Executive Function in Young Monolingual and Bilingual (German-English) Children

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Graduate Student Research Day
May 7, 2011

Centre for Early Childhood Research and Policy

University of Victoria
Overview

- Why study bilingual children?
- What is Executive Function?
- Limitations of Current Research
- Present Study
Why study bilingual children?

• Canada is bilingual
• Being bilingual influences:
  – Organization of language (Green, Crinion & Prince, 2007)
  – Cognitive decline in older adults (Bialystok, Craik & Ryan, 2006)
  – Executive Function (Carlson & Meltzoff, 2008)
Executive Function (EF)

Definition
- Cognitive processes such as working memory, inhibitory control, and cognitive flexibility (Garon, Bryson & Smith, 2008)

Relevance
- EF has been implicated in various developmental disorders (Zelazo & Müller, 2009)
Executive Function (EF) & Bilingualism

Bilinguals = Monolinguals
- **Working Memory** (Bialystok, Craik, & Luk, 2008)
- **Short Term Memory** (Bialystok, 1999; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008)
- **Response Inhibition** (Bialystok, Craik, Ryan, 2006; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008)

Bilinguals perform better than Monolinguals
- **Cognitive Flexibility** (Bialystok, 1999; Bialystok & Martins, 2004; Carlson & Meltzoff, 2009)
  * Not Consistently found (Morton & Harper, 2009)
Limitations of Current Research

1. Most studies only use one aspect of EF

2. Limited research on different language combinations
Hypotheses

1. Bilingual and monolingual children will not differ on short-term memory, working memory and response inhibition tasks

2. Bilingual children will outperform their monolingual peers on cognitive flexibility

*Controlling for age, SES, and verbal ability
Method

Participants
• 56 children ages 3 to 6 years old (31 male, M= 65 months, range = 37-65 months)
• Recruited from local daycares, German language schools, and word of mouth

Procedure
• One 60 minute session or two 30 minute sessions on different days
• Task order was counterbalanced
Method: Child Measures

Working Memory
1. Backward digit span
2. Backward word span

Short Term Memory
3. Forward digit Span
4. Forward Word Span

Response Inhibition
5. Continuous Performance Task (CPT)
6. Go/ No-Go Task

Cognitive Flexibility
7. Dimensional Change Card Sort (DCCS)
8. Animal- Color Task

Language Proficiency
9. Peabody Picture Vocabulary Test (PPVT-III)
10. Clinical Evaluation of Language (CELF)
Dimensional Change Card Sort

- Color rule
- Shape rule
Results

1. Correlations among measures

2. Raw scores of vocabulary test

3. MANCOVA (Monolingual & Bilingual)
## Zero-Order Correlations

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td>1. Age</td>
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<tr>
<td>2. Sex</td>
<td>-.18</td>
<td>-</td>
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<td>3. PPVT</td>
<td>.71**</td>
<td>-.18</td>
<td>-</td>
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<td>4. CELF</td>
<td>.64**</td>
<td>.04</td>
<td>.79**</td>
<td>-</td>
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<tr>
<td>5. Forward Span</td>
<td>.53**</td>
<td>.02</td>
<td>.45**</td>
<td>.48**</td>
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<tr>
<td>6. Backward Span</td>
<td>.62**</td>
<td>-.02</td>
<td>.66**</td>
<td>.59**</td>
<td>.59**</td>
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<td>7. Animal Color</td>
<td>.39**</td>
<td>.15</td>
<td>.44**</td>
<td>.43**</td>
<td>.48**</td>
<td>.41**</td>
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<tr>
<td>8. DCCS</td>
<td>.33*</td>
<td>.09</td>
<td>.53**</td>
<td>.47**</td>
<td>.34*</td>
<td>.35**</td>
<td>.38**</td>
<td>-</td>
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</tr>
<tr>
<td>9. Boy Girl Stroop</td>
<td>.44**</td>
<td>-.02</td>
<td>.51**</td>
<td>.37**</td>
<td>.41**</td>
<td>.53**</td>
<td>.35*</td>
<td>.32*</td>
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<tr>
<td>10. Go-NoGo</td>
<td>.34**</td>
<td>.04</td>
<td>.50**</td>
<td>.29*</td>
<td>.13</td>
<td>.46**</td>
<td>.32*</td>
<td>.36</td>
<td>.34*</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: n = 56, **p < .01, *p < .05
## Raw Vocabulary Scores

<table>
<thead>
<tr>
<th>Age &amp; Language Group</th>
<th>PPVT Version</th>
<th>CELF Version</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>English</td>
<td>German</td>
</tr>
<tr>
<td>Younger (37-64 months)</td>
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<tr>
<td>Monolingual ($n = 17$)</td>
<td>98.71</td>
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<tr>
<td>(SD)</td>
<td>(28.09)</td>
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<tr>
<td>Bilingual ($n = 11$)</td>
<td>91.00</td>
<td>69.38</td>
</tr>
<tr>
<td>(SD)</td>
<td>(23.92)</td>
<td>(27.94)</td>
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<tr>
<td>Older (67-83 months)</td>
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<td></td>
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<tr>
<td>Monolingual ($n = 12$)</td>
<td>124.83</td>
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<tr>
<td>(SD)</td>
<td>(9.09)</td>
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</tr>
<tr>
<td>Bilingual ($n = 16$)</td>
<td>116.06</td>
<td>85.31</td>
</tr>
<tr>
<td>(SD)</td>
<td>(16.85)</td>
<td>(44.90)</td>
</tr>
</tbody>
</table>

Note: Bilingual $n = 27$, Monolingual $n = 29$ **$p < .01$**, *$p < .05$
MANCOVA

- DV’s = Short Term Memory score, Working Memory score, Cognitive Flexibility score, Inhibition score
- IV’s = Language Group (monolingual and bilingual)
- Covariates = Age, English Vocabulary score, SES score

- English language score had a significant effect on EF
- Interestingly, language group had no effect on EF
Discussion

No significant difference on:

- **short term memory tasks** (Bialystok, 1999; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008)

- **working memory tasks** (Bialystok, Craik, & Luk, 2008)

- **inhibition tasks** (Bialystok, Craik, & Ryan, 2006; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008)
Discussion

No significant difference on cognitive flexibility tasks

1. Specific language combinations (Spanish, Chinese, French)

2. Bilingual children had significantly higher SES
   - Bilingual advantage buffers against effects of low SES
Limitations

1. Same form of the PPVT was used for both the English and the German translation
   - Not a problem with the CELF

2. Using German translation of PPVT
   - May have contributed to why significant differences in EF performance were not found
Thank you!

A big thank you to the parents, children and staff from:
- Gingerbread Preschool Ltd.
- Victoria German School
- Vancouver German School
- Surrey German School
- Westview German School