

A NON-VERBAL VERSION OF THE BAYLEY SCALES OF INFANT DEVELOPMENT

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Based on the Dutch version of the Bayley Scales of Infant Development a new set of norms and pantomime instructions have been developed. The purpose of this new version is to provide a supplement to developmental diagnostics of very young children with suspected hearing losses or specific language impairment. We describe the non-verbal version, its application and interpretation of the scores.

Diagnosis of developmental disorders in very young children very often depends on the ability to evaluate different areas of functioning separately. When we consider the area of early cognitive development a number of areas come to mind. For example, early development of concepts based on the achievement of object permanence or the development of symbolic play. When considering the clinical groups of children suspected of having developmental delay due to hearing loss or children suspected of having a specific language impairment we are often hampered by the integration of auditory (or verbal) and non-language specific tasks in the instruments that are available to psychologists for use in comparing these children with their normally developing cohorts. The Bayley Scales of Infant Development is such an instrument that is widely used for detecting developmental delay in children from the age of 2 to 30 months. This article discusses an adaptation of the Dutch version of the instrument to accommodate the need for assessing language and non-language (related) development separately when evaluating children with a suspected hearing loss or suspected specific language impairment.

The nature of the relationship between language development and cognitive development is certainly complex and it is beyond the scope of this article to discuss it (see for a recent review of the literature concerning this relationship in relation to specific language impairment: Friel-Patti,

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1992, and for hearing impairment: Marschark, 1993). We will refer here only to a short summary of a few standpoints on the relationship of verbal and non-verbal development of two clinical groups (deaf and hard of hearing children on one hand and specific language impaired children on the other) in reference to their early development. A detailed description of these clinical groups will not be given here. We will only discuss the differential diagnostics in relation to verbal and non-verbal development. When one suspects a hearing or language/speech disorder, separate assessment of a child's verbal and non-verbal skills is often preferred in order to discover where the lag in development lies. In the case of hearing disorders it is known that the deaf and hard of hearing perform on a much lower level than their hearing counterparts on tests with linguistic components (Fundudis, Kolvin, Garside, & Scanlon, 1979; Furth, 1966; Marschark, 1993, especially chapter 7; Mittler, 1974). Deciding whether this lag can be attributed to the hearing loss or is part of a general cognitive delay is the problem. Most authors agree that early cognitive development can take place without the mediation of verbal language. This cognitive or concept development has its basis in concrete experience (for example in manipulating objects and toys). See for example, Furth (1966) and Meadow (1975). When use is made of non-verbal tests or tests with a non-verbal pantomimic instruction the possibility of assessing a child's non-language related basic cognitive skills is enlarged. A similar argument is valid for the group of language and speech disturbed children. McCune, Kalmanson, Fleck, Glazewski, and Sillari (1990) also agree when discussing the problem as follows: "...an 18-month-old with cleft palate or hearing impairment might be unable to perform some age-appropriate language tasks. In such cases, it is vitally important to ascertain the age placement of non language items for which the child is showing adequate performance. While a standard score cannot be computed for such children, the age-graded nature of the items allows identification of some areas of cognitive strength" (p. 228).

It is well known that speech and language disorders are very frequent in mentally handicapped children (Yule, 1987), therefore the question of whether a lag in general cognitive development exists is important in determining whether one is dealing with a specific language disorder which in turn has consequences for the choice of therapy. In the case of speech and language impaired children the literature refers to the fact that these children often have a normal non-verbal mental development (as measured by general intelligence tests). These children perform significantly better

on the performance scale of the WISC-R than on the verbal scale, the mean results (total IQ) generally lie within the normal range (Fundudis et al., 1979). In generalizing the above-mentioned to young children (under two and a half years) we must make some additional observations. The developmental level of very young children is much more difficult to estimate than that of kindergartners and older children. This is partially due to the fact that intelligence at such a young age is not yet crystallized and also that young children are generally less able to adapt to a test situation. In some situations however we are forced to attempt to assess the cognitive functioning of young children. This is the case, for example, when questions arise as to whether a child is developing language at a normal rate. With the use of the non-verbal version of the Bayley Developmental Scales (BOS 2-30, VanderMeulen & Smrkovsky, 1983) presented here, we argue the position that when one is interested in the question of whether a child functions at age level and one knows that the child has a hearing loss, one should make use of a mental scale with pantomimic instructions. When dealing with language disordered children with no hearing loss this is more difficult. These children often turn up in clinical practice at the age of about 24 months. Nevertheless we hope that use of the non-verbal version of the BOS 2-30 can provide an adequate view of their early cognitive development to the exclusion of their (receptive and productive) language abilities. In this way one can aid the process of distinguishing between specific language disorders and language disorders accompanying general cognitive delay. In this article we attempt to formalize diagnostic statements about young children's behaviour independent of their language skills.

