Chapter 5

The BSID-II-NL for assessing children with visual impairment

Abstract
To be able to adjust guidance, intervention and education to the developmental level of a visually impaired young child, it is necessary to gain insight into the developmental level of a visually impaired child, based on a standardized and specifically adapted diagnostic tool. In order to provide such an assessment tool for this specific group, we have adapted the procedures, item instructions and play material of a standardized instrument, the Bayley Scales of Infant Development –Second Edition (BSID-II). The purpose of constructing low vision adaptations is only to compensate for the child’s visual impairment; item content and degree of difficulty of the items have remained practically unchanged. In doing so, the standard norms still apply. This chapter describes a study that has produced an experimental version of the BSID-II-NL Low vision for the age range of 30-42 months. A pilot study (n=8) was conducted to find an indicative answer to the question how appropriate the adaptations of the BSID-II-NL are for low vision children and to give a first impression of validity and reliability of the BSID-II-NL Low Vision (30-42 months).

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3 This chapter has been submitted for publication and was co-authored by Bieuwe F. van der Meulen, Han Nakken and Henk C. Lutje Spelberg.
5.1 Introduction

If a child is at risk for a developmental delay, early identification and intervention can be crucial in order to minimize lasting effects of the child’s difficulties (Kenny & Culbertson, 1993; Conlon, 2002) and to promote a child’s successful adaptation to the environment (Yeates & Taylor, 1998). Visually impaired children belong to the group of at-risk children. Because of their impairment they are less able to visually explore and understand the world around them and are therefore more at risk of a delayed development (Warren, 1984; Best & Corn, 1993).

To facilitate effective interventions and follow-up for low vision children it is essential that appropriate and fair assessment is made available. An adapted diagnostic tool will enable the child to perform on a test without being hindered by its visual impairment, taking into account the child’s possibly less developed eye-hand coordination and spatial orientation when the child has to demonstrate certain skills (Baerwaldt, Dik, Van Gendt-Van Evert, Hordijk, Melis, Overbeek, Roorda, Verschuren, & De Vroet, 1993; Gerestein, 1990; Kraijer and Plas, 2006). To offer a child with low vision the right kind of guidance, intervention and education that meet its specific needs, it is essential to employ a standardized and adapted diagnostic tool that provides insight into the visually impaired child’s developmental course. At the same time, an adapted and standardized instrument enables better research on the specific development of the group of low vision children. Relatively few studies have been conducted on how low vision influences a child’s development compared to the amount of research on a child’s normal development or the development of blind children. (Looijestijn, 2004).

Worldwide, only few developmental tests are available that take visual impairment into account. Three of them measure young children’s cognitive development: The Reynell-Zinkin Scales (Reynell, 1979; Vervloed, Hamers, Van Mens-Weisz, & Timmer-Van de Vosse, 1999), The Callier-Azuza Scale (Stillman, 1978) and The Oregon Project for Visually Impaired and Blind Pre-School Children (Brown, Simmons, Methvin, Anderson, Boigon, & Davis, 1991) These scales all cover a large part of the aspects of a child’s cognitive development, however, none of them offer the possibility to determine norm scores. The above-mentioned scales are primarily targeted
at providing information for assessment and intervention based on a developmental profile (reference scores). Next to the Reynell-Zinkin scales there is one other instrument available in the Netherlands for children with low vision: the adapted version for children with low vision of the Dutch version of the BSID (Bayley, 1969), the BOS 2-30 (Bayley Ontwikkelingsschalen 2-30 months, Van der Meulen & Smrkovsky, 1983; adapted version of the BOS 2-30 for visually impaired children, Smrkovsky, Looijestijn, Wiegman, & Dik, 1995). Although the test is widely used by all relevant care services in the Netherlands little research has been conducted on the psychometric properties of the test, nor has there ever been a separate normative study within the target group. Test results are based on the dated norms of the standard version of the BOS 2-30 (1983).

Because of the lack of standardized and adapted developmental instruments with actual norm tables, and the concern of visual impairment bias when using standard procedures and materials with visually impaired children, we have developed an adapted version of a well known, standardized assessment instrument, the Bayley Scales of Infant Development – Second edition (BSID-II: Bayley, 1993). The Bayley is a widely used instrument for assessing young children’s cognitive and motor development, also known as the ‘golden standard’ (Aylward, 2002; Gauthier, Bauer, Messinger, & Closius, 1999). The Dutch version (BSID-II-NL; Van der Meulen, Ruiter, Lutje Spelberg, & Smrkovsky, 2002) formed the basis of our current study.

