Chapter 4

The Non-Verbal BSID-II-NL<sup>2</sup>

Abstract

The non-verbal version of the Mental scale of the Dutch version of the Bayley Scales of Infant Development – Second Edition (BSID-II-NL) allows us to get a general view of the cognitive development of children with hearing and/or speech/language impairments, without using spoken language. The items of the non-verbal scale are a selection from the original items and where needed, adapted instructions were provided. These adaptations consist of extra emphasis on natural gestures or pantomime instructions. Dutch norms and reliability intervals were determined for the age group of 12 to 30 months old. This chapter describes the content and psychometric qualities of the non-verbal version of the Mental scale of the BSID-II-NL. Also a comparison was made between the standard and non-verbal version of the Mental scale with a group children with serious developmental delay. The results support the applicability and validity of the non-verbal version of the BSID-II-NL. Test results on the non-verbal version were significantly higher on the non-verbal version for this group of children.

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<sup>2</sup> A part of this chapter has been published before in *Tijdschrift voor Orthopedagogiek* and was co-authored by Aafke T. Hoekstra, Bieuwe F. van der Meulen, Han Nakken and Henk C. Lutje Spelberg.
4.1 Introduction

The incredible speed at which a child acquires skills and the close ties between the developmental areas, make the first phase of life a very vulnerable part of human life. A problem in one developmental area immediately impacts the acquisition and development of skills in other developmental areas (Couturier & Tak, 2002). Using developmental tests enables us to determine the seriousness and background of a child’s problem (taking into account the child’s family history, previous test results and medical history), to determine an appropriate strategy for intervention and to evaluate this strategy. Assuming that early child development can be influenced and “the sooner, the better”, it’s important to detect problems as early as possible and take appropriate action. That’s why in the last decades a lot of attention has been given to diagnosing developmental problems in very young children (pre school ages). As a result, improved research techniques have become available, among others psycho-diagnostic instruments and intervention programs for young children and their families.

The choice of instrument for assessing the developmental course of a young child should of course be determined by the specific need for help and the age of the child, but also by the possible sensory limitations. For instance, for a young child with a serious hearing problem or a young child that has trouble acquiring language skills for other reasons, the items in a diagnostic test that require verbal instructions or those that require the child to use verbal skills, will be impossible to perform. Standard instruments are therefore not adequate for determining the developmental level of children with specific limitations. In the most recent edition of General Standard Test Practices (Algemeen Standaard Testgebruik’, 2004), the NIP (The Dutch institute for psychologists) states: “The use of psycho-diagnostic instruments with special groups, such as persons with physical or mental limitations, people that don’t speak Dutch, etc., places special demands on the test procedure.” With regard to the children with hearing and/or speech/language impairments, an adapted version of an well known developmental instrument, the Bayley Scales of Infant Development – Second Edition – Dutch version (BSID-II-NL; Van der Meulen, Ruiter, Lutje Spelberg & Smrkovsky, 2002; original BSID-II, Bayley, 1993), was constructed. The BSID-II-NL is an individually
administered and standardized instrument for developmental diagnostics that can be used to get a general impression of the cognitive and motor development of young children. The non-verbal version of the Mental scale of the BSID-II-NL (BSID-II-NL NV; Ruiter, Hoekstra, Van der Meulen, Lutje Spelberg, 2005) is considered an important addition to developmental diagnostic tools for young children in general and for children with hearing and/or speech/language problems in particular (Kroese, 2003; Bradley-Johnson, 2001; Ruiter, Hoekstra, Van der Meulen, Lutje Spelberg & Nakken, 2006). This instrument enables us to judge the general cognitive developmental level of a young child, based on test results from a non-verbal but standardized instrument. Kraijer and Plas (2006) hold the view that the non-verbal Mental scale should be a standard part of using the BSID-II-NL, for a more differentiated picture of a child’s cognitive development.

When dealing with cognitive development problems, any language problems should be incorporated into the general developmental picture. The relation between verbal and non-verbal development should be examined (Van der Meulen & Smrkovský, 1987; Kroese, 2003). For children with a (suspected) hearing impairment and children that have (suspected) speech/language problems, it is useful to get an impression of the cognitive skills of the child that are not based on language. For planning intervention, it’s important to know if the child has a specific language/speech problem or if the child is experiencing a general cognitive delay. From practical experience it is found that 20-25% of the children that are referred for speech and/or language problems also experience a delay in non-verbal development (Beveren - Valk, Coster, Knijff & Goorhuis – Brouwer, 1999).

