Construction of a Danish CDI short form for language screening at the age of 36 months:

Methodological considerations and results

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Background

- Lack (in Denmark and worldwide) of effective language screening tools to detect children with a delay (Nelson et al. 2006; Law et al. 2000; Slott, Vach & Bleses, submitted)

- The MacArthur Bates Communicative Development Inventories (CDI) provide a valid and reliable tool for research and clinical assessment in children up to the age of 36 months (cf. overview in Fenson et al., 2007..but see e.g. Feldman 2000; Bornstein et al., 2006; Houston-Price et al., 2007)

- The CDI is too comprehensive to be used as a screening tool for screening in unselected populations

- Development of CDI short forms (not only for screening) (Fenson et al., 2000; Grantham-McGregor et al., 2008; Pike et al., 2006; Pérez-Pereira et al., 2007; Sachse et al., 2007; Marschik et al., 2007; Caselli et al., 2007; Jackson-Maldonado et al., 2005; Eriksson et al., 2002)
In Denmark (2006)

- Increasing interest and considerations concerning population language screening from the authorities/public (e.g. governmental report on national reading strategy, 2005)

- Explore and document the possibility of performing a nation wide screening at low costs using parental reports (screening first step of further evaluation and assessment) (Center for Child Language; Mikro Værkstedet A/S)

- High rate of institutionalization opens opportunities for population language screening in day care settings

- Used our experience with and norms from a large CDI-study with 6,112 children from 8 to 36 months as the basis to create a Danish CDI short form (Bleses et al., 2007; 2008)
Topics of the talk

• How did we come to a Danish CDI short form specifically for screening at age 36 months?

• How did the CDI short form perform?
The general principles

• Difficult to distinguish (and predict) persistent and transient language difficulties (e.g. Dale et al. 2003)

• When screening normally interested in identifying 5% to 20% lowest performing children (depending on the resources for further assessment/intervention)
  – Screening tools should allow to discriminate among these children

• Aim of Danish short form to identify children (36 months) at the lower end of the distribution of language development
  – Using a single summary score, the score should allow to discriminate the 5, 10 and 15% percentiles
  – Due to some measurement errors, right skewed distribution of the summary score with substantial distances between lower percentiles
  – No need to discriminate between the 50% and 90% percentile

• A sample of 278 children at age 35 and 36 months from the Danish norming study used for construction of short form
Based on the construction sample

- Vocabulary shows the desired distribution
- There are too many boys with low grammar scores
- There is no tail to the left in the distribution of MLU3

→ Only vocabulary is included in the short form

Select items which are most appropriate to identify children in the lower tail of the distribution
Selection of items (1)

- **Step 1: Selection in dependence of the production frequency**

  - Items with a low production frequency will move also high performing children to the lower end of the distribution
  - Items produced by nearly all children are also produced by some of the low performing children
  - Too many items with high production frequency may imply that a substantial fraction of children score 100%. (this may reduce the acceptance of the tool)

→ Picked the 302 items with a production frequency between 60% and 90%
Selection of items (2)

- Step 2: Removing items with no development around 36 months

- Production frequency $f_1$ at age 35/36 months compared to production frequency $f_0$ at age 30-32 months using odds ratio (OR)
  
  (ORs close to 1 $\rightarrow$ no development)

- Items with nearly no development
- Removed all items with an developmental OR $\leq 1.33$
Selection of items (3)

- **Step 3: Removing items with large gender differences**
  - 8 items with very large gender difference were removed

<table>
<thead>
<tr>
<th>Item</th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-shirt</td>
<td>95%</td>
<td>48%</td>
</tr>
<tr>
<td>jakke (coat)</td>
<td>98%</td>
<td>83%</td>
</tr>
<tr>
<td>bælte (belt)</td>
<td>91%</td>
<td>69%</td>
</tr>
<tr>
<td>klapvogn (buggy)</td>
<td>78%</td>
<td>98%</td>
</tr>
<tr>
<td>aah aahh</td>
<td>73%</td>
<td>92%</td>
</tr>
<tr>
<td>cykel (bicycle)</td>
<td>62%</td>
<td>86%</td>
</tr>
<tr>
<td>mor (mother)</td>
<td>60%</td>
<td>84%</td>
</tr>
<tr>
<td>morfar (mother's father)</td>
<td>78%</td>
<td>89%</td>
</tr>
</tbody>
</table>
Selection of items (4)

- **Step 4: Ordering items by their item-total correlation**
  - We regard the summary score of the remaining 265 items as a first appropriate tool.
  - Determine for each item the item-total correlation in the lower half of the children to find out, which items are most appropriate to discriminate among low performing children
  - The items with highest correlation (0.55-0.61)
    - Words with clear semantic, not related to social factors (e.g. vindue (window), give (to give), forsigtig (careful))
  - The items with lowest correlation
    - Some may be family specific, some may be related more to social/cognitive development (e.g. bønner (beans), tak (thank you), ingen (nobody))
Selection of items (5)

- Step 5: Manual selection starting at top of the ordered list removing inappropriate items
  - Not belonging to the vocabulary of all families
    e.g. pizza, sut (pacifier), family relations
  - Related to the social status of the family
  - Related to seasons e.g. julemand (Father Christmas)
  - With ambiguous semantic e.g. fuld (full or drunken)

