Historical and Theoretical Study of the Use of the Montessori Cylinder Block as a Screening Test Instrument for Developmental Disorders

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(Received June 29, 1994)

Abstract

Studies investigating mental development screening tests and the Montessori cylinder block were described. The theoretical possibility was discussed for the use of the Montessori cylinder block B type as a mental development screening test instrument.

It was a theoretically unique idea to use the Montessori cylinder block B type as a screening test instrument in measuring the child's mental development. As a result of researching previous studies, not only in Japan but also in other countries, there has been no study identified concerning the Montessori cylinder block B type being used or not used as a screening test instrument. It therefore became clear that from a very basic starting point a study must begin of the possibility of using the Montessori cylinder block B type as a screening test instrument.

Key words: Binet, development, mental, Montessori, screening

Introduction

Dr. Maria Montessori (1870–1952), Italian psychiatrist and educator, created the Montessori educational method. Using this method, she first educated mentally retarded children, and later, normal children who lived in very poor areas in Rome. (Kramer, 1976)

In Holland, there is now the International Society of Montessori. There are branches of the Society and training centers for teachers in more than ten countries. In 1968, the Japan Montessori Society was established and has become a center for teacher training and educational practice. (Nishimoto, 1975)

The character of the Montessori educational method is sensory education, and the cylinder block is one of the sensory educational instruments used. There are four types of cylinder blocks: A, B, C and C’. Figure 1 shows the B-type cylinder block, which is 46

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The purpose of this paper is to discuss the possibility for using the Montessori cylinder block B type not only as an educational material but also as a mental development screening test instrument. Studies investigating mental development screening tests and the Montessori cylinder block are described. The theoretical possibility is discussed for the use of the Montessori cylinder block B type as a mental development screening test instrument.

Discussion

Studies concerning mental development screening tests.

Concerning the beginning of the mental development screening tests, Meisels (1989) stated the following:

Beginning with the 1966 adaptation of the Gesell Developmental Schedules by Knobloch et al. and the 1967 introduction of the Denver Developmental Screening Test (DDST) by Frankenburg and Dodd, developmental screening instruments have been administered to millions of children. (p.578)

Concerning the problem of mental development screening tests which had been devised at that time, Frankenburg and Dodds (1967) stated the following:

Many pediatricians have devised developmental scales which are made up of items from standard psychological tests such as the Gesell Developmental Schedules, the Cattell Infant Intelligence Scale, and the Bayley Infant Scales of Development. [Thirteen references are listed.] One of the problems in devising a test in this

Figure 1. Montessori cylinder block B type.
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manner is that achievement of some of the developmental items is placed at different ages in the different tests. (p.181-182)

Frankenburg and Dodds (1967) standardized the Denver Developmental Screening Test which was made up of 105 test items selected from twelve developmental tests and preschool intelligence tests.

Meisels (1989) stated, "The most frequently used screening instrument for detecting young children who are at risk for developmental delays is the Denver Developmental Screening Test (DDST)." (p.578)

But Meisels (1989) added the following:

Evidence from more than a dozen studies has been presented to substantiate the claim that the DDST's original validation studies have not been replicated. Specifically, the DDST fails to identify a high proportion of children who are developmentally at risk. (p.582)

And Meisels (1989) stated the following to recommend three screening tests:

... only three have sensitivity and specificity ratios $\geq 0.80$. Data concerning the validity of a parent report scale with the same age range as the DDST, the Minnesota Child Development Inventory, and two individually administered preschool tests—the Early Screening Inventory and the Minnesota [Minneapolis] Preschool Screening Inventory are given ... (p.583)

As Meisels stated, these three tests showed excellent data concerning the validity. However, it takes about thirty minutes for a parent to complete the Minnesota Child Development Inventory, (Gottfried, Guerin, Spencer & Meyer, 1984) and this test may not be useful in the practical field. The Early Screening Inventory can be administered for children from four to six years of age, but not for children under three years of age (Meisels, Wisk & Tivnan, 1984). The Minneapolis Preschool Screening Inventory can be administered for children from four to five years of age, but not for children under three years old (Lichtenstein, 1982). It is impossible, therefore, for these two tests to detect children who are developmentally at risk under three years of age.

Lichtenstein (1982), who devised the Minneapolis Preschool Screening Inventory, stated the following to point out the limit of screening accuracy:

Given that developmental variability and measurement error impose such restrictive limits upon prediction, it is important to deal realistically with the issue of identification errors. This involves trying to maximize identification accuracy, yet allowing for the fact that errors in identification do occur. (p.71)

Discussion about the limitations of screening accuracy.

In this section, the reason for the limitations of early mental development screening accuracy is discussed.

First, the border between normal and abnormal mental development is not clearly
distinct, but continuous. As shown in Figure 2, the distributions of the normal and abnormal intelligence are continuous and overlapping. Even if we screen referrals (positive) from nonreferrals (negative) by any cut-off points, we always have two sorts of errors: overreferrals (false-positive) and underreferrals (false-negative).