The Dutch version consists of a translation of the BSID-II, a Dutch standardization and a discussion of validity and reliability studies for the BSID-II-NL (Ruiter, Van der Meulen, Lutje Spelberg, 2005).

With the development of an adapted version of the BSID-II-NL for assessing visually impaired children (the BSID-II-NL Low Vision), we will provide a diagnostic tool that is based on a well-known, psychometrically sound instrument that can be used to examine the cognitive and motor development of visually impaired children in an adapted, but standardized way.

Although each adaptation of the test procedure, item instruction and/or play material relevant to the standard instructions implies that the original norm tables no longer apply, the adaptations we propose are only meant to compensate for the child’s visual impairment. By leaving the item content and degree of difficulty essentially unchanged
the original standardization will apply as before. Batshaw-Clair, Church, and Batshaw (2002) described these changes in format, response, environment, timing or scheduling that do not alter in a significant way what the test measures as accommodations. In contrast, when changes in the assessment alter what the test is supposed to measure or the comparability of the scores, the term modifications is used. If sufficient evidence shows that the adapted version of the BSID-II-NL involves only accommodations, it will be unnecessary to conduct large-scale and time-consuming standardization research for this specific group of children. At the same time, the use of the low vision version combined with the original standardization will make it possible to compare the cognitive and motor development of low vision children with that of their average peers.

As a first step in determining the validity of the BSID-II-NL Low Vision, we give an account of the construction of the instrument and the applicability of the adapted testing procedures, item instructions and play material. A pilot study provides us with an indicative answer to the research question: Is the experimental version of the BSID-II-NL Low Vision an applicable instrument for measuring cognitive and motor development in young children (30 – 42 months) with low vision?

The three following sub questions are to be addressed:

(1) Are the adapted test procedures adequate?
(2) Are the adapted item instructions adequate?
(3) Are the adapted play materials adequate?

The target group consists of Dutch children whose visual ability is about 1/20 to 1/3 of normal and/or who have reduced range of vision between 10 and 30 degrees, in the developmental age between 30 and 42 months. This is the age range of the target group for whom the experimental version of the BSID-II-NL was developed. The results of the current study will be used to make the experimental version also suitable for the age range between 1-30 months.

The answer to the main research question is positive if the answer to all three sub questions is positive. To accomplish this, the adapted testing procedure, adapted item instruction and play material must meet the requirements of applicability for this target group.
5.2 Construction of the BSID-II-NL Low Vision 30-42 months

Qualm (2003) used the results of a literature survey and an interview with administrators, who used the adapted version for low vision children of the BOS 2-30, to formulate recommendations for developing an adapted version of the BSID-II-NL. On the basis of these recommendations Pepping (2004) adapted the general testing procedures, item instructions and play material of the BSID-II-NL for the group of visually impaired children in the developmental age range of 30-42 months. In doing so, an experimental version of the BSID-II-NL was developed for the age group 30-42 months.

The general instructions for test administration were evaluated and where needed adapted to the situation of testing a child with low vision. In reviewing each item, not only the content of the item was addressed, but also the procedure for item instructions for the administrator and the response possibilities for the child. The goal was to preserve the original content of the item. To determine whether this was actually the case, a group of experts (researchers and practitioners) evaluated the adapting process. The changes should provide the children with the unbiased item, maintaining its original content and difficulty. When evaluating each item there were five options, as mentioned in Table 1 below. This table presents an overview of the number of adapted items and the scales to which they belong.
Table 1  
*Overview of the number of adapted items and the scales to which they belong*

<table>
<thead>
<tr>
<th>Options</th>
<th>Number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mental scale</td>
</tr>
<tr>
<td></td>
<td>item 131-178</td>
</tr>
<tr>
<td>Item is acceptable as it is</td>
<td>8</td>
</tr>
<tr>
<td>Item requires instruction adaptation</td>
<td>4</td>
</tr>
<tr>
<td>Item requires material adaptation</td>
<td>6</td>
</tr>
<tr>
<td>Item requires instruction and material adaptation</td>
<td>28</td>
</tr>
<tr>
<td>Item is biased but cannot be changed to be acceptable</td>
<td>1</td>
</tr>
</tbody>
</table>

Concerning the general test procedure, for instance, directions are given for the child’s position (its back to the window) and position and intensity of artificial light (perpendicular to the material and intensity between 500 and 2000 lux). The item instructions of the Low Vision version, include e.g., special directions for an extension of the time limit so that children can be given sufficient time to explore material and environment visually and tactilely before the item instructions are offered (specifically when the child is asked to point to or name objects). In addition, especially when testing the Motor scale, the voice of the test administrator and/or a parent is used more. Finally, adaptations to material and diagnostic environment include for instance more combinations of a dark background and light-colored materials, more use of contrasting colors for the materials, darker lines to accentuate the contours of the pictures and in some cases enlarged material which is made more visually attractive.

