test results often have a large influence on choices regarding care and education.

However, many professionals indicate that suitable instruments are lacking.[9-13] Applying the standard procedures when testing children with a motor and/or visual impairment seriously threatens the validity of the test results. Most instruments that measure cognitive development in children rely heavily on motor skills, especially in the case of young children, whose language skills are not yet well developed.[14] Test manuals often provide suggestions for adaptations, but using unstandardized adaptations may introduce additional sources of measurement error and bias, and therefore preclude interpreting the test results using the standard norms.[15]

To meet the need for appropriate instruments for children with impairments, one could develop a new instrument for a population of children with a specific impairment. This approach has been taken, for example, in the Mayes Motor-Free Compilation (MMFC)[16] for children with motor impairments. Alternatively, one may accommodate an existing, well-developed and high quality instrument that has been designed for the entire population of young children. Accommodating an instrument implies that changes are made to the format, response possibilities, test circumstances, and/or procedures in order to minimize impairment bias, without

altering what it measures.[17,18] In other words, accommodations do not change the content and difficulty of the test items, but they do increase the construct validity by decreasing the influence of an impairment on the test results. Studies are needed to assess the impact that accommodations have on test validity. If changes to a test are indeed just accommodations, it will then not be necessary to conduct large-scale and time-consuming standardization research for a specific group of children. The original norm tables will apply, hence allowing for a direct comparison of the test results of children with an impairment with the results of typical children of the same calendar age.

In the current study, accommodations were made to the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III)[19] to increase its suitability for assessing children with a motor and/or visual impairment. The aim of the resulting Low Motor/Vision accommodated version is to enhance children's prospects of being able to show their cognitive, language, and motor skills in a test situation. The term "Low" refers to the amount of motor and visual components in the items. We removed the motor and visual components as much as possible in order to obtain an accommodated version. For example, the motor component (e.g., pointing) was eliminated in items designed to measure cognitive ability (e.g., connecting similar pictures). Since our intention was not to change the item content and difficulty, we will be using the term "accommodations" to describe the changes made to the test. The result should be that children for whom the standard version is suitable have equal scores on the accommodated and standard versions of the item (apart from measurement error). We expected that the construct validity of the resulting measurement would increase as a result of a more precise estimation of the competencies of interest. If this proved to be the case, then the use of the standardized Low Motor/Vision accommodated version, combined with the original norm tables, should enable

professionals to compare the development of a child with a motor and/or visual impairment with the typical development of children with the same calendar age.

Comparable research has been done with the Dutch second version of the Bayley Scales of Infant Development (BSID-II-NL).[20] Pilot research into this Low Motor and Low Vision version suggests that the accommodations make the test easier to administer, more engaging for the children, and produce more valid outcomes.[14,21]

The purpose of the present study was to evaluate whether the Low Motor/Vision accommodated version of the Bayley-III would yield more valid test results, when testing children with a motor and/or visual impairment, than the standard version of the instrument. Furthermore, we studied whether the instrument was practicable for the person administering the test.

METHOD

Study design

We evaluated the Low Motor/Vision accommodated version of the Bayley-III in a pilot study using a within-subject design. We tested the children once with the Low Motor/Vision accommodated version and once with the standard version of the Bayley-III. The average time interval was two weeks (range 3 to 22 days, with two outliers of 28 days for child 2 and 45 days for child 8). The target interval was 7 to 14 days, but for organizational reasons it proved to be impossible to meet this target for all the children. However, the impact of this variation in interval length would appear to be limited: the impaired development of the children in combination with their relatively older calendar age (i.e., 22 months or older) should result in no great difference in developmental level being expected within a one-month period.

We also counterbalanced the order in which the children were tested. Eleven children were first tested with the Low Motor/Vision accommodated version and then with the standard version; eight children were tested in the reverse order. As a consequence of age-specific starting points, and of reversal and discontinue rules in the Bayley-III, only part of the items per scale were administered. Note that the actual items administered to a child could differ across the two test administrations as a consequence of differences in responses to the test items.

The referring developmental psychologist filled in a short referral form for each child. A test administrator then tested the child. The nine test administrators in our study were advanced university students in special needs education or psychology, who had gone through an intensive training session to learn how to administer and score the test. After this training session, the test administrators conducted a practice test with five children before starting to test for our research data. Two of these five test administrations were observed via video recording by one of the two principal researchers, who are professionals in administering and training for administering the Bayley-III. For each video, the researcher offered feedback about the interaction with the child (e.g., how to deal with shyness), the way of administering the test items (e.g., "You should remove the colored disks from the picture after each answer by the child"), and the scoring (e.g., "I saw that you also administered item number X, but the stopping rule should already have come into effect at that point"). No serious errors were observed for any of the administrators, and the feedback was limited to only a few feedback points. During the entire testing period, the principal investigators and the test administrators held regular meetings. In those meetings, questions were asked and experiences shared, including discussions about certain items that appeared to be difficult to score in some cases.