Second, child development is not fixed, but changeable. For example, a child who was thought to be normal before may have become abnormal, and a child who is thought to be abnormal now may become normal in the future. This changeability reduces the predictive validity of mental development screening tests.

Allowing for the fact that errors in identification do occur, Lichtenstein (1982) stated the following:

Given the evidence, it appears that extensive assessment of young children at a single point in time is a poor investment of system resources. Alternatively, the use of brief, cost-effective identification procedures may lead to changes in the early identification process that improve accuracy in the long run. (p.71)

In addition, it is probable that one of the reasons for the limitations of early mental development screening accuracy rests with the basic idea of screening tests which are currently administered. As stated in the preceding section, the mental development screening tests—the Denver Developmental Screening Test included—were made up of items from standard psychological tests. Even if we improved the reliability and validity of screening tests as much as possible, we could not achieve theoretically the same high reliability and validity of screening tests as that attained by standard psychological tests. Naturally, we have two sorts of errors: overreferrals (false-positive) and underreferrals (false-negative).

The origin of standard psychological tests which are currently administered is the scale which Alfred Binet, a French psychologist, devised. Gearheart (1981) stated that “Binet, in 1904, was asked by Paris educational authorities to find a way to separate the educable from the uneducable.” (p.34) It seems that, from the view point of the present day, the scale which Binet devised can be seen as a screening test.
Concerning the scale which Binet devised, Gearhart (1981) stated the following:

Binet searched for tasks that could be categorized in terms of averages of performance at successive age levels. After much effort, the elimination of many of the original tasks and the addition of others, he was able to establish a series that could be arranged by patterns of performance at successive age levels. (p.34)

For nearly a century since he devised the scale, Binet's basic idea has been applied to many subsequent standard psychological tests.

However, as stated in the preceding section, the limit of mental development screening tests has been determined. It is possible that one of the reasons of the limitation exists in Binet's basic idea. Standard psychological tests using Binet's method can not detect certain aspects of intelligence and development. One example of these is learning disability.

Concerning the character of learning disabled students, Gearheart (1981) stated the following:

Great variations may exist in some of the characteristics of learning disabled students, but one characteristic is found in all such students. This is a severe discrepancy between achievement and intellectual ability in some area such as oral expression, written expression, listening comprehension, reading comprehension, reading, or mathematics. This basic discrepancy in learning is the basis for the individual being considered learning disabled. (p.14)

We can not identify learning disabled students only by standard psychological tests based on Binet's method. Concerning tests to be used in the identification of learning disabled students, Gearheart (1981) stated the following:

Three major types of assessment tools are in common use for purposes of identification of learning disabled students and the subsequent planning for remediation. These are: (1) measures or indicators of level of intellectual functioning, (2) measures or indicators of level of academic functioning, and (3) measures in such areas as visual or auditory perception, memory, sensory integration, or motor abilities. (p.33)

We can not screen learning disabled children only by mental development screening tests which are currently administered.

The ideal mental development screening test.

Theoretically, what is the ideal mental development screening test which does not actually exist and exceeds the limitations of screening tests that are currently administered?

First, the ideal mental development screening test should show a clear separation between normal and abnormal intelligence.

The distributions of normal and abnormal intelligence, which are shown in figure 2, are measured by standard psychological tests based on Binet's method. As shown in figure 3,
the ideal mental development screening test can screen the abnormal from the normal in the form not of overlapping but separation. If this screening test could be devised, neither the overreferrals (false-positive) nor underreferrals (false-negative) would exist, and both the sensitivity and specificity would become one.

Second, the ideal mental development screening test can detect an abnormal aspect of intelligence or development earlier and more precisely than can be done at present. The screening tests which are administered now may neglect abnormal aspects of those whom we think to be normal. The neglect can explain the phenomenon that a child whom we thought to be normal before has become abnormal now. The ideal screening test which can detect an abnormal aspect of intelligence or development early and precisely can help reduce the occurrence of this phenomenon.

In addition, we might consider which method is thought to provide a more ideal screening test than those which are currently administered.

The basic idea of current screening tests is that the risk of abnormal intelligence or development is measured by the degree of deviation from normal intelligence or development. As stated in the preceding section, the origin of this idea can be found in Binet’s work.

The new idea which is presented here is that the risk of abnormal intelligence or development can be measured by observing abnormal behavior. We can observe this abnormal behavior when we give a child a task which typically shows abnormal behavior, and we can screen high-risk children by observing the degree of the behavior abnormality. The abnormality of intelligence or development is not the degree of the deviation from the norm but the abnormal behavior which a task typically shows.