Table 2 presents some examples of adapted items on the Mental and Motor scale. The standard procedures and play material are described in the middle column; in the right column are the adapted item instructions, scoring procedures and test material.
<table>
<thead>
<tr>
<th>Mental scale</th>
<th>BSID-II-NL Standard</th>
<th>BSID-II-NL Low Vision (adaptation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>162 Sorts pegs by color</td>
<td>Administration: In a random fashion, place all of the pegs on the table in front of the child. Then place the three plastic bags in front of the child and say: Put all of the red pegs in one bag, all of the yellow pegs in another bag, and all of the blue pegs in another bag.</td>
<td>Administration: Place the pegs in the child’s hands and allow the child enough time to complete the item. Scoring: Give credit if the child sorts the pegs by color, either by placing the pegs in the appropriate bags or by placing them in separate piles.</td>
</tr>
<tr>
<td>Mental scale</td>
<td>Administration: Place the pieces on the table, in front of you. Place the board on the table, in front of the child. Hand the child a round piece. Motioning toward the holes, say: Put the block in its hole. Put it where it belongs. Start timing as soon as the child grasps the piece. Proceed by alternately handing the child a square and a round piece, one at a time, until the child has placed each to her</td>
<td>Administration: Same as standard</td>
</tr>
<tr>
<td>165 Complete blue board in 30 seconds</td>
<td>Material: Four red pegs, four yellow pegs, four blue pegs and three plastic bags.</td>
<td>Material: White pegs instead of blue pegs</td>
</tr>
</tbody>
</table>
Motor scale 88

*Laces three beads*

satisfaction, regardless of whether the pieces are correctly placed. Stop timing when the child places all of the pieces correctly or when 150 seconds elapse.

**Scoring:** Give credit if the child correctly places all the pieces in 30 seconds or less. To be correctly placed, a piece must fit completely in the hole.

**Material:** Puzzle board (blue side), four round pieces, five square pieces from the blue block set and stopwatch.

**Administration:** Knot one end of each shoe string and place the beads on the table. Lace two beads on your string. Then give the child the other shoe string and three of the beads. Say to the child: *Here is a string for you. Put the beads on the string. Put them all on.* If the child places all three beads on the string, push the remaining three beads to the child and say: *Put these on. Put them all on.*

**Scoring:** Time limit can be extended by half given to complete the item. Observe and record how the child solves the question, for instance: the child places forms directly or by trial and error, tries a form, takes it out and tries another one.

**Material:** Puzzle board (blue side, standard) and white pieces (low vision adapted shapes)

**Administration:** Show the child slowly how to do it. Lace a yellow bead followed by a green bead and then another yellow bead on a string. Give the child a red string and the yellow and green beads. If the child looks for the beads, help the child by placing them nearby or by ticking them.
Scoring: Give credit if the child puts at least three beads on the string at one time. Scoring: Same as standard

Material: Two shoe strings and eight square beads. Material: Red string and 3 yellow and 3 green beads (standard)

The adapted manual is an addition to the standard manual of the BSID-II-NL. It provides adapted instructions for administering the BSID-II-NL Low Vision, however, its design, and principles are maintained as in the BSID-II-NL.

5.3 Pilot Study

A pilot study was conducted to provide us with expert judgments concerning the applicability of the experimental version of the BSID-II-NL Low Vision (age range 30 – 42 months). Answers are given to the three sub questions, whether the changes in testing procedures, item instructions and play material satisfy the conditions for providing an applicable, unbiased diagnostic instrument suited to low vision children.

Method

Participants. Eight children with low vision participated in this pilot study. Low vision was defined as having visual acuities between 1/20 and 1/3 and/or reduced range of vision between 10 and 30 degrees. All children were between 30 and 42 months of developmental age. In two cases the children’s chronological age was above 42 months,
but their level of functioning was estimated to be within the age range of 30 - 42 months of age. They were all known by one of the centers for assessment and intervention for visually impaired and blind children in the Netherlands or Belgium. Children were recruited via an international organization for educational psychologists working with blind and visual impaired children (ILO).

Four experts of two different centers filled out surveys with regard to the appropriateness of the adapted test procedures, item instructions and play materials, after applying the test to a child with low vision. Another five experts only filled out the surveys on the adapted materials. All experts are qualified educational psychologists participating in the ILO, who have ample experience in the assessment of young low vision children.

