Consequences of bilingualism: Focus on language co-activation and cognitive control

Gregory Poarch

What is bilingualism?

Defining Bilingualism

Any definition follows an interpretation that is either...

Green Issues

dichotomy or continuum?

languages balanced?

Are bilinguals two monolinguals 'rolled into' one?

Overview

historical perspective on bilingualism research

ternal mental lexicon

language co-activation

language control and cognitive control
Overview
- historical perspective on bilingualism research
- bilingual mental lexicon
- language co-activation
- language control and cognitive control

Historical Overview I
- lower IQ scores for bilinguals (Gould, 1981)
- IQ deficits found for bilingual children (Saer, 1924)
- IQ tests administered verbally in English
- bilingual populations mostly 'fresh' immigrants to the USA

Historical Overview II
- enhanced mental flexibility (Paal & Lambert, 1962)
- communicative sensitivity (Ben-Zeev, 1977)
- verbal divergence & divergent thinking (e.g., Cummins, 1977)
- increased language awareness (Cenoz & Valencia, 1994)
- overall literacy boosted (Shwartz et al., 2005; Zaunbauer et al., 2005)

Psycholinguistic Research
- production & comprehension tasks
  - picture naming "fiets"
  - word naming "fiets"
  - word translation "fiets"

Word Retrieval & Translation
- Revised Hierarchical Model (adapted from Kroll & Stewart, 1994)
- L1 to L2 faster
- little L2 semantic interference
Word Retrieval & Translation

'balanced' bilingual speaker

symmetric

strong semantic interference

L1

L2

unrelated tasks

unrelated tasks

L1 to L1 tasks

L2 to L1 tasks

consensual tasks

consensual tasks

L1

L2

consensual tasks

consensual tasks

concepts

Conceptual links

Lexical links

Strong semantic interference

Predictions for Beginning Learners

If conceptual link is weak, then:

- semantically-related and unrelated will not differ

If the conceptual link is stronger, then:

- semantically-related will be slower than unrelated

Translation Recognition Task

Translation condition

Unrelated condition

strong semantic interference

symmetric

L1

L2

duck

word

duck

word

related condition

unrelated condition

Evidence

Dutch child L2 learners
Exposed to meaningful and context-rich L2 learning environment

Adult L2 classroom learners
Less rich and meaningful L2 learning environment

Word Retrieval & Translation

Revised Hierarchical Model (adapted from Kroll & Stewart, 1994)

Second language learner

L2 to L1 tasks

L1 to L2 semantic interference

old-school L2 learner
Word Retrieval & Translation

Supplemented version of the Revised Hierarchical Model (adapted from Kroll & Stewart, 1994)

L1

L2

conceptual links

lexical links

new-school L2 learner

highly-proficient L2 learner

Conclusion Mental Lexicon

Activation and access depend mainly on:
- frequency of retrieval,
- linked information during retrieval process,
- manner and quantity of input.

Overview

- historical perspective on bilingualism research
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- language control and cognitive control

Bilingual Language Control

When bilinguals speak, they need to ...
- 'choose' target language,
- 'disengage' or 'disregard' nontarget language,
- depending on context and interlocutor.

Lexical Production in Bilinguals

- language selective activation (activation of target language words only)
- language non-selective activation (activation of both target and nontarget words)
Lexical Production in Bilinguals

Language Co-Activation

Evidence so far suggests that...
- both languages are always active = co-activated,
- which leads to cross-language effects
- in, for example, phonology and lexical retrieval

e.g., Costa et al. 2000; Poarch & Van Hell, in revision.

Language Co-Activation

during lexical retrieval while picture naming

Picture Naming

e.g., Costa et al. (2000); Kroll et al. (2008); Poarch & van Hell, in review.

Bilinguals and Picture Naming

e.g., Costa et al. (2000); Kroll et al. (2008); Poarch & van Hell, in review.
**Language Co-Activation I**

Cognate Effects during Picture Naming (L2 learners)

Conceptual link

L1 Katze ➔ L2 cat

Asymmetric cross-language activation

Poarch & Van Hell, in revision

**Language Co-Activation II**

Cognate Effects during Picture Naming (bilinguals)

Conceptual link

L1 Katze ➔ L2 cat

Symmetric cross-language activation

Poarch & Van Hell, in revision

**Trilingual language co-activation?**

L1 Katze ➔ L2 cat ➔ L3 kat

**Bilingual ‘Disadvantages’**

Using two languages also leads to...

- smaller vocabulary in each language,
- slowed word access & retrieval,
- reduced verbal fluency.

**Overview**

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**Language Control**

If two or more languages need to be juggled...

'Does this have nonverbal effects?'
Cognitive Control in Bilinguals

Bilinguals need to control their languages

- possible mechanism = inhibition/selective attention,
- results in extensive, daily practice with inhibitory control,
- leads to bilinguals’ nonverbal executive control advantages.