What is the most suitable task for the ideal screening test? As far as I have been able to research, no study about such tasks or screening tests has as yet been done. I will therefore consider the Montessori cylinder block B type to investigate as a suitable screening instrument.
The reasons for selecting the Montessori cylinder block for this study.

Dr. Montessori, from her educational experience in which she taught mentally retarded and normal children, thought that the basic factors of the child's intelligence were (a) recognition of identities, (b) recognition of contrasts, and (c) discrimination of similarities. She created educational materials which included three manipulations—(a) pairing, (d) grading, and (c) sorting—matching with these three basic factors of the child's intelligence.

The Montessori cylinder block includes pairing and grading. The first reason why the Montessori cylinder block was selected is that the children who have an abnormality of recognition of identities and contrasts will have more difficulty and will take more time to inset cylinders than will normal children.

The second reason why the Montessori cylinder block was selected is that the Montessori cylinder block is the educational instrument by which Dr. Montessori discovered the fundamental principle of the Montessori educational method. This principle is the concentration of attention. By using the Montessori cylinder block, normal children can more easily concentrate their attention. However, abnormal children find it harder to concentrate their attention and will often stop inserting cylinders, or they will take more time to inset them than will normal children.

The factors which are screened by the Montessori cylinder block include: (a) recognition of identities, (b) recognition of contrasts, and (c) ability in concentrating attention. In addition, dexterity of hands and fingers, eye-hand coordination, the strategy to solve a task, and the speed of learning achievement may be screened. As a result of abnormality of these abilities, abnormal children take more time to inset all the cylinders into the block than do normal children.

The third reason for selecting the Montessori cylinder block is that in the Montessori educational method the Montessori cylinder block is manipulated by the youngest children and is therefore suitable for the purpose of early screening. In the Montessori educational method, sensory education takes place before arithmetic and language education. In sensory education, children manipulate the Montessori cylinder block first. It is the same reason why, of the four types of blocks, the B-type was selected for this study, as the youngest children manipulate the B-type first.

The fourth reason is that it is easy to attach switches to the Montessori cylinder block in order to measure and record automatically the time and the order in which the child insets the cylinders into the block.

Studies on the Montessori cylinder block.

On 20th July, 1992, I researched twelve files in the DIALOG data-base, which are shown in Table 1, and, using the key words of both "MONTESSORI" and "CYLINDER", an attempt was made to trace back and find relevant papers and books as far in the past as
Table 1
Names of Files to Research in the DIALOG Data-base

<table>
<thead>
<tr>
<th>File number</th>
<th>Names of files and dates to trace back</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ERIC 66-92/JUN.</td>
</tr>
<tr>
<td>5</td>
<td>BIOSIS PREVIEWS 69-92/JUL.</td>
</tr>
<tr>
<td>11</td>
<td>PSYCINFO 67-92/JUL.</td>
</tr>
<tr>
<td>37</td>
<td>SOCIOLOGICAL ABSTRACTS 63-92/JUN.</td>
</tr>
<tr>
<td>54</td>
<td>ECER/EXCEP CHILD 66-92/MAR.</td>
</tr>
<tr>
<td>73</td>
<td>EMBASE 74-92/ISS29</td>
</tr>
<tr>
<td>86</td>
<td>MENTAL HEALTH ABSTRACTS 69-92/JUN.</td>
</tr>
<tr>
<td>144</td>
<td>PASCAL 73-91/DEC.</td>
</tr>
<tr>
<td>151</td>
<td>HEALTH PLANNING AND ADMINISTRATION 75-92/AUG.</td>
</tr>
<tr>
<td>155</td>
<td>MEDLINE 66-92/SEP.</td>
</tr>
<tr>
<td>265</td>
<td>FEDERAL RESEARCH IN PROGRESS JUN.92</td>
</tr>
<tr>
<td>291</td>
<td>FAMILY RESOURCES 70-92/JUN.</td>
</tr>
</tbody>
</table>

possible. However, only one paper was found in this search. Ball and Campbell (Ball & Campbell, 1970) divided thirty-two kindergarteners into two groups--experimental and control groups. The children in the experimental group worked with the Montessori cylinder blocks and the children in the control group worked with jigsaw puzzles. The conclusion was that the Montessori cylinder block training did not enhance, and may even have disrupted, the acquisition of Piagetian conservation of volume.


However, in Japan there has been no study concerning the possibility of using the Montessori cylinder block as a mental development screening test instrument.

### Conclusion

It is a theoretically unique idea to use the Montessori cylinder block B type as a screening test instrument in measuring the child's mental development.

As a result of researching previous studies, not only in Japan but also in other countries, there has been no study identified concerning the Montessori cylinder block B type being used or not used as a screening test instrument. It therefore became clear that from a very basic starting point a study must begin of the possibility of using the Montessori cylinder block B type as a screening test instrument.
The author wishes to thank Mr. Michael Unher for checking English sentences of this paper.

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