Most instruments for developmental assessment target cognition, motor skills, social behavior and self-sufficiency. For very young children, behavior is stimulated by using sound-producing play material and voice. For older children, more use is made of language, both in the instructions the test administrator gives and in the response of the child. More and more importance is attached to language comprehension and from the age of one year old, language production becomes a more important component in assessing the cognitive developmental level as well. Because of this, the cognitive developmental level for children that are deaf or hearing-impaired and children with
speech/language problems may be underestimated. They are unable to profit fully from item instruction and are incapable of showing the requested behavior because of their limitations.

The number of developmental tests that can be applied non-verbally is limited. For young children as far as we know only two non-verbal standardized tests with current norms exist: the non-verbal version of the BSID-II-NL and the Snijders Oomen Non-verbal intelligence test for children between 2½ and 7 years (SON-R 2½-7; Tellegen, Winkel, Wijnberg-Williams & Laros, 1998). This SON-R is the most-used non-verbal test for young children. The test consists of 6 different subtests that together determine a general intelligence score. Intelligence is examined in ways that are not dependent on language. Because of this, the test is considered very suitable for children with problems and limitations in speech and language development and communication. The test has both verbal and non-verbal instructions. Which are used depends on the possibilities of the child (Tellegen, Winkel, Wijnberg – Williams & Laros, 1998).

The BSID-II-NL NV is developed for children with (suspected) hearing, speech and/or language problems and for children for whom it is thought useful to administer a test independent of language production and language understanding for other reasons. By selecting the non-verbal items, (in some cases) by adapting item instruction and by determining separate norm tables, the non-verbal version of the Mental Scale for 12 to 30 months was constructed.

In this chapter, next to a general evaluation of the content and psychometric qualities of the BSID-II-NL NV, an empirical study provides us with the answer to the research question: *Is the non-verbal version of the Mental scale of the BSID-II-NL a more appropriate instrument to determine general cognitive development in children with serious developmental delay?*

It is expected that speech and language development is a limiting factor in understanding language based items and performing items that require active language use for these children. Our expectation therefore is, that this group of children profit from the non-verbal instructions and response possibilities by showing significantly higher test results on the non-verbal version than on the standard version of the BSID-II-NL.
The purpose of the non-verbal BSID-II-NL is to assess the general development level without the use of spoken language in the instruction and without expecting any language based actions of the child (Wortelboer, 2000). The starting point in the construction of the non-verbal version was the situation of a deaf child. Every item that is characterized by hearing or producing of sounds or language and/or in which the item instruction could not be replaced by pantomime instruction or emphasized natural gestures was removed. The non-verbal version consists of 103 items (standard version: 178). The selected items can be divided into three groups:

(a) items that can remain unchanged.
An example is item 82 on the Mental Scale (item 59 on the non-verbal scale): ‘Suspends ring by string’. In this item, the test administrator shows how a ring can be moved with a string. The child should follow this example by obtaining the ring and suspending it by the string. The item has no verbal instruction and also doesn’t require a verbal response or adequate hearing. That is why the item can be used unchanged in the non-verbal Scale.

(b) items that require extra emphasis on the instructions.
An example is item 60 on the Mental Scale (item 45 on the non-verbal scale): ‘Attends to scribbling’. In this item, the test administrator should clearly and with clear writing movements take a crayon and scratch some paper. The administrator then gives the pencil to the child, gestures and says: Write on the paper. Make a mark like this! The verbal instruction isn’t absolutely necessary for understanding the item, but the test administrator should make sure that the child has seen the required gestures. The instruction of this item should be performed with extra emphasis on the gestures in the non-verbal version.