The test administrator was the same person across test sessions for 10 of the children and was different for nine of the others. The tests took place in the Netherlands at a rehabilitation center or an organization supporting persons with a visual impairment, which the children attended multiple days a week. A parent or teacher who knew the child well was present during the test.

Participants

Nineteen children participated in this study. The children were referred by the developmental psychologist of the referring organization. The first inclusion criterion for children participating in the study was a diagnosis of mild to severe motor impairment affecting arm and/or hand movement, and/or a diagnosed or suspected visual impairment. Note that a child with a motor impairment affecting only a lower extremity does not meet the inclusion criterion. We expect that such impairments would have no effect on the test score in the standard version of the test, and therefore the Low Motor accommodations only relate to the hands and arms, not the legs. Visual impairment was defined broadly, including disorders of the eye as well as visual impairment due to damage to the brain (e.g., cerebral visual impairment). The developmental psychologist provided the information about diagnoses and impairment via the referral form. We did not obtain any information about the process leading to the diagnosis such as who had made the diagnosis and which instruments had been used.

Additional inclusion criteria were: (a) calendar age between 6 months and 10 years; (b) presumed developmental age between 1 and 42 months (age range Bayley-III); (c) ability of the child to sit upright in a chair or wheelchair so that a table could be used to work upon; (d) ability of the child to use at least one hand; and (e) some visual perception ability (hence blind children

were excluded). The last three criteria describe the minimum abilities needed to perform the actions required for the test items.

Five different organizations referred children on the basis of the inclusion criteria. All the referred children were tested. The test results were used simultaneously for our research and in the diagnostic process performed by that organization. One child was tested with the Low Motor/Vision accommodated version, but could not be tested with the standard version as a consequence of moving out of the region. We excluded this child's data from the study, and the child was not included in the total number of 19.

The mean calendar age of the children at the first testing session was 38 months (range 22-90 months), and there were 11 boys and 8 girls. Table 1 shows detailed information, provided by the developmental psychologist, about the children in terms of calendar age, gender, type of referral organization, diagnoses, and impairment. The children numbered one to eight in Table 1 had a motor impairment (n = 8); the children numbered nine to 19 had a motor and visual impairment (n = 11). We divided the information about the impairment into three categories: disorder or disease (based on the International Classification of Diseases – 10th edition),[22] body functions and structures, and activities (both based on the International Classification of Functioning, Disability and Health – Children and Youth version).[23] A "-" means that the child was not diagnosed with any specific disease or disorder, or that the referral form did not specify any information about the implications of the impairment for the activities of the child. In all of the cases, the referring organization had classified the child as having a motor or visual impairment, and thus granting access to their services.

Both the standard Bayley-III and the Low Motor/Vision accommodated version were administered to all children. Both versions consist of five scales. The children with a primary

visual impairment were administered all five scales. The children with a primary motor impairment were not administered the two scales pertaining to motor abilities. The Motor scales were not accommodated for any motor impairment, because that would have threatened the construct validity of these scales. The impaired skill, in this case, is meant to be measured.

For some of the children (n = 6) the test could not be carried out completely due to time constraints of the organization involved and tiredness of the child, resulting in an early completion of the test for these children. Table 1 shows which scales were administered per child.

- Insert Table 1 about here –

Instruments

The standard version of the Bayley-III is an individually administered instrument that assesses the psychological and psychomotor development of children with a developmental age of between 1 and 42 months. The instrument consists of the scales of Cognition, Receptive Communication, Expressive Communication, Fine Motor Development, and Gross Motor Development. Items are scored positively (1) when a child has shown the target behavior and negatively (0) when not. The starting point depends on the calendar age of the child, and the highest starting point is used when a child is more than 42 months of calendar age. Items before the starting point are then not administered and are automatically scored as 1. The stopping rule is to stop after five consecutive items have been scored 0, and all items after the final administered item are not administered and are automatically scored as 0. The domains of social-emotional development and adaptive behavior were assessable on the basis of primary caregiver

responses to a questionnaire, which was not part of the current research. In this study we used the experimental version of the Dutch Bayley-III, which is identical to the American version, except for the language. Standardization research in the Netherlands is currently ongoing.

