Verbal Short-term Memory in Internationally Adopted Children

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Sequence

- Literature review
  - Internationally adopted children
  - VSTM for monolinguals
  - VSTM for bilinguals
- Methods
- Results
- Discussion
- Questions
Learning a Second First Language

- Disrupted language learning
- Prior to adoption children are exposed to
  - different birth languages
  - fewer social interactions and stimulation
- After adoption they often
  - receive more social interactions and stimulation
  - stop listening to and expressing their birth language
  - learn a second first language at an older age
Post-adoption Catch-up

- Rapid developmental cognitive and linguistic catch-up compared to:
  - peers who remained in institutional care
  - domestically adopted peers
  - nonadopted peers
- Persistent expressive language delays
- Meta-analyses show early variability and differences in
  - School-age Language development
  - Academic achievement

(Juffer & Van IJzendoorn, 2009; Gauthier & Genessee, 2011; Glennen, 2007; Hwa-Froelich & Matsuo, 2010; Odenstad et al., 2008; Roberts, et al, 2005; Scott, Roberts, & Glennen, 2011)
Chinese adopted children acquire vocabulary similarly but faster than vocabulary–matched U.S. children
  * Cognitive and early language development facilitated learning

Chinese and Eastern European adopted children learn English differently
  * Chinese children learned more different words and expressed less

VSTM not measured

Hwa-Froelich & Matsuo, 2010; Snedeker, Geren, & Shafto, 2007
Why study children adopted from abroad?

- Early adverse care as well as disrupted language learning may affect underlying cognitive, linguistic, or memory processing.

- Differences in birth language and English language exposure may affect performance on English VSTM tasks.
VTSM is defined as temporary storage of information that is accessible for a short period of time before it decays.

Tasks to measure VSTM include
- Nonword repetition (NWR)
- Forward digit span (FDS) or word span
Verbal short-term memory increases with age and exposure

FDS and NWR correlate to each other and vocabulary knowledge

Sensitive to lexical and sub-lexical knowledge

Predictive of early vocabulary learning
Bi-directional relationship: NWR predicts vocabulary learning at 4-5 years then vocabulary predicts NWR

Sensitive to:
- phonotactic probability: word-likeness
- language impairment across English dialects and SES levels

Dollaghan & Campbell, 1998; Gathercole, et al., 2004; Masoura & Gathercole, 2005; Messer, Leseman, Boom, & Mayo, 2010; Oetting & Cleveland, 2006; Oetting, Cleveland, & Cope III, 2008; Rodekohr & Haynes, 2001;
Predictive of aptitude

Lexicality effect: words are easier to recall than nonwords

Recall is affected by
- semantic similarity
- articulation rate and word length
- SES and education level

Less correlated to vocabulary knowledge than NWR

Cowan, et al., 2005; Ellis & Hennelly, 1980; Gathercole & Adams, 1993; Nightingale & Walker, 1991; Ostrosky-Solis & Lozano, 2006; Richardson, 2007
VSTM in Other Languages

- **FDS**
  - **Welsh** (Ellis & Hennelly, 1980)
  - **Chinese** (Hedden et al., 2002)
  - **Spanish**
  - **Hebrew**
  - **Arabic** (Naveh-Benjamin & Ayres, 1986)
  - FDS varied according to articulation rate and word length

- **NWR**
  - **Icelandic** (Thordardottir, 2008)
  - **Spanish** (Ebert, Kalanek, Cordero, & Kohnert, 2008)
  - **Italian** (Bortolini et al., 2006)
  - **Cantonese** (Stokes, Wong, Fletcher, & Leonard, 2006)
  - NWR did not discriminate between Cantonese speakers with and without LI
VSTM in Bilinguals
NWR in Foreign Language Learners

* English NWR correlates with English vocabulary learning

* English vocabulary knowledge predicted NWR scores for
  * 9-10 yo Finnish children learning English
  * 12 yo Chinese children learning English

Cheung, 1996; Service, 1992; Service & Kohonen, 1995
Linguistic exposure influences FDS/NWR performance

* Study 1:
  * 4;1-8 yo French/English bilinguals (exposed 1-8 years)
  * 5;8-9 yo French ESL learners (exposed about 3 years)
  * 4;5-7;10 yo English monolinguals