(c) Items that require the replacement of the original instructions by a pantomime instruction.
An example of this is item 89 (item 65 on the non-verbal scale): ‘Puts six beads in box’. In this item, the test administrator should show how to put a bead in a box while giving verbal instructions: See! They go in here. (Child’s name), put them in. Put them all in! Verbal instruction is given to put the beads in the box. For a deaf child, if this instruction
is not changed to pantomime, it will not understand part of the instruction and therefore be at a disadvantage when compared to a hearing child. Therefore, the instruction of the non-verbal version is:

*Clearly demonstrate putting the bead in the box. Point to the child, point at the rest of the beads using an ‘open hand gesture’, point to the box and again point to the child.*

The pantomime instructions that are given should not be equated to sign language. Sign language is an independent language, with its own grammar. Pantomime instructions are meant to explain and support an assignment. Not every child with hearing, language or speech problems and not every test administrator will know sign language. But they as well should be able to perform or administer the test. That is why we chose pantomime instructions to enable non-verbal administration of the test. The item instructions for the SON 2½-7 and the BOS 2-30 were used as an example in formulating the instructions for the BSID-II-NL NV (Hoekstra, 2004). It should be noted that following the non-verbal instructions is no reason for the test administrator not to use language. That would soon cause unnatural, forced situations. Dependent on the possibilities of the child, next to emphasized gestures and pantomime instructions, spoken language may be used. The basal and ceiling rules were adapted with regard to the standard version of the BSID-II-NL. Cut-off rules for the non-verbal version were based on the average number of non-verbal items per age group (Ruiter, Hoekstra, Van der Meulen & Lutje Spelberg, 2005).

### 4.3 Psychometric characteristics

Language plays an ever-increasing role in the cognitive development of a child and therefore in the test administration. As age increases, so does the language component in the items. This leads to the problem that not many items suited for non-verbal administration remain for the oldest (30-42 months) children. The upper developmental age boundary for the BSID-II-NL NV was therefore set at 30 months. For age groups under 12 months old, internal consistency was found to be very low ($0.50 \leq \text{lambda.2} \leq 0.65$). This leads to very large reliability intervals and therefore a (relatively) low dependability of the test result. For this reason, the lower age boundary was set to 12
months. Using data from the standardization study for the standard version, norm scales were constructed for the non-verbal version for children aged 12 to 30 months. The achieved result can also be expressed in terms of a so called developmental age. This allows for a score to be expressed in the age at which children on average achieve this score. Using caution, this can be used for children that are too old to apply the norm tables but that achieve a score belonging to a lower age (Van der Meulen, Ruiter, Lutje Spelberg & Smrkovský, 2002).

The purpose of administering the non-verbal version of the Mental Scale is getting a picture of the general developmental level of a child without using receptive or expressive language. The non-verbal scale is a selection from the range of abilities that reflect the general cognitive skills of a child. The correlation between the raw scores on the standard version of the Mental Scale and the non-verbal version is high: mean .86. This means that the non-verbal version gives a good picture of the general development level when compared to using the standard version of the Mental Scale. For more detailed information on the norms and psychometric characteristics, please see parts II and III of the BSID-II-NL instructions.

### 4.4 Method

**Sample**

Forty-two children were included in the sample: 16 girls and 26 boys, see table 1. All children were diagnosed with severe developmental delay, they all receive care and education in a Child Day Care centre (CDC centre). The children were selected via the orthopedagogue or psychologist of the centres. Inclusion criteria were: an expected developmental age between 12 and 30 months (within the norm range of the BSID-II-NL non-verbal) and able to sit up in a (wheel) chair to work at a table. Children would not be included in the sample when diagnosed with a hearing problem or when was expected that a test administration would be to stressfull for a child. As a result of their severe developmental delay and in several cases the combination with autistic spectrum disorders, all children were experiencing serious language delay. Most of the CDC centres in the provinces of Groningen, Friesland and Drenthe (Northern part of the
Netherlands) and one in Amersfoort (centre of the Netherlands) were contacted and asked to take part in the research. Of the 11 centres contacted, nine answered positively.

Table 1

Sex and mean chronological age for girls and boys in the sample

<table>
<thead>
<tr>
<th>Sex</th>
<th>n</th>
<th>Mean chronological age in months</th>
<th>Range in months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girl</td>
<td>16</td>
<td>73</td>
<td>34-161</td>
</tr>
<tr>
<td>Boy</td>
<td>26</td>
<td>83</td>
<td>41-162</td>
</tr>
</tbody>
</table>

Procedure

All children were tested twice within a period of two weeks. In counterbalanced order the children were examined with the standard version and separately with the non-verbal version of the Mental scale of the BSID-II-NL. All testing took place at the CDC-centres and by 12 master students orthopedagogy of the University of Groningen. The students had ample experience with the administration of the BSID-II-NL and received intensive training in the non-verbal version. Two combination of tests with a child was mostly administered by two different students.