Procedure. Assessments with the BSID-II-NL Low Vision were administered in one session and for research purposes only. The assessment was administered by an expert with ample experience in the assessment of low vision children and in administering the BSID-II-NL. The assessment provides the expert with the information needed to fill out a survey concerning the adapted general procedure, item instructions and play materials. To estimate the reliability, the test administrations were recorded on videotape so that they could be evaluated by a second administrator in order to determine the inter-rater reliability. To get an impression of validity, the test results were compared to the estimated developmental level of the child by the experts (administrators) beforehand, based on file information. A positioning of the child’s expected performance was rated on a scale 1 to 3: 1: developmental delay; 2: normal development and 3: accelerated development.

Via the international ILO group, 23 surveys were sent to experts responsible for psychological assessment of children with low vision. Nine experts provided information for the surveys on the adapted test procedure, play materials and item instructions. These nine experts represent centers for assessment and intervention of blind or visually impaired children in the Netherlands (three) and one in Belgium (out of four). The experts who also administered the BSID-II-NL Low Vision to one of the children in the pilot study were asked not only to comment on every adapted general test procedure, item instructions and all adapted play materials but also to answer specific questions with
regard to individual assessments. The main question was: Are the adaptations applicable and if not how can they be improved?

Results

Table 3 presents the characteristics of the children in the pilot study and test results with the experimental version of the BSID-II-NL Low Vision (30-42 months).
Table 3
*Characteristics of the children and test results with the BSID-II-NL Low Vision Mental Scale*

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Chronological Age¹ (CA)</th>
<th>Ophthalmologic diagnose</th>
<th>Raw score</th>
<th>Developmental Index</th>
<th>Developmental Age (DA)</th>
<th>Raw score inter-rater³</th>
<th>Expert judge- ment⁴</th>
<th>DA/CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>43</td>
<td>Cataract</td>
<td>166</td>
<td>--²</td>
<td>39</td>
<td>165</td>
<td>2</td>
<td>.91</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>Nystagmus and Hypermetro py</td>
<td>142</td>
<td>91</td>
<td>28</td>
<td>144</td>
<td>2</td>
<td>.90</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>Retinal dystrofy</td>
<td>166</td>
<td>--²</td>
<td>39</td>
<td>165</td>
<td>2</td>
<td>.78</td>
</tr>
<tr>
<td>4</td>
<td>37</td>
<td>Retinal dystrofy</td>
<td>158</td>
<td>108</td>
<td>37</td>
<td>158</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>Aniridy, serious glaucoma and nystagmus (L+R)</td>
<td>106</td>
<td>55</td>
<td>17</td>
<td>--²</td>
<td>1</td>
<td>.57</td>
</tr>
<tr>
<td>6</td>
<td>42</td>
<td>Albinism</td>
<td>166</td>
<td>86</td>
<td>39</td>
<td>163</td>
<td>2</td>
<td>.93</td>
</tr>
<tr>
<td>7</td>
<td>34</td>
<td>Retinal dystrofy</td>
<td>152</td>
<td>105</td>
<td>35</td>
<td>154</td>
<td>2</td>
<td>1.03</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>Retinal dystrofy</td>
<td>117</td>
<td>62</td>
<td>20</td>
<td>--²</td>
<td>1</td>
<td>.63</td>
</tr>
</tbody>
</table>

¹ In months
² Results are not within the norm range (chronological age is > 42 months)
³ Raw score of an observer-inter-rater
⁴ 1: developmental delay; 2: normal development; 3: accelerated development
Three children were functioning at a developmental level of roughly one year below their chronological age level. The other five children were more or less functioning at the age-adequate level.

The reliability of the experimental version of the BSID-II-NL Low Vision was estimated by determining the inter-rater reliability. Six out of eight assessments were recorded on videotape and on the basis of these tapes the first author evaluated the assessments as a second administrator (inter-rater). The inter-rater reliability of the test results on the Mental scale is $\rho = .95^{**}$ (n=6).

Content validity was established by correlating administrator’s assessment of a low vision child’s cognitive development with children’s standardized developmental age (DA/CA). The validity coefficient is $\rho = .76$ (n=8).

Test procedure (sub question1)

The experts’ response to whether the adapted test procedure is adequate can be summarized as follows:

In general the adaptations proposed for the test procedures are found to be both adequate and appropriate. Particularly the extension of the time limits and the additional auditory, tactile and visual stimuli are considered very appropriate. Some specific adaptations meet the desired criteria but may be difficult to realize in the home situation. An example is how a room should be adapted to the special test requirements. A room without interfering sunlight, light colored walls, no visually disturbing stimuli such as wall posters and no disturbing auditory stimuli such as zooming lamps.