* More French exposure resulted in similar French FDS/NWR
* More English exposure resulted in better English FDS/NWR
Study 2:

- 4;1-7;6 yo simultaneous bilingual children had similar French and English FDS/NWR
- 4;5-7;7 yo sequential bilingual children had better FDS/NWR in dominant language

Thorn & Gathercole, 1999
2 groups of Greek children (8;6-13;7) learning English

- At least 3 years of English exposure
- Performed similarly on Greek and English NWR
- High or low English vocabulary knowledge did not influence NWR

With 3 years of language exposure, long-term instead of short-term phonological memory may mediate older children’s word learning

Masoura & Gathercole 2005
* Shorter digit duration and articulation rate in Swedish
* Constant bilingual Finnish and Swedish college students received same language at home and school (FF or SS)
* Compound bilinguals learned 1 language at home and 1 at school (FS or SF)
  * FF had larger Finnish DS, SS had larger Swedish DS
  * FS and SF had equivalent DS in both languages
* Dominant language influence for FF and SS

* Language of schooling influence for FS and SF

* Articulation rate and long-term memory of digits underlies FDS

Conclusion

- Children with 3 years of L2 exposure have similar NWR performance
- Articulation rate, language of schooling, and linguistic exposure influences forward digit span
- Internationally adopted children may have:
  - similar NWR scores as same-aged peers but higher NWR scores than younger children with similar English exposure
  - shorter FDS as same-aged peers or similar FDS as younger children
Research Questions

* Do children adopted from Asian and Eastern European countries perform differently on VSTM tasks than nonadopted U.S. peers matched by age and SES status?

* Do children adopted from Asian and Eastern European countries perform differently on VSTM tasks than younger nonadopted children with similar English language exposure?
Methods
Participants

- 80 participants
  - 39 adopted from Asia/Eastern Europe, 41 nonadopted
  - Excluded 1 Asian, 3 Eastern European children (2 males)
  - Excluded 9 nonadopted U.S. children (6 males)

- Remaining sample of
  - 20 Asian, 3 males, Mean age=52.15(3.031) months
  - 15 Eastern European, 8 males, M age=52.533(3.226) months
  - 32 nonadopted, 14 males, M age=52.875(3.15) months
Asian Group

- 9/20 (45%) reported receiving some foster care
- English language exposure $M=39.925(4.438)$ months

Eastern European Group

- 2/15 (13%) reported receiving some care from relatives
- English language exposure $M=39.733(7.076)$ months

No significant differences in English language exposure ($t(33)=-.098, p=.461$)
No differences between Asian and Eastern European groups for age, receptive, expressive, or core CELF-P2 scores.

3 groups for age, receptive language scores, or SES.

Significant differences in expressive and core language scores with large effect:

Asian and nonadopted group (Expressive $p=.00$, Core $p=.02$, $d=1.373$, 1.01)

Eastern European and nonadopted group (Expressive $p=.00$, Core $p=.015$, $d=1.295$, .923)
<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Adoption Age</th>
<th>English Exposure</th>
<th>Foster-Relative Care</th>
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</thead>
<tbody>
<tr>
<td>Asian</td>
<td>52.15</td>
<td>11.625</td>
<td>39.925</td>
<td>45%</td>
</tr>
<tr>
<td>Eastern European</td>
<td>52.533</td>
<td>13.20</td>
<td>39.733</td>
<td>13%</td>
</tr>
<tr>
<td>U.S. nonadopted</td>
<td>52.758</td>
<td>NA</td>
<td>52.758</td>
<td>NA</td>
</tr>
<tr>
<td>34-37 month sample</td>
<td>~36.0</td>
<td>NA</td>
<td>36.0</td>
<td>NA</td>
</tr>
</tbody>
</table>
Materials

- NWR
  - Task created for children between 34-37 months old (Adams & Gathercole, 1993)
  - 1-3 syllable nonwords

- FDS
  - Created 2 lists of digit series ranging from 2 to 9 digits in length
**Procedures**

* Children recruited for a larger longitudinal study.
* Consent then CELF-P2 to determine eligibility.
* All tasks were counterbalanced

* NWR
  * Directions recorded on audacity software
  * All nonword stimuli were recorded with audacity
  * Each child repeated the nonwords and scored simultaneously
FDS