The standardization sample of the Bayley-III in the United States included 1,700 children. Validity data were given in the form of moderate to high correlations of Bayley-III test scores with scores on other instruments. The internal consistency and test-retest stability appeared to be good.[24]

Bayley-III Low Motor/Vision accommodated version is similar to the standard version of the test except for the accommodations made to test procedures, item instructions, and play materials. The scoring procedure is also identical to that of the standard version. The accommodations were based on those of the Low Motor and Low Vision accommodated versions of the Dutch Second Edition of the Bayley Scales of Infant Development,[14,21] complemented with accommodations for the new Bayley-III items, which were developed in close cooperation with developmental psychologists working in the field. We did not delete any items.

The Low Motor accommodations were made for the full age range of the Cognition and Language scales. The Low Vision accommodations were made for the full age range of all five scales. We were able to combine the Low Motor and Low Vision accommodations into one test version, which then had the clear advantage that the test was suitable for children with both motor and vision problems.

Items were accommodated in terms of materials, item instructions, or both. Table 2 gives the number of items that were accommodated and the total number of items per scale of the Bayley-III. If possible, we made larger versions of standard test materials that were too small for a child

with a motor impairment to handle because of the need for using mature fine motor skills. We added a placemat colored dark blue and changed the color of most materials to yellow, which provides optimal color contrast with the dark blue placemat.

There were three categories of accommodations to the item instructions: (1) the use of eye pointing instead of finger pointing (Low Motor); (2) support of the child's elbow by the test administrator (Low Motor); and (3) placing objects and pictures closer to the child, if necessary (Low Vision). We applied these accommodations to each applicable item in the Cognition and Communication scales (both Low Motor and Low Vision) and Motor scales (Low Vision only).

In addition to the accommodations in materials and instructions, we accommodated the test procedure by eliminating the time limits for all items, because a motor and/or visual impairment commonly results in more time needed to complete a task. Accommodations to the test procedure thus also apply to those items without any accommodations to the materials or instructions.

- Insert Table 2 about here –

Evaluation form. The test administrator filled in an evaluation form to determine whether the accommodations were practicable for the person administering the test and suitable for the specific child being tested. We defined practicable as "able to be put into practice successfully"[25] and suitable as "right or appropriate for a particular person, purpose, or situation,"[26] in this case for the assessment of a child with a motor and/or visual impairment. If the test administrator differed across test sessions, the form was completed by the person who administered the Low Motor/Vision accommodated version. If a developmental psychologist or teacher observed the

test administration, their feedback was included. The questions in the evaluation form were: “Do the test results from the accommodated version correspond with your view of the developmental level of this specific child?”, “Were the Low Motor/Vision accommodations practicable when testing this child?”, and “What were the advantages of the Low Motor/Vision accommodations for this child when compared to the standard version?”. We also asked for additional comments, and we asked whether the test manual and item instructions were clear and unambiguous, and whether the record form contained all necessary information.

Analysis

We took into consideration the *raw score difference* per scale, which is computed as the raw score on the Low Motor/Vision accommodated version minus the raw score on the standard version. Hence, a positive figure indicates a higher score on the Low Motor/Vision accommodated version than on the standard version. The total raw score was calculated following the default scoring rules of the Bayley-III.

Noting that the total raw score also included non-accommodated items, we also took into consideration the *percentage score difference on adjusted items*. Adjusted items are accommodated items that were actually administered to that specific child using both versions. The percentage indicates how large the improvement (or decline) in test score is, in relation to the total number of adjusted items. In identifying the adjusted items per child, we took into account the impairment of the child. Thus, for children with a motor impairment, we only took into consideration the items with a Low Motor accommodation. For children with a motor as well as a visual impairment, we took into consideration the items with a Low Motor and/or Low Vision accommodation.

We used the percentage score difference rather than the absolute difference, because a score difference of, for example, 3 is a large difference, when only 9 accommodated items are administered, but not so large when 25 items are administered. The reason for considering both the *raw score difference* and the *percentage score difference on adjusted items* as outcome measurements is that both are clinically relevant. The *percentage score difference on adjusted items* is a very clean measurement of the influence of the accommodations. The *raw score* difference is relevant because the raw score is used in daily practice as a basis for the test results. If a child is able to complete an item as a consequence of accommodations, this may influence the course of the test administration. If the discontinue rule is not met at the same point that it would be in the standard version, the child gets the chance to show his or her abilities on items higher on the scale. The *raw score difference* can therefore be larger than the *score difference on adjusted items*.