The Bayley Developmental Scales

The instrument, the BOS 2-30, is used for developmental assessment of very young children, aged 2 to 30 months. This instrument is the Dutch version of the Bayley Scales of Infant Development (BSID, Bayley, 1969). It has been adapted for use with very young children with (suspected) hearing or language disorders because of its practical qualities and the fact that very few existing developmental scales achieve a similar level of reliability and validity (VanderMeulen & Smrkovsky, 1985) for the age group concerned here.

With the help of the Bayley Developmental Scales we can make statements in quantitative terms about cognitive and motor development,

and in less quantitative terms, about the temperament of a child (VanderMeulen & Smrkovsky, 1985). The quantitative assessments of mental and motor development are expressed as two standardized scores: Developmental Index (DI) and the Developmental K-scores (DK) for both of the scales. The Developmental Index ($\mu = 100$; $\sigma = 16$) is comparable to the Developmental Quotients of the BSID. The Developmental K-scores ($\mu = 6.33$; $\sigma = 1.33$) are alternatives to the Developmental Quotients in the Dutch version (VanderMeulen & Smrkovsky, 1984, in Appendix one we show the structure of the BOS 2-30). When a child shows a considerable lag in development a mental or motor age can be determined.

According to Bayley (1969) - and adopted by VanderMeulen and Smrkovsky (1983, 1985) - a more refined analysis of young children's behaviour can be achieved by assuming the items to represent part of one or more distinct domains of functioning. Along this line of thinking one can consider the following areas: language skills, perceptual/sensory skills, discriminative ability, achieving object constancy, learning abilities, skills for classification and generalization, fine manipulative motor skills. In this sense we feel that use of a non-verbal version of the BOS 2-30 can aid in distinguishing between the verbally modulated and non-verbally modulated domains.

The BOS 2-30 includes a corpus of item instruction rules that should be adhered to by the examiner as carefully as possible. Some of these rules assume a certain level of language skill acquisition in the child. Performing on the corresponding items can be difficult for children showing a lag in language development. The sums of the raw scores in such cases, in particular on the mental scale, are lower.

An inaccurate evaluation of children with hearing losses or specific language disorders can be made during assessment by failing to abstract from the domain of language development. In such cases it seems sensible to assess the cognitive developmental level of the child apart from his or her language development when possible.

Adaptation of the standard version

The point of departure for the construction of the non-verbal version of the BOS 2-30 is to permit the user to continue using the standard scoring forms and materials, and to limit other modifications as much as possible. Only the mental scale has been adapted. The motor scale is of course not

entirely free of verbal instruction, but the examiner can easily model the expected behaviour. The selection of the items for the non-verbal version has been primarily based on the situation one encounters when testing a deaf child. Each item that is essentially characterized by hearing or producing sounds or language has been eliminated. Furthermore, we eliminated all items that require the understanding of spoken language. Fifty items were eliminated in this manner so that the non-verbal mental scale now consists of 113 items. See Appendix two, in which we show the items of the BSID (corresponding to the Dutch item division) that have been excluded from the non-verbal version. It must be noted that a verbal version has not been developed because of the small number of items (50), either the integrated version or the non-verbal version can be used.

Instructions for the examiner

The instructions for most of the remaining items have not been altered. Diagnosticians should, in the first place, have an accurate knowledge of the original instructions: the general guidelines for administration of the BOS 2-30, the item descriptions, scoring, standardization and interpretation of behaviour during testing. When administering the non-verbal version of the test the original (unaltered) instructions should be presented as expressively as possible, making use of natural gestures and facial expressions. The non-verbal version has three types of instruction:

1. The original instructions are unchanged because they were already based on natural gestures, imitation or spontaneous behaviour.
2. The original instructions are supplemented with emphasis on natural gestures.
3. New pantomimic instructions are added to the original instructions.