- Audacity software and embedded into PowerPoint slides
- Digit series ranging from 2-9 digits presented
- Task ended when 2 digit series of the same length were incorrect
To compare 3 groups, a one-way ANOVA was completed with Bonferroni correction
- Post hoc repeated measures ANOVA compared syllable productions within and between groups

To compare this sample with 34-37 month-old children,
- group mean total FDS and NWR scores were set as baseline and the mean scores for the Asian and Eastern European groups were set as the ceiling for a one sample t-test
Results
Question 1: NWR Results

Nonword Repetition

* Main effect of Syllable \([F (2, 63) = 3.66, p = .031, \eta^2_p = .196]\)  
  * Significant quadratic effect \([F = 5.906, p = .018]\)

* Syllable x Group interaction \([F (4, 126) = 3.122, p = .017, \eta^2_p = .099]\)

* US different than Asian on two syllables \([p = .010]\)
NWR Mean Scores Across Syllables

Mean Score

Syllables

Asian

Eastern

European

US

*
NWR Total Mean Scores

Asian  Eastern European  US
Digit Span

- Main effect of Group \( [F (2) = 5.624, p = .006, \eta_p^2 = .149] \)

- US different than Eastern European \( [p = .008] \)
Digit Span Mean Scores

Mean Number Digits Recalled

- **Asian**: 2.5
- **Eastern European**: 3
- **US**: 4

* denotes a significant difference.
Question 1: Main Findings

* Children adopted from Asian and Eastern European countries do perform differently on VSTM compared to nonadopted U.S. peers matched by age and SES status.

* Difference in NWR at 2 syllable level only for Asian and US
* Difference in digit span for Eastern European and US
Question 2: Results

* Nonword repetition
  * Eastern European group did not differ from younger group at any syllable \( (p > .05) \).
  * Asian group did not differ from younger group at 1 and 2 syllables \( (p > .05) \).
  * Asian group significantly different than younger group at 3 syllables \[ t (19) = 5.522, p < .001, d = .97 \].

* Digit span
  * Three groups did not differ \( (p > .05) \).
NWR Mean Scores Across Syllables

- **Mean Score**
- **Syllables**

Graph showing NWR Mean Scores across syllables for different groups:
- Asian
- Eastern European
- 2-3 year olds†

†From Gathercole & Adams (1993)
Digit Span Mean Scores

<table>
<thead>
<tr>
<th></th>
<th>Mean Number Digits Recalled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>2.8</td>
</tr>
<tr>
<td>Eastern European</td>
<td>2.4</td>
</tr>
<tr>
<td>2-3 year olds†</td>
<td>3.5</td>
</tr>
</tbody>
</table>

† From Gathercole & Adams (1993)
Question 2: Main Findings

Question 2

* Asian and Eastern European children perform similarly to the nonadopted children with similar language exposure, with one exception.
  * Asian group scored higher than nonadopted children with similar language exposure on 3 syllable NWR.

* No significant differences on FDS
Discussion
Discussion

* Typically developing children who are internationally adopted have differences in VSTM, compared to nonadopted peers.

* NWR differences at 2 syllables (Asian-same aged), 3 syllables (Asian-younger)

* Differences in forward digit span (Eastern European-same-aged)
Typically developing children adopted from different regions have differences in VSTM.

* Children adopted from Asia had a different pattern of results than children adopted from Eastern Europe.
* Children adopted from Eastern Europe followed pattern of U.S. peers.
* VSTM may not operate independently of early linguistic and environmental exposure.
Discussion

* Digit span and NWR appear to be tapping different aspects of VSTM.
Limitations

* Sample size may have limited power to detect group differences.

* Sample did not allow comparisons for regions within Asian and Eastern European groups.

* NWR tested at 1-3 syllables only.
Clinical Implications

- Need to consider similarity or difference of birth language to the adopted language
- VSTM measures should be selected to match English language exposure
- Internationally adopted children should score as well as or better than monolingual children matched for language age
Future Directions

- Other memory differences
  - Visuospatial memory, working memory

- Causes of differences
  - Differences in preadoption care, differences in early linguistic exposure

- Longitudinal effects of international adoption
  - Beyond preschool and early school years
Questions and Comments

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