We expected a higher score on the Low Motor/Vision accommodated version when compared to the standard version, because this would indicate that the child benefited from the accommodations. We used the one-sided one-sample Wilcoxon Signed Rank test adopting a significance level of 0.05 to test whether the median of the *raw score difference* and the median of the *percentage score difference on adjusted items* were significantly larger than zero. With this test, we examined whether support is found for the hypothesis that scores on the Low Motor/Vision accommodated version would be larger than the scores on the standard version in the target population of children.

To answer the research questions of whether the instrument was suitable for the children and practicable for the test administrator, we summarized the answers to the questions in the evaluation form. We identified areas of improvement on the basis of the results of this study.

RESULTS

Test results

We have summarized the test results in Table 3. This table shows the total raw scores on the standard version and the Low Motor/Vision accommodated version, the *raw score difference* (Raw score diff.) and the *percentage score difference on adjusted items* (% score diff. adj. items), per child and per subscale.

From the Wilcoxon Signed Rank tests on the scales of Cognition, and Receptive and Expressive Communication, it appeared that the median was not significantly larger than zero ($p = 0.432$, $p = 0.224$, and $p = 0.340$, respectively). We did the same test on the *percentage score difference on adjusted items* and these results were also not significant ($p = 0.101$, $p = 0.378$, $p = 0.104$, respectively).

As can be seen in Table 3, for all three scales the *raw score difference* indicates that some children obtained equal scores on both versions, some children obtained a higher score on the Low Motor/Vision accommodated version, and some children obtained a higher score on the standard version of the Bayley-III. The two children with a large *raw score difference* on the Cognition scale in favor of the Low Motor/Vision accommodated version (child 2 and child 4) both have a motor impairment and no visual impairment. The test reports revealed that both children had cooperated well during both test administrations. Alertness of the child as a confounding factor had thus probably not played a large role in the test results. The reports also revealed that child 2 had clearly benefitted from the enlarged materials. Except for the motor impairment, there is not much overlap in type of impairment: child 2 has cerebral palsy, while child 4 has psychomotor developmental delay (see also Table 1). Although the children were

both 27 months old at the time of testing, the raw scores are not in the same range, which means that these two children were largely not assessed the same range of items. Therefore, it cannot be deducted from the current data why some children do have a high score difference. The same is valid for child 8 and child 9, who both obtained a relatively large *raw score difference* on the Expressive Communication scale: no overlap in specific impairment or assessed items can be found for these children.

The *percentage score difference on adjusted items* shows that on the Cognition and Expressive Communication scales, some children obtain a substantially higher score on adjusted items in the Low Motor/Vision accommodated version than on the standard version (with 9 and 5 children, respectively, showing an increase). This large benefit for some children is reflected in average percentages of change in the scores on adjusted items of 6% and 11% for Cognition and Expressive Communication, respectively.

The Motor scales were administered to child 18 and child 19 only; both had a visual impairment. We did not include these test results on the Motor scales in Table 3. Child 18 was administered the Low Motor/Vision accommodated version first and scored higher on the standard version for the Fine Motor scale: the *raw score difference* was -5, and the *percentage score difference on adjusted items* was -22% (-4/18). Child 19 was administered the standard version first and scored higher on the Low Motor/Vision accommodated version for the Fine Motor scale: the *raw score difference* was 2, and the *percentage score difference on adjusted items* was 22% (2/9). For the Gross Motor scale, Child 18 had a *raw score difference* of 3 and a *percentage score difference on adjusted items* of 50% (3/6). Child 19 had a *raw score difference* of -4 and a *percentage score difference on adjusted items* of -33% (-3/9), scoring lower on the Low Motor/Vision accommodated version.

The Bayley-III provides age equivalents for each raw score. An age equivalent indicates the average of the ages (in months) at which children in the population obtain that particular raw score. We calculated the age equivalent differences between the two versions of the test (i.e., as Low Motor/Vision minus standard). For the Cognition scale, the range of age equivalent differences in the current sample was -4 months (i.e., standard version age equivalent 4 months higher than the Low Motor/Vision version) to 5 months (i.e., Low Motor/Vision version age equivalent 5 months higher than the standard version). For the Receptive Communication scale, this range was -7 months to 5 months; for Expressive Communication -9 months to 5 months. Thus, for the Cognition, Receptive Communication and Expressive Communication scales, developmental age equivalents of the accommodated versions were up 5 months higher than the one belonging to the standard version, which implies a clinically significant difference. This result should be interpreted with caution, however, because it is not possible to check whether a difference in age equivalent is statistically significant or to provide a confidence interval, as is possible with standardized scores.[24]

These age equivalents are not included in the table for visual clarity's sake, but are very relevant in clinical practice.

