A Novel Means-End Problem Solving Assessment Tool (MEPSAT): Evaluation of Validity and Reliability

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Introduction

Means-end problem-solving (MEPS) tasks can serve as early indicators of infants’ cognitive development (Lobo & Galloway, 2013). Previous studies have highlighted delays in performance and learning of MEPS in at-risk infants compared to typically developing infants (Clearfield et al., 2015; Cunha et al., 2018). However, real-time identification of delays in MEPS can be challenging since MEPS behaviors have traditionally been analyzed using time-intensive behavioral coding methods (Babik et al., 2018; Cunha et al., 2018). To provide an affordable and feasible assessment of MEPS for research and clinical settings, we developed a novel Means-End Problem-Solving Assessment Tool (MEPSAT).

The goal of this study was to evaluate construct validity and reliability of the MEPSAT.

Methods

- 22 typically developing infants (Mean=5.9 months at the first visit; SD=0.2) and 30 infants with motor delays [Mean=10.4 months (prematurity-corrected)] at the first visit; SD=2.4).
- Infants were assessed longitudinally at 5 visits across 1.5-years in their homes.
- At each visit, infants engaged in a MEPS task: pulling a towel to retrieve a distant, supported toy (Figure 1).

The MEPSAT was used to score videos: 1) Means-end learning; and 2) level of performance (Figures 2 A-B).

Infants were also assessed using the Bayley Scales of Infant and Toddler Development (Bayley-III).

For both groups, variations in MEPSAT scores across time were related to variations in the Bayley-III scores across time.

Children with motor delays who showed greater MEPSAT scores on average also had higher Bayley-III scores on average.

Results

Validity

- Significant within-child associations (p<.05) were observed between MEPSAT scores and Bayley-III scores for both typically developing children and those with motor delays.
- Significant between-child effects (p<.05) were observed only for children with motor delays.

Table 1. Associations between MEPSAT outcomes (means-end learning and level of means-end performance) and Bayley-III.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bayley-III</th>
<th>Means-End Learning</th>
<th>Level of Means-End Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
<td>0.56</td>
<td>0.09 &lt;.001</td>
<td>0.10</td>
</tr>
<tr>
<td>Motor delay</td>
<td>0.17</td>
<td>0.05 &lt;.001</td>
<td>0.11</td>
</tr>
<tr>
<td>Typical</td>
<td>0.59</td>
<td>0.09 &lt;.001</td>
<td>0.22</td>
</tr>
<tr>
<td>Motor delay</td>
<td>0.16</td>
<td>0.04 &lt;.001</td>
<td>0.14</td>
</tr>
<tr>
<td>Typical</td>
<td>0.58</td>
<td>0.09 &lt;.001</td>
<td>0.35</td>
</tr>
<tr>
<td>Motor delay</td>
<td>0.22</td>
<td>0.05 &lt;.001</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Reliability

- Strong intra- and inter-rater reliability of means-end learning and level of means-end performance scores was found for both typically developing children and children with motor delays.

Table 2. Table 3. Intra- and inter-rater reliabilities (with 95% CI) for MEPSAT scores

Conclusions

- The MEPSAT is supported by validity and reliability evidence and is thus a promising tool for screening to identify early problem-solving delays in infants with a range of motor abilities.
- The MEPSAT can be performed in the home environment quickly and with minimal resources.
- The. MEPSAT has a simple scoring system that can distinguish differences in performance among infants with varying levels of motor delay and detect changes in performance for a child across time.
- The MEPSAT can be used in clinical and research settings to assess the efficacy of interventions aimed at advancing problem-solving skills, motor ability, and cognitive outcomes in at-risk infants.

References


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