Adaptation of the examiner's instructions, or item instructions rules ensures that the hearing disabled are much less disadvantaged by the way in which the instructions are presented and can be more easily compared with the reference group of normal, hearing children on whom the original norms are based. Deciding which instructions to use (standard or pantomimic) depends on the available information about the child in question. It is important that the child understands the object of the tasks presented during the testing situation. For most children, the standard instructions provide

sufficient stimulation and motivation for performing the task at hand. In some cases, it is preferable to start out already using the pantomimic instructions. It is essential that pantomimic instructions give no information other than that provided by the standard instruction. The examiner should adapt to the child's verbal possibilities. When a child cannot or can barely hear speech sounds it is clear that one should use the pantomimic instructions. It is often easy to speak normally while doing so, but it is not necessary. A deaf child, however, is often more attuned to the use of gestures and needs them for communication. For children with a slight hearing loss who have used a hearing-aid for some time, it is sometimes unclear which form of instruction works better. When one is unsure, it is always better to use both; in this case, the verbal instructions should be carefully articulated.

Norms and scoring

A standardization was carried out in 1977-1982 (Dutch population; $N = 1283$; fourteen age categories) for the standard version of the BOS 2-30 (VanderMeulen & Smrkovsky 1983; 1984). This data was used in the construction of the norms for the non-verbal version. In order to make

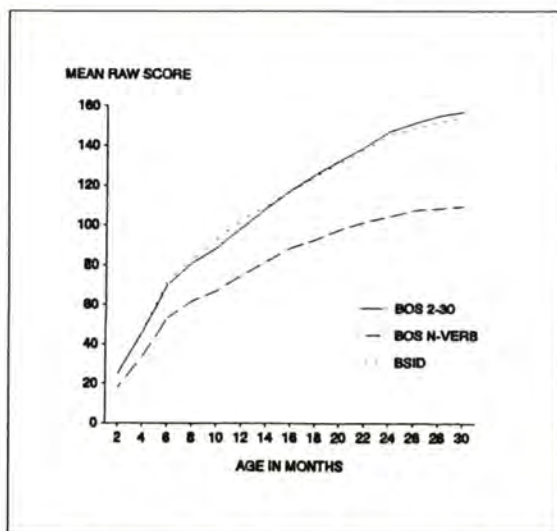


Figure 1. Mean raw scores of BSIS Mental Scale, BOS 2-30 Mental Scale, BOS 2-30 Mental Non-verbal Scale, in relation to age.

comparison possible, we also show the corresponding curve of the BSID Mental Scale (Bayley, 1969) in this Figure.

Each raw score can be transformed into either a non-verbal Mental Development Index, a non-verbal Developmental K-score, or a non-verbal mental age. It is clearly evident that the standard mental scale comprises items that require an increasing amount of linguistic knowledge as age increases. This affects the non verbal scale by reducing the discriminative quality from the age of around 27 months on. The non-verbal items are shown on the Dutch scoring forms in grey. When the examiner uses both versions of the BOS 2-30 the basal level and the top level are determined according to the standard procedure for determining the raw score (10 items scored positive and 10 items scored negative). When one only uses the non-verbal version the basal level or top level can be determined in the following manner: compare the non-verbal rank order number of the expected top (or basal level) with the rank order number of this item in the standard version; then, using the rank order number standard version, determine which item lies ten numbers above (or below) this; then refer back to the corresponding rank order number of the non-verbal version; this is then the top (or basal level). See for example Figure 2.

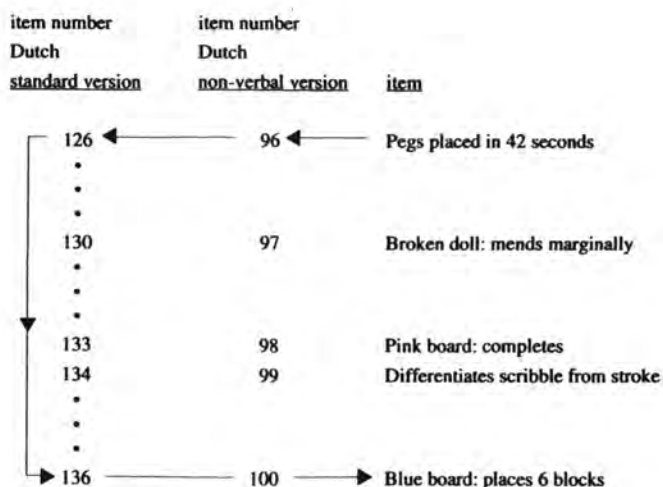


Figure 2. Example of the determination of the ceiling level.