- Insert Table 3 about here –

Evaluation form

The test administrators filled out an evaluation form immediately after they had administered the Low Motor/Vision accommodated version. In total, 12 evaluation forms out of 19 (63%) were returned by five different test administrators. The non-response was due to a lack of time on the

part of the test administrators. Table 4 gives a summary of the responses on the three key questions of the evaluation form.

The first question pertained to whether the test results corresponded to the view of the respondent concerning the development of the child. All respondents answered positively, with six of them indicating that this correspondence was caused specifically by the Low Motor/Vision accommodations. We did not observe a difference between children with motor, visual, or motor as well as visual impairment with respect to the answer to this first question.

The second question asked whether the "Low" accommodations were practicable when testing this child. Two respondents indicated that the enlarged stimulus book was not useful, because the distance between the pictures was too large for the child to see all the pictures at once within his or her visual field. Two respondents indicated that the pictures were too dark and had too little contrast. One respondent indicated that the enlarged blocks caused the tower of blocks to become too high for the child to reach the top.

The third question asked what the advantages of the "Low" accommodations were for this child. Respondents could give multiple answers. Five respondents answered that the child benefitted from the accommodations to the test materials, with one of them specifically mentioning the adjusted picture book. Six respondents indicated that the accommodations to the procedures were beneficial, with two of them specifically mentioning the removal of time limits. Two respondents indicated that the accommodations had led to more successful experiences, and one respondent noted that items could now be administered that would otherwise have been skipped.

- Insert Table 4 about here –

DISCUSSION

The current pilot study focused on whether the Low Motor/Vision accommodations to the Bayley-III were practicable for the person administering the test, and suitable and beneficial for the children in the target population.

Considering the whole sample, the statistical tests revealed that the median *raw score difference* and the median *percentage score difference on adjusted items* were not significantly larger than zero. This means that the current data do not support the hypothesis that the majority of the children with a motor and/or visual impairment would obtain a higher score on the Low Motor/Vision accommodated version than on the standard version. The non-significance can be due to a lack of power – the sample size is rather small – or due to an absence of the expected score difference in the population. Even if the latter was the case, the accommodations could be beneficial for some of the children within the target population.

When considering the individuals' *raw score difference* and *percentage score difference on adjusted items*, it is salient that the variability between the children is rather large. The *raw score difference* ranges between -7 and 11 points, and the *percentage score difference on adjusted items* between -33% and 67% across the five scales. We presume that this variability is due to both differences in responses to the accommodations, and to factors as mood, health, and attention level of the child. The latter factors, typically referred to as measurement error, complicate the demonstration of structural differences between the scores on the Low Motor/Vision accommodated version and those on the standard version.

For the Cognition scale, two children (out of 19) stand out by scoring substantially higher (10 and 11 points, 25% and 43%, respectively) on the Cognition scale of the Low Motor/Vision accommodated version, compared to the standard version. This also resulted in a major difference in age equivalent scores (i.e., an increase of up to five months in developmental age). The two children both had a motor impairment and no visual impairment. One of these two children had clearly benefited from the enlarged materials, as revealed by the test report. It would be very interesting to know what caused the two children to obtain such a large score difference, but this cannot be deducted from the data in the current study.

When considering the average *percentage score difference on adjusted items* at the sample level per scale, the Low Motor/Vision accommodated version and the standard version showed about equal results for Receptive Communication (average change 1%), in contrast to the Cognition and Expressive Communication scales (average change 6% and 11%, respectively). The lack of difference in the Receptive Communication scale could be due to a negative influence from the enlarged stimulus book in combination with a positive influence from other accommodations. The stimulus book was one of the main accommodations in the scale and appeared to be unsuitable for some children because of the large distance between the pictures and the poor contrast found in those pictures.

The responses on the evaluation form indicated that the accommodations are practical. In addition, all respondents indicated that the test results corresponded to their picture of the developmental level of the child. Half of the respondents indicated that the Low Motor/Vision accommodated version had advantages, compared to the standard version of the Bayley-III. This

implies that the Low Motor/Vision accommodated version is an improvement compared to the standard version of the instrument for a subgroup of children in the target population.