The experts were presented with open questions so that they could comment on the testing procedure. The remarks that were made more than once are given below:

- All items involving a stimulus booklet and drawing activity should be performed at a working table with a slanting elevation of the surface.
- Care should be taken that the items are not to be presented in the child’s shade.
- The test administrator’s clothing need not necessarily be blue, as recommended in the instructions, as long as the color is not conspicuous or distracting and the color of the clothing should contrast with the background.
- Allow the child enough time to explore the play material before proceeding with the item instruction.

**Item instruction (sub question 2)**

The low vision adaptations of all separate items were judged by the experts. A small group of items meet all the criteria. For the remaining items, comments were given, such as:

- Allow the child enough time to explore the materials before proceeding with the item instruction.

- In some cases it may be necessary for the child to explore the materials together with the test administrator, for instance for the item MR 101. Buttons up; together with the test administrator the child can feel the button and button hole.

**Play material (sub question 3)**

The question referring to the appropriateness of the adapted play material was answered as follows:

- In general terms the play material was found to be adequate and appropriate for the target group. For instance, the way in which the pictures in the stimulus booklet were made clearer, by accentuating the contours, and the fact that more contrasting colors were used against the background.

Some additional remarks:

- The natural color of wood is not appealing to children and it does not contrast sufficiently with the surroundings. Bright colors are more appealing.

- A light background with bright colored materials is considered more suitable than a dark blue background (placemat and test administrator’s clothing) with for instance light colored cubes.

- The pictures from the stimulus booklet are clearer but the finishing can be improved.

**5.4 Discussion**

By developing the BSID-II-NL Low Vision, which takes into account a child’s visual impairment, a diagnostic tool will become available that test administrators can use to determine norm scores of the child’s mental and motor development based on
standardized test administration. The main purpose of this study was to examine the appropriateness of the adapted materials of the BSID-II-NL for applying the test to children with low vision. All sub research questions were answered positively. For the test procedure this means that all proposals for an adapted testing procedure were accepted for the final version. Only a few additions were needed to the suggested adaptations, for instance “make sure not to offer the stimuli in the child’s shade”.

According to the experts, all the proposals for adapting the item instructions meet the demands for application with children with low vision. It is emphasized that the administrator should allow the child ample time to explore the materials before giving the item instructions.

The adapted play materials meet low vision conditions with reference to colour and measure of contrast. However, some of the play material will need adjustment before being applicable for use with low vision children. The wooden materials should be coloured and the colouring and quality of the adjusted pictures (stimulus booklet) should be enhanced.

The main research question: Is the experimental version of the BSID-II-NL Low Vision an applicable instrument for measuring cognitive and motor development in young children with low vision (30 – 42 months) can be answered positively on condition that the necessary improvements will be made.

Although the study resulted in an adapted Low Vision version of the BSID-II-NL for children between 30 and 42 months of age, the question whether the validity of the instrument has been enhanced for children with low vision has not been addressed sufficiently. The small pilot sample does not provide us with a sound empirical indication that item content and item difficulty remain unaltered, so norm tables of the standard BSID-II-NL are still applicable in a valid and reliable way. To gain substantial support for the assumption that the Low Vision version is needed for children with low vision and the adaptations are truly helpful, future research should consist of a comparative study. Within a short period of time the Standard version as well as the Low Vision version of the BSID-II-NL should be administered to the same group of children with low vision. Results would support the value of the instrument in case children with low vision receive significant higher scores on the Low Vision version in comparison with the
standard version. This means that the Low Vision adaptations maximize the child’s test results. At the same time a comparative study among children from the standard population should provide us with the answer to the question whether the low vision adaptations alter the item difficulty. To support the assumption that item difficulty remain unchanged, test results should not significantly differ between the Standard and Low Vision version. Our (pilot) study was limited to the Netherlands and Belgium; our findings should be corroborated by studies in other countries, a more extensive international replication is recommended in order to gain sufficient empirical support for the validity and reliability of the adapted test. The Low Vision adaptation is applicable to the BSID-II worldwide (irrespective of translation and standardization), because the adaptation only concerns the test procedure, item instructions and play material. These components of the instrument are equal worldwide.

The positive results for our BSID-II-NL Low Vision study for the age range 30-42 months suggest a follow-up study to develop a fully adapted BSID-II-NL for assessing children with low vision. The next step will be to construct the necessary adaptations for the age range of 1-30 months, with regard to the test procedure, item instructions and play material. Once completed, this step will lead to a new experimental version of the BSID-II-NL Low vision (1-42 months) that will in turn facilitate large scale research on the applicability and psychometric properties of this newly developed instrument for assessing children with low vision.
References