- Select the 100 items with maximal item-total correlations
  - 34 nouns, 29 verbs, 9 adverbs, 10 prepositions, 3 other
The distribution of the score in the construction sample

*5%, 10% and 15% percentiles indicated

How does the short form perform?
Internal validation

- Grammar part of the CDI can be used to identify children with a delay (N=117)

- sensitivity measures

<table>
<thead>
<tr>
<th>INDICATION</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>5%</td>
</tr>
<tr>
<td>not combining words often</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>not yet plural</td>
<td>9</td>
<td>44</td>
</tr>
<tr>
<td>not yet genitive</td>
<td>9</td>
<td>44</td>
</tr>
<tr>
<td>not yet past tense</td>
<td>29</td>
<td>17</td>
</tr>
<tr>
<td>grammar score below 5%</td>
<td>7</td>
<td>29</td>
</tr>
<tr>
<td>grammar score below 10%</td>
<td>14</td>
<td>21</td>
</tr>
</tbody>
</table>

Correlation of short form with full form: vocabulary 0.97; grammar 0.71; MLU3 0.28
External validation: pilot study

- Municipality of Fredericia identified all 106 children at age 35, 36 or 37 months
  - Overall response rate 84%
  - 72 monolingual children; 17 bilingual (immigrant) children

  ![Distribution of Score](chart.png)

- Obtained desired skewed distribution
- Bilinguals spread over full spectrum
External validation: pilot study

- Comparison with reference tests (receptive and productive vocabulary)
  - 9 children below 10\(^{th}\) percentile (based on preliminary gender-specific norms)
    - 1 child deaf, other 8 children assessed by speech therapists

<table>
<thead>
<tr>
<th>Reference tests</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reynell (impressive part)</td>
<td>1;3 and 2;10 (median 2;4)</td>
</tr>
<tr>
<td>Language test 1</td>
<td>at or &lt; age 2 years</td>
</tr>
<tr>
<td>Viborg</td>
<td>&lt; 25(^{th}) percentile</td>
</tr>
</tbody>
</table>

- All confirmed delayed → high positive predictive value (but speech therapist not blinded)
Discussion (1)

- A new strategy to construct a CDI short form to be used specifically as a *screening tool* at a specific age
  - Only applicable if a population and full CDI based study is available

- The strategy applied “with success”
  1. Reasonable sensitivity in identifying children with delay in grammar acquisition
  2. Desired skewed distribution of summary score in pilot study
  3. Speech therapists could confirm delay in screening-positive children

- The CDI short form today part of the screening tool used for population language screening in DK (this symposium)
  - Norming studies of the short form has shown moderate to high correlations with other dimensions of early language acquisition
Discussion (2)

• The strategy quite different from those used by other groups
  – Eriksson et al., 2002: Focus on words typically produced by low performing children
  – Sachse & von Suchodoletz 2007: Focus on sub categories allowing to identify late talkers

• Such approaches have the risk that children in the lower end cannot be discriminated well

• Our approach ensure in the first place a skewed distribution (vs. high correlation with full form) and then try to select the optimal items to discriminate among low performing children
Discussion (3)

- Short forms need new norming studies!

- Percentage score deviate distinctly from a uniform distribution

- Parents of low performing children set more marks when confronted with a short form

*compared with preliminary norms
Discussion (4)

- At what age can we use a vocabulary based screening?
- We applied our strategy at different ages

- Does not work below 27 months $\Rightarrow$ “Optimal” 30 – 33 months
Thank you for your attention!!
<table>
<thead>
<tr>
<th>Language</th>
<th>Reference</th>
<th>Age</th>
<th>No of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am. Eng.</td>
<td>Fenson et al. 2000</td>
<td>8-18</td>
<td>89 (Comp-Prod)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-30</td>
<td>100 (Prod) + 1 compl.</td>
</tr>
<tr>
<td>Bangeli</td>
<td>Grantham-McGregor et al 2008</td>
<td>8-18</td>
<td>60 (Comp-Prod)</td>
</tr>
<tr>
<td></td>
<td>Pike et al 2006</td>
<td>Adap. AE</td>
<td>Adap. AE</td>
</tr>
<tr>
<td>Galician</td>
<td>Pérez-Pereira et al 2007</td>
<td>8-15</td>
<td>89 (Comp-Prod)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-30</td>
<td>100 (Prod)</td>
</tr>
<tr>
<td>German</td>
<td>Sachse et al. 2007</td>
<td>24</td>
<td>42 (Prod)</td>
</tr>
<tr>
<td>German (au.)</td>
<td>Marschik et al 2007</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Italian</td>
<td>Caselli et al 2007</td>
<td>18-30</td>
<td></td>
</tr>
<tr>
<td>Mex. Spanish</td>
<td>Jackson-Maldonodo et al 2005</td>
<td>8-18</td>
<td>104 (Comp-Prod)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-30</td>
<td>100 (Prod) + 1 compl</td>
</tr>
<tr>
<td>Swedish</td>
<td>Eriksson et al 2002</td>
<td>18</td>
<td>13 Gest. 90 (Comp – Prod)</td>
</tr>
</tbody>
</table>