We used the feedback from the respondents to adjust the Low Motor/Vision accommodated version. For example, we removed the enlarged stimulus book and the enlarged blocks, and in the manual we emphasized that the Low Motor accommodations were only beneficial for children who had motor impairments affecting the hands and/or arms. These adjustments were not applied during the current pilot study, but will be used for future study.

The results on both the test administrations and the evaluation form imply that some of the children with a motor and/or visual impairment did benefit from the Low Motor/Vision accommodations to the Bayley-III and some did not. The results on the current pilot study are consistent with those of earlier pilot studies on the Low Motor and Low Vision versions of BSID-II-NL,[14,21] which found that the accommodations resulted in more valid test results and a smoother test administration. The experiences of test administrators and developmental psychologists in the current study were positive. That said, as a result of this pilot study we know that there is still room for improvement to be made to the instrument.

It is important to take into account a few issues when interpreting the results, namely the relatively small sample, the inclusion of children with a calendar age above 42 months, and the large variability in test scores within as well as between children. We minimized variability due to inconsistencies in test administrations by giving an intensive training to the test administrators. The small sample in combination with the large variability in test scores means that we are unable to draw conclusions about the effect of the accommodations on the test results in the

target population. We have to keep in mind the goal of this pilot study, which was to get a first impression of the scores that assessment with the Low Motor/Vision accommodated version yields. The inclusion of children with a calendar age above 42 months in the sample should be kept in mind when interpreting the results, because not much is known about the use of the Bayley-III with these older children. However, the inclusion of the older children was important, because many children with motor and/or visual impairment who are in need of developmental assessment are older than 42 months of age and have developmental delay.

Future research should focus on the use of the Bayley-III with children older than 42 months and on the construct validity of the Bayley-III Low Motor/Vision version. The idea of increased construct validity would be supported if (a) children with a motor and / or visual impairment obtain a higher score on the Low Motor/Vision accommodated version than on the standard version, and (b) the expected value of the item score is equal for the accommodated and standard versions of the item, in so far as both versions are suitable for the child under study. The latter would imply that the norm tables of the original version still apply when the accommodations are applied.

If future research manages to develop assessment instruments that are more suitable for children with an impairment than the current set of instruments are, and research results support their validity, this will have major implications for practice. Developmental psychologists will then be able to assess the development of children with a motor and/or visual impairment more validly than is currently possible and will consequently be able to provide more adequate support.

CONCLUSION

The overall aim of this pilot research was to examine whether a Low Motor/Vision accommodated version of the Bayley-III is more suitable and practical than the standard version when evaluating the development of young children with a motor and/or visual impairment. In sum, the results mean that it is possible to apply the Low Motor/Vision accommodations to the Bayley-III in test administrations with children with a motor and/or visual impairment, and that the accommodations are beneficial for at least a subgroup of children within the target population.

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Table 1

Characteristics of the n = 19 children in the pilot sample. Children numbered 1 - 8 have a motor impairment; children numbered 9 - 19 have a motor and visual impairment.

Child number	Calendar age (months; days)	Gender	Referring organization	Disorder or disease [a]	Body functions and structures [b]	Activities [b]	Administered subscales Bayley-III
1	26;15	girl	Rehab.	Neonatal convulsions	Developmental delay Motor impairment Disorder of tonus regulation	Prefers to use left hand	Cog, RC
2	27;0	girl	Rehab.	Perinatal asphyxia Ischemic brain damage Cerebral palsy	Bilateral spastic cerebral palsy, GMFCS 3	Able to walk	Cog, RC, EC
3	27;4	boy	Rehab.	Perinatal porencephalic cyst, left frontal	Developmental delay Motor impairment in right upper extremity Hypokinesia Hypotonia of the torso	Right hand in fist, child uses this hand sometimes	Cog, RC, EC
4	27;25	boy	Rehab.	-	Psychomotor developmental delay Slow processing of stimuli	-	Cog
5	33;23	girl	Rehab.	Premature birth with bleeding in ventricular system Cerebral palsy	Bilateral cerebral palsy, especially legs are affected	Walks with walker	Cog, RC, EC
6	41;11	boy	Rehab.	Cerebral palsy	Spastic bilateral cerebral palsy, GMFCS 4	Can play with two hands when in good form Cooperation between the two hands is tiring and not smooth Movement jerky with grasping and letting go	Cog, RC, EC
7	47;13	boy	Rehab.	Cerebral palsy	Spastic bilateral cerebral palsy, GMFCS 4	Impaired torso balance affecting alertness Uses both hands Often uses palmar grasp; decreased force and coordination when using more advanced grasping	Cog, RC, EC

(Table continues)

Table 1 (Continued)