4.5 Results

We have analyzed test results by looking at developmental age equivalents. Raw scores could not be converted to developmental indices because of the age of the children. All children were older than 30 months. Norms were determined for the age range of 12 to 30 months. Analyzing raw scores was not possible either, since the number of items is not equal for both versions. With regard to the comparison between the test results on the standard version and the non-verbal version of the BSID-II-NL, figure 1 shows the mean developmental age equivalents for girls and boys.
Figure 1

*Mean developmental age equivalents for girls (n=26) and boys (n=16) on the standard and non-verbal version of the BSID-II-NL*

With regard to the clear difference between girls and boys on both versions, it was decided to first examine the effect of sex-differences on the test results. A multivariate analysis of variance was performed. Results are based on the developmental age equivalents. See table 2.

Table 2

*Results of a one-way multivariate variance analysis on the effect of sex on the test results on the standard and non-verbal version of the BSID-II-NL*

<table>
<thead>
<tr>
<th></th>
<th>Standard version</th>
<th></th>
<th>Non-verbal version</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>df</td>
<td>F</td>
</tr>
<tr>
<td>Sex</td>
<td>42</td>
<td>1</td>
<td>6.65</td>
</tr>
</tbody>
</table>

- *df*: degrees of freedom; *F*: F-test; *Sig.*: significance
From table 2 it becomes clear that the difference between girls and boys on the standard version is significant. This was reason for examining differences between test results on both versions not only for the total group children, but also separately for girls and boys. The results of performing the Wilcoxon signed-ranks test, in order to compare test results between the standard and non-verbal version of the BSID-II-NL, are shown in table 3. Results are based on developmental age equivalents.

Table 3

<table>
<thead>
<tr>
<th></th>
<th>Developmental age</th>
<th>Developmental age</th>
<th>Z</th>
<th>Sign.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard version</td>
<td>Non-verbal version</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl</td>
<td>26</td>
<td>23.81</td>
<td>24.34</td>
<td>-.72</td>
</tr>
<tr>
<td>Boy</td>
<td>16</td>
<td>20.34</td>
<td>21.73</td>
<td>-2.69</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>21.67</td>
<td>22.71</td>
<td>-2.78</td>
</tr>
</tbody>
</table>

Table 3 shows significant higher scores for the total group on the non-verbal version in comparison with the standard version of the BSID-II-NL. When girls and boys are divided, boys show a clear significant difference. They receive higher test results on the non-verbal version.

### 4.6 Discussion

The BSID-II-NL NV offers the possibility to assess the cognitive development of young children (12-30 months old) with hearing loss and/or speech and language problems, without using spoken language. High correlations between the non-verbal and standard versions of the Mental scale allow us to conclude that the non-verbal version may be used to make a sound judgment of the cognitive development level of a child without using spoken language. Extra validating research has been carried out on a group of children with a general developmental delay. Both the standard version and non-verbal version of the BSID-II-NL were administered to a group of children visiting a CDC-centre. The
results show that this group of children scores significantly higher on the non-verbal version of the BSID-II-NL. In other words, they profit from the non-verbal instructions and response possibilities offered when the non-verbal version of the BSID-II-NL is administered. These results allow us to answer the research question: Is the non-verbal version of the Mental scale of the BSID-II-NL a more appropriate instrument to determine general cognitive development in children with serious developmental delay, positively. Analyzing the data did however raise some new questions that will be, together with the limitations of the present study, discussed in this paragraph.

At this moment, only a non-verbal version of the Mental scale of the BSID-II-NL is available (Ruiter, Hoekstra, Van der Meulen & Lutje Spelberg, 2005). The Motor scale consists of items that can be performed by the child without spoken language. In the instructions of some items, however, the use of language is required. An adaptation of these instructions that leads to a non-verbal version of the Motor scale could be the subject of a follow-up study. The nature and content of the items on the Behavior Rating Scale eliminate the need for a non-verbal adaptation. These items are not administered directly, but are scored based on observation, and spoken language is not a part of the item content.