When the corresponding item in the standard version is not included in the non-verbal version, one chooses the nearest item that is included as top or basal level.

When children fall outside the norms it becomes advisable to calculate a mental and motor development age. A table has been constructed for those who prefer to see the non-verbal test performance expressed in terms of a non-verbal mental test age in months (see VanderMeulen & Smrkovsky, 1987, p. 10; in this table estimated reliability coefficients are presented for each norm group, ranging from .65 to .90, with a mean of .85).

We expect that the Dutch non-verbal norms - based on a large representative sample - can be applied to the original BSID without many problems. The correlation between the age placements of the BOS 2-30 and the BSID (mental scale) is high ($r = .99$), as is the correlation between the item ranks ($r = .98$). The mean raw scores per norm group (see Figure 1) and the corresponding standard deviations differ little). The values for KR20 and the standard error of measurement per norm group also show a good correspondence.

Interpretation in the clinical situation

The clinical application of the non-verbal version of the BOS 2-30 generally depends on what is already known about the child and the setting (whether audiological information is available and whether the child's speech has been screened for levels of comprehension and expression). In general developmental practice when one is performing a diagnostic examination in a center for developmental examination (including children referred for psychiatric examination) one can encounter the problem that a top or basal level cannot be determined when using the full scale instrument (there is no sequence of ten items that have been scored positively). This occurs when a child performs poorly on too many of the consecutive items in the scale and it is impossible to determine a basal level (10 items) because of too many gaps (due to refusals or negative scores). It can be important to examine the possibility of whether the gaps occur in specific domains of functioning, for example, one can survey the scores to determine whether it is possible to achieve a non-verbal basal level and score the non-verbal scale. This enables one to compare the child with the non-verbal norms. Of course gaps in other developmental domains should be assessed separately.

We present two situations here, a child with (suspected) hearing loss or

(suspected) specific language impairment.

In the first situation the question is focused on acquiring additional knowledge about the mental and motor development of a child of whom hearing loss is suspected. One specifically wants to assess the level of cognitive and motor development as separate from the (suspected) hearing loss.

The non-verbal version of the BOS 2-30 can be applied using the pantomimic instructions. The examiner can then be assured that the child understands the tasks that lie within his or her non-verbal capacities. By comparing the outcome with the information on his or her language abilities one can achieve a good assessment of the developmental level of the child. This gives one a starting point for planning interventions. In many cases it is advantageous to repeat the measurement, certainly when a general developmental lag is suspected. When a child with a severe hearing loss has a normal non-verbal developmental level and has not yet started to develop language, it is imperative that one takes steps to revalidate the hearing problem. When the child has a lag in his or her non-verbal development one cannot be sure that hearing revalidation will have the intended effect. The expectations for speech development should not be placed too high and one should prepare the parents to deal with a child that not only has a hearing loss but also a general cognitive delay.

In the case of a suspected developmental language disorder the child has shown a lag in language comprehension and expression (without suspected hearing loss). The question here is whether one can exclude the possibility of general cognitive delay. This has implications for the intervention strategy. If a child has a specific language impairment the prognosis for speech therapy is relatively positive, because one can assume an normal non-verbal mental functioning as a basis for language learning (Friel-Patty, 1992). When cognitive delay (in this case both verbal and non-verbal) is indicated a more general type of stimulation for a child's development would be advised. The non-verbal instructions of the BOS 2-30 are useful in such cases because children with language disorders often have built up resistance to language mediated tasks. It is also of importance to separate the language component from the non-verbal component of behaviour in order to estimate the possibility of general cognitive delay. When the speech problem is part of a much more general cognitive delay speech therapy alone is not recommended and further interventions are needed.

Conclusion

By adapting the standard version of the BOS 2-30 for non-verbal testing, we feel we have provided a useful instrument for non-verbal assessment of cognitive abilities. Our experience with this instrument (see for example LeCoultré-Martin, Wijnberg-Williams, VanderMeulen, & Smrkovsky, 1988) has been positive, in many cases we have been able to make progress in the differential diagnosis of speech and hearing problems. We will provide more information on the use of the non-verbal BOS 2-30 with clinical groups.