Child number	Age (months; days)	Gender	Referring organization	Disorder or disease [a]	Body functions and structures [b]	Activities [b]	Administered subscales Bayley-III
8	90;6	boy	ID	Epilepsy	Developmental delay Hypotonia Short attention span	Difficulty sitting for extended period of time	Cog, RC, EC
9	22;19	boy	Rehab.	Cerebral palsy	Unilateral spastic cerebral palsy Increased tonus / spasticity at the right side Minor visual impairment	Right hand often in fist, rarely used Sits with support in adjusted chair	Cog, RC, EC
10	29;27	girl	Rehab.	Cerebral visual impairment	Problems with visual information processing Psychomotor developmental delay	Needs time to respond to stimuli	Cog, RC, EC
11	30;26	girl	Rehab.	IFAP syndrome Epilepsy	Severe developmental delay Motor impairment Visual impairment	Does not walk or crawl Uses glasses	Cog
12	31;28	girl	Rehab.	-	Delayed motor development Hypotonia Visual acuity 0.02 – 0.08	Optimal visual capacity in faint light	Cog, RC, EC
13	32;13	boy	Rehab.	Mowat-Wilson syndrome Absence of neurohypophysis Possible optic nerve hypoplasia at right side	Motor impairment Visual impairment	Needs time to grasp Difficulty with visual fixation	Cog, RC, EC
14	34;23	boy	Rehab.	-	Developmental delay Motor impairment Visual impairment	Sensitive to stimuli Has glasses but does not tolerate them Able to walk	Cog
15	35;26	boy	Rehab.	Unknown syndrome Palatoschisis	Psychomotor retardation Mild impairment in vision and hearing	Unable to move from place to place independently	Cog, EC
16	36;5	girl	Rehab.	Hydrocephalus Microcephaly Epilepsy	Psychomotor developmental delay Visual impairment	-	Cog, RC

(Table continues)

Table 1 (Continued)

Child number	Age (months; days)	Gender	Referring organization	Disorder or disease [a]	Body functions and structures [b]	Activities [b]	Administered subscales Bayley-III
17	39;7	boy	Rehab.	West syndrome	Developmental delay Impaired registration of taste, hearing and visual stimuli Motor impairment Visual impairment Short attention span	Finds it difficult to stay seated Needs clear instructions	Cog, RC, EC
18	53;16	boy	Visual imp.	Infantile encephalopathy Polymicrogyria Velo-Cardio-Facial Syndrome Possible Cerebral Visual Impairment	Severe psychomotor retardation Spasticity Hypotonia Auditory and visual information processing problems with a normal visual acuity Fine motor skills moderately developed Gross motor impairment	Looks at objects while playing, but does not look during social interaction Able to crawl Not able to walk	Cog, RC, EC, FM, GM
19	56;12	girl	Visual imp.	Microcephaly Palatoschisis Epilepsy Possible Cerebral Visual Impairment	Severe psychomotor retardation Hypotonia Flat feet Epileptic seizures with severe shaking Visual acuity 0.20-0.25 with glasses	Does not crawl, stand or walk Able to play seated Easily distracted Slow processing of sensory stimuli	Cog, RC, EC, FM, GM

*Note.*Rehab.: Rehabilitation Centre; ID: Organization supporting people with Intellectual Disabilities; Visual imp.: Organization supporting people with Visual impairment; GMFCS: Gross Motor Function Classification System; Cog: Cognition scale; RC: Receptive Communication scale; EC: Expressive Communication scale; FM: Fine Motor scale; GM: Gross Motor scale.

[a]In line with the International Classification of Diseases, ICD-10.[22]

[b]In line with the International Classification of Functioning, Disability and Health for Children and Youth, ICF-CY.[23]

Table 2

Number of items that were (not) accommodated in the Bayley-III Low Motor/Vision, per Type of Accommodation

	Cognition		Receptive Communication		Expressive Communication		Fine Motor Development	Gross Motor Development
	LM	LVi	LM	LVi	LM	LVi	LVi	LVi
Materials only	15	29	3	27	16	14	7	14
Instructions only	24	15	4	2	1	0	28	13
Materials & Instructions	30	22	31	4	0	2	26	0
None	22	25	11	16	31	32	5	45
Total	91	91	49	49	48	48	66	72

Note. LM: Low Motor accommodation; LVi: Low Vision accommodation.