*e.g., Bialystok, 2001; Green, 1998 (but see Frisbie et al., 2006)*

Testing Cognitive Control

Two behavioural approaches:

- Simon Task (e.g., Bialystok et al., 2004)
- Attentional Networks Task (e.g., Costa et al., 2008)

both tasks exploit control mechanisms responsible for
- task switching and
- cognitive control processes.

Simon Task - Trial Types

- congruent trial
- neutral trial
- incongruent trial

Attentional Networks Task

- Adult version
- Child version (Rueda et al., 2004)

Bilinguals & Cognitive Control I

- e.g., Bialystok et al., 2004, 2005; Martin-Rhee & Bialystok, 2008
  - Bilinguals show more effective processing (children & older adults);
  - attributed to more developed conflict resolution mechanism.

Bilinguals & Cognitive Control II

- Being bilingual may keep your mind young
- Napping two languages as a child can slow mental decline
Bilinguals & Cognitive Control II

Costa et al., 2008; Costa et al., 2009 (ANT with adults)
- bilinguals faster on both congruent and incongruent trials;
- bilinguals suffer less interference in incongruent trials.

Kovacs & Mehler, 2009 (eye-tracking with infants)
- 7-month-old bilingual infants showed cognitive gains;
- higher efficiency with two conflicting structural regularities.

Our Research Questions

- What about trilinguals?
  - even more ‘daily practice’ = even better cognitive control?
- What about early second language learners?
  - does their growing L2 proficiency affect cognitive control?

Focus of Study

Extension of earlier research with a focus on
- children aged 5-8 and 11-12,
- early and late second language learners,
- bilinguals and trilinguals.

Aims
- tap into developing language systems & multiple languages,
- control for socio-economic status (Carson & Meltzoff, 2008).

Participants - Simon Task

<table>
<thead>
<tr>
<th>Language Status</th>
<th>n</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td></td>
<td>Monolinguals, (M = 6;11), L1 German</td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td>L2 Learners, (M = 7;1), L1 German / L2 English (low proficiency)</td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td>Bilinguals, (M = 6;11), L1 German / L2 English (high proficiency)</td>
</tr>
<tr>
<td>Group 4</td>
<td></td>
<td>Trilinguals, (M = 6;10), L1 German / L2 English (varying proficiency)</td>
</tr>
<tr>
<td>Group 5</td>
<td></td>
<td>L2 Learners, (M = 11;4), L1 Dutch / L2 English (low proficiency)</td>
</tr>
</tbody>
</table>

Proficiency Measures

Children - L1 German
- Receptive Grammar Test in English & German (ages 3 to 11) (TROG Bishop, 2003; Fox, 2006)
- British Picture Vocabulary Scale (BPVS)
- Language background questionnaire

Children - L1 Dutch
- L1_Lex (Sustrova Vocabulary Test - Meeus, 1996)
- Language background questionnaire & self-rating of language proficiencies

Magnitudes – Simon Effects

- Plot showing Simon Effect Magnitude in ms for different language groups.
Participants - ANT

<table>
<thead>
<tr>
<th>Language Status</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 2: L2 Learners, (M = 7;5), L1 German / L2 English (low proficiency)</td>
<td>n=19</td>
</tr>
<tr>
<td>Group 3: Bilinguals, (M = 7;2), L1 German / L2 English (high proficiency)</td>
<td>n=18</td>
</tr>
<tr>
<td>Group 4: Trilinguals, (M = 7;2), L1 German / L3 English (varying proficiency)</td>
<td>n=19</td>
</tr>
<tr>
<td>Group 5: L2 Learners, (M = 11;4), L1 Dutch / L2 English (low proficiency)</td>
<td>n=28</td>
</tr>
</tbody>
</table>

Magnitudes – ANT Effects

Results

- significant between-group differences in effect magnitudes in both tasks
- bilinguals and trilinguals differ significantly from monolinguals and L2 learners.

Conclusion

Early bilinguals & trilinguals show...

- enhanced executive control
- more efficient conflict resolution
- more efficient conflict monitoring?

...compared to both monolinguals & early L2 learners!

see Bialystok et al., 2010; Costa et al., 2008, 2009; Poarch & van Hell, in prep.

Very General Outlook

Future research could focus on...

- 'heavy' vs. 'light' switchers
  see Feitman, Rodriguez-Formals, & Monte, 2010
- switching vs. inhibition
  see Prior & MacWhinney, 2010
- low- vs. high-SES bilinguals
  see Kempert, Saebisch, & Hardy, in press

Overall Conclusions

Bilinguals show...

- enhanced executive control
- more efficient conflict resolution

Being bilingual may keep your mind young

Juggling two languages as a child can slow mental decline
Take-Home Messages

Bilinguals...

- are rarely fully balanced,
- have permanently co-activated languages,
- need to control their languages,
- which has effects on their inhibitory control.

Two or more languages need to be juggled and...

'It works'

Contact: g.poarch@gmx.net

Thank you.

Collaborating colleagues:

- Janet van Hell
- Judy Kroll
- Gerrit Jan Kootstra
- Julia Festman

Contact: g.poarch@gmx.net