The empirical study is limited to only one specific group of children, future research should provide insight in the appropriateness and added value of the non-verbal version with other clinical groups of children, especially those with hearing loss and/or speech and language problems. Besides additional validity studies, reliability should be further examined by determining inter-rater reliability. This allows us to determine the level of agreement of judgments of different test administrators for the same test administration.

Individual differences between test results on the standard version and the non-verbal version seem striking in some cases and are significant when analyzed as a group (see table 3). As a whole, the children in the sample with serious developmental delay achieve higher scores on the non-verbal version than on the standard version. This result can be attributed to the use of the selection of non-verbal items with adapted instruction. It should, however, be noted that test administration is subject to (random) factors such as time of day, events prior to test administration and the child’s physical condition, and in
case of this specific group of children probably the sensitiveness to unfamiliar people, testing situation and test material. When the sample size is extended, the possible influence of these factors will decrease.

When the group is subdivided in girls and boys, differences in test results become apparent on the standard version and the non-verbal version. The differences are somewhat enlarged by the axis scale in the figure. When analyzed, only the difference on the standard version is statistically relevant. Reasons for the lower scores of the boys cannot be deducted from our current data. Taken the limited sample into account, these results could be indicative research findings for the assumption that also in the group of children with severe developmental delay, girls on average experience a somewhat faster development of language skills than boys (see e.g., Verhulst-Schlichting, Morelli-Kayser & Peddemors-Boon, 1987). The large contribution of language development on general cognitive development might be a partial explanation for the difference between girls and boys on the standard version of the BSID-II-NL. On the other hand, it seems a logical explanation that the difference between boys and girls is a result of the fact that in this sample the boys are more severely delayed than the girls. Future research should, however, put our research finding in perspective.

With regard to the use and interpretation of the BSID-II-NL NV we would like to make some final remarks.

The characteristics of the child that are known before the test is administered determine whether the standard version (all items on the Mental Scale) or the non-verbal version of the BSID-II-NL will be administered (Ruiter et al., 2005). To get an impression of the general cognitive skills of the child that has already been diagnosed with hearing and/or a speech/language problem, it suffices to administer the non-verbal version of the BSID-II-NL. If the researcher wishes to know how the child would score on the standard version, because he/she wants to know what the influence of the problem is on the test result, all items of the Mental scale should be administered and for non-verbal items, the non-verbal instructions should be followed. In this way, both a non-verbal and a standard score can be determined. A non-verbal score can be determined because the non-verbal instructions were used on non-verbal items. A standard score can be determined because all items were administered (provided that not too many refusals,
skipped items or items mentioned by parents were scored). If one is unsure of the possibilities of a child, it is always advisable to use language and gestures (pantomime). The verbal instruction should be carefully articulated in such a case. It is essential that the pantomime instruction does not give different or more information than the standard instructions do.

When comparing scores between the non-verbal version and the standard version, there are three possible outcomes, here described with regard to Developmental Indices (DI) and considering that a difference of 23 DI points is significantly significant.

1: Non-verbal version \( (DI_{nv}) \) scores higher than score on standard version \( (DI_{st}) \) : \( DI_{nv} > DI_{st} \).

For children that are expected to have an average general development but have a known hearing, speech and/or language problem, this result (non-verbal version scores higher than standard version) is expected.

2: Non-verbal version scores lower than score on standard version: \( DI_{nv} < DI_{ms} \).

This result is possible for children with (very) good development of verbal skills, but that experience problematic motor development. Many non-verbal items appeal to fine motor skills of a child. If a child experiences problems with its motor skills, this could negatively affect the score on the non-verbal version. Problems with motor development should also lead to a relatively low score on the Motor scale of the BSID-II-NL.

And 3: Equal scores on non-verbal version and standard version: \( DI_{nv} \approx DI_{ms} \).

Almost equal scores on the non-verbal and standard version show that the development of a child is harmonious.

There are at least three reasons for determining standard and non-verbal test results in practice. First, differences in test results can be a reason for referral for more specific assessment. Second, to be able to decide on intervention and education the optimal level of cognitive functioning should be determined. A suitable (learning) environment should allow a child to maximum development. Third, for applying the right teaching strategies and methods it can be important to know whether a child scores higher on the standard version or the non-verbal version of the BSID-II-NL. Herewith information is provided on the question whether a child profits more from verbal or non-verbal instruction when performing the tasks.

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References