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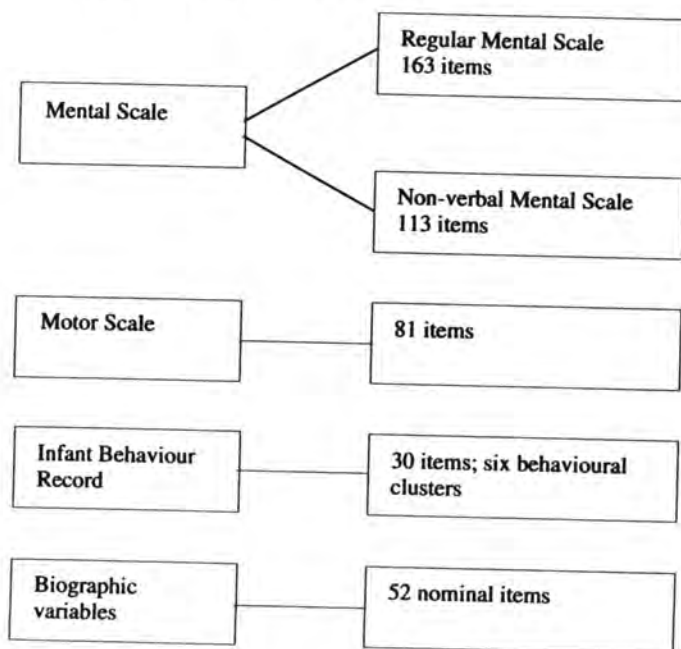
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APPENDIX 1

The structure of the BOS 2-30 (the Dutch version of the BSID)



APPENDIX 2

Excluded items from the the non-verbal version

BSID items Verbal/language/sound	BSID rank	BSID placement	age Dutch rank	Dutch age placement
Responds to sound of bell	1	0.1	1	...
Responds to sound of rattle	3	0.1	4	...

Responds to voice	11	0.7	6	...
Responds to sharp sound	4	0.1	7	...
Vocalizes once or twice	13	0.9	9	...
Vocalizes at least 4 times	21	1.6	21	...
Searches with eyes for sound	28	2.2	28	2.1
Vocalizes to E's social smile	27	2.1	27	2.1
Simple play with rattle	36	2.8	31	2.6
Glances from one object to another	30	2.3	32	2.6
Turns head to sound of bell	47	3.8	47	3.9
Turns head to sound of bell	47	3.8	48	3.9
Vocalizes attitudes	55	4.6	52	4.7
Turns head after fallen spoon	62	5.2	62	5.4
Bangs in play	66	5.4	68	5.6
Interest in sound production	72	5.8	69	5.6
Looks for fallen spoon	75	6.0	77	6.8
Vocalizes 4 different syllables	79	7.0	81	8.1
Rings bell purposevily	83	7.8	82	8.6
Listens selectively to fam. sounds	84	7.9	85	9.0
Says 'da-da' or equivalent	85	7.9	88	9.7
Responds to verbal request	89	9.1	91	10.5
Jabbers expressively	101	12.0	96	11.6
Repeats performance laughed at	97	10.8	97	11.9
Pats whistle doll, in imitation	104	12.2	102	12.4
Imitates words	106	12.5	111	13.9
Says 2 words	113	14.2	116	15.3
Shows shoes or other clothing	117	15.3	117	15.8
Follows directions, doll	126	17.8	123	17.2
Names 1 object	124	17.8	127	18.7
Uses words to make wants known	127	18.8	128	19.1
Points to parts of doll	128	19.1	129	19.1
Finds 2 objects	131	19.7	131	19.3
Names 1 picture	130	19.3	132	19.5
Sentence of 2 words	136	20.6	135	20.7
Points to 3 pictures	132	19.9	137	21.1
Names 2 objects	138	21.4	138	21.4
Points to 5 pictures	139	21.6	141	22.4
Names 3 pictures	141	22.1	142	22.7
Names watch, 4th picture	145	23.8	143	22.7
Names 3 objects	146	24.0	145	23.2
Discriminates 2: cup, plate, box	144	23.4	148	23.9
Names watch, 2nd picture	150	25.2	149	23.9
Points to 7 pictures	148	24.7	150	24.1
Names 5 pictures	149	25.0	154	24.8
Understands 2 prepositions	158	28.2	156	25.9
Discriminates 3: cup, plate, box	152	28.2	156	25.9
Understands 3 prepositions	163	30+	162	30+
Concept of one	162	30+	163	30+