Table 3

Test results on the standard version and the Low Motor/Vision accommodated version

Child	Cognition			Receptive Communication			Expressive Communication		
Number (Impairment)	Raw score LM/LVi – Stand.	Raw score diff. [a]	% score diff. adj. items [b]	Raw score LM/LVi – Stand.	Raw score diff.	% score diff. adj. items	Raw score LM/LVi – Stand.	Raw score diff.	% score diff. adj. items
1 (M) [1]	36 – 34	2	20% (2/10)	11 – 11	0	0% (0/7)			
2 (M) [1]	49 – 38	11	43% (6/14)	24 – 25	-1	-9% (-1/11)	22 – 22	0	67% (2/3)
3 (M) [2]	28 – 27	1	6% (1/18)	13 – 13	0	0% (0/8)	13 – 13	0	0% (0/1)
4 (M) [2]	32 – 22	10	25% (4/16)						
5 (M) [2]	71– 68	3	18% (2/11)	36 – 34	2	9% (2/23)	45 – 46	-1	-8% (-1/12)
6 (M) [2]	72 – 76	-4	-22% (-2/9)	39 – 39	0	0% (0/17)	42 – 42	0	7% (1/14)
7 (M) [2]	65– 67	-2	-8% (-1/12)	32 – 31	1	7% (1/15)	35 – 33	2	11% (1/9)
8 (M) [1]	66 – 67	-1	-7% (-1/15)	31 – 27	4	19% (4/21)	31 – 25	6	57% (4/7)
9 (MV) [1]	41 – 39	2	21% (3/14)	12 – 11	1	14% (1/7)	15 – 9	6	33% (1/3)
10 (MV) [2]	50 – 52	-2	-8% (-2/25)	22 – 25	-3	-21% (-3/14)	23 – 25	-2	0% (0/4)
11 (MV) [1]	15 – 22	-7	7% (1/14)						
12 (MV) [2]	67 – 68	-1	0% (0/13)	36 – 39	-3	-12% (-3/26)	35 – 40	-5	-10% (-1/10)
13 (MV) [2]	30 – 30	0	0% (0/18)	9 – 10	-1	0% (0/4)	11 – 11	0	0% (0/1)
14 (MV) [1]	48 – 50	-2	-10% (-2/20)						
15 (MV) [2]	57 – 54	3	14% (2/14)				16 – 15	1	0% (0/3)
16 (MV) [1]	57 – 57	0	0% (0/23)	25 – 22	3	25% (2/8)			
17 (MV) [2]	58 – 61	-3	-12% (-3/26)	31 – 32	-1	-11% (-1/9)	33 – 34	-1	-10% (-1/10)
18 (MV) [2]	30 – 30	0	0% (0/24)	8 – 7	1	25% (1/4)	3 – 4	-1	0% (0/0)
19 (MV) [1]	24 – 24	0	20% (2/10)	7 – 4	3	-25% (-1/4)	4 – 3	1	0% (0/0)
Average		0.5	6%		0.4	1%		0.4	11%

Note. M: Motor impairment; MV: Motor and Visual impairment; LM/LVi: Low Motor/Vision accommodated version; Stand.: Standard version ; diff.: difference.
[1]Standard version administered first. [2]LM/LVi version administered first.

[a] A score difference is calculated by subtracting the score on the standard version from the score on the Low Motor/Vision version. E.g., child 6 obtained a raw score of 72 on the Cognition scale for the Low Motor/Vision version and a raw score of 76 on the standard version. The raw score difference is therefore 72 - 76 = -4.
Empty cells indicate that the scale concerned was not administered to that child.

[b] % score diff. adj. items: percentage score difference on adjusted items. This percentage indicates how large the improvement (or decline) in test score is, in relation to the total number of adjusted items. Adjusted items are accommodated items that were actually administered to that specific child using both versions.

Table 4

Responses to the main questions in the evaluation form

Question	Number of "Yes" answers	Number of "No" answers
1. Do the test results from the accommodated version correspond with your view of the developmental level of this specific child?	12	0
If "Yes", is this specifically due to the Low Motor/Vision accommodations?	6 Of which:	6
- Yes, because of accommodated materials and procedure	4	
- Yes, because of accommodated procedure	1	
- Yes, because of accommodated materials	1	
2. Were the Low Motor/Vision accommodations practicable when testing this child?		
- No, enlarged stimulus book not useful		2
- No, pictures too dark and too little contrast		2
- No, enlarged blocks were a disadvantage		1
3. What were the advantages of the Low Motor/Vision accommodations for this child when compared to the standard version? (More than a single answer possible)		
- Materials	5	
- Procedure	6	
- Successful experiences	2	
- No need to skip items	1	
- No advantage	5	