Language Control, Executive Control and Processing Control in Bilinguals and Translators/Interpreters

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1. Parallel activation in bilingual memory
2. Language control in bilinguals performing monolingual tasks
3. The relation between language control and non-verbal executive control
4. Language control in simultaneous interpreting
5. Processing control in simultaneous interpreting and translation
6. Executive control in simultaneous interpreters
EARLY EVIDENCE OF PARALLEL ACTIVATION IN BILINGUAL MEMORY; MÄGISTE (1979)

SO THE MORE LANGUAGES THE SLOWER THE RESPONSES

SUGGESTS CO-ACTIVATION OF ELEMENTS IN NONTARGET LANGUAGE; COMPETITION
DE GROOT, DELMAAR & LUPKER (2000): visual word recognition; Dutch-English bilinguals

Word recognition in two conditions: L1 Dutch and L2 English (different groups of subjects)

Comparison of response times for interlexical homographs and matched control items

Interlexical homographs:
- **room** (meaning ‘cream’ in Dutch)
- **boot** (meaning ‘boat’ in Dutch)
- **tree** (meaning ‘step’ (of staircase) in Dutch)
So form and/or meaning in other language is activated as well
Are the words within a pair semantically related? The translations of half of the related and unrelated pairs shared a Chinese character.

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<th>Semantically related</th>
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Subjects: Chinese-English bilinguals and monolingual English controls
The bilinguals showed effects of form resemblance Automatic activation of translation equivalents!
How about speech production?

A common task used in speech production studies: picture naming

Crucial assumption: Following a visual analysis of the picture, the concept associated with the depicted entity is activated in memory

(just as the production of a word starts off with the activation of the associated concept in memory)
Colomé (2001), a Catalan-Spanish study

Does Catalan name of picture contain a P?

Catalan for chair is CADIRA

Does Catalan name of picture contain an S?

Spanish for chair is SILLA

Slower RT
2. LANGUAGE CONTROL IN BILINGUALS PERFORMING MONOLINGUAL TASKS

• So, parallel activation is a widespread phenomenon; it occurs in comprehension and production (if affects both L1 and L2; also in context)

• How then is language control (language maintenance) exerted in monolingual tasks?
PROPOSED SOLUTIONS

1. Differential activation of the two language subsystems (e.g., Grosjean; Paradis)
2. Ignoring activated elements in the non-target language (e.g., Costa)
3. Extra activation of the targeted item; this extra activation is emitted by a “language cue” in the preverbal message (e.g., Poulisse; LaHeij)
4. Reactive suppression/inhibition of activated elements of the non-target language, called “inhibitory control” (e.g., Green)
GROSJEAN (1997), THE BILINGUAL’S LANGUAGE MODES;
DIFFERENTIAL ACTIVATION OF LANGUAGE SUB-SYSTEMS);
(Figure taken from De Groot, 2011; adapted from Grosjean, 1997)
PARADIS’ LANGUAGE SUBSETS; THE ACTIVATION THRESHOLD OF THE NON-TARGET LANGUAGE IS RAISED (e.g., Paradis, 2004)

- Functionally equivalent to Grosjean’s idea about differential activation of language subsystems.
- Different terminology: activation of representations by neural impulses; if activation reaches the threshold level, comprehension/production ensues.

![Diagram showing L1 and L2 languages with an outer layer representing the activation threshold.]

L1  L2
The mechanism that ensures language control plausibly is a **general control mechanism that secures the control of action in general** (not language-specific; e.g., Green; Bialystok, Costa)
Language control and executive control

- If the brain network for executive control in general is used for language control, then bilinguals are plausibly relatively skilled in executive control in general. After all, they continuously exploit the associated brain network.
- This hypothesis is tested by means of non-verbal tasks that are used in studies on executive control.
- Comparison of performance of monolinguals and bilinguals on those tasks.
Stop task: measures efficiency in interrupting a cognitive process

"press left if the arrow points left
press right if the arrow points right
do not press (stop) if the arrow turns red"

Demo’s by Wery van den Wildenberg
Simon task: measures efficiency in ignoring/inhibiting conflicting information

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<th>INTERFERENCE</th>
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<td>&quot;press left if the circle is blue, press right if the circle is green&quot;</td>
<td>color and location of circle both activate the left hand</td>
</tr>
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Ellen Bialystok’s work

- (Active) bilinguals perform better in the Simon task than monolinguals
- In other words: they are good at ignoring/inhibiting conflicting information
- This seems to result from their incessant use of the brain’s executive-control network (specifically, in ignoring/inhibiting conflicting language information)
Brain areas involved in executive control and language control: the dorsolateral prefrontal cortex and the anterior cingulate cortex.

e.g., Abutalebi & Green (2006)

Figure taken from De Groot, 2011)
4. LANGUAGE CONTROL IN SIMULTANEOUS INTERPRETING
PARADIS, 1994, 2004; different threshold settings

Activation thresholds for both L1 and L2 are set low enough to enable comprehension of source language and production of target language.

But thresholds of elements of source language are set at a higher level than those for target-language elements (comprehension still possible).
Grosjean, 1997, 2001: two language subsets (knowledge stores) and four processing mechanisms (Figure taken from De Groot, 2011; adapted from Grosjean, 2001)

Differential activation of output-processing mechanisms
Christoffels & De Groot, 2005; separate input and output lexicons for each language (Figure taken from De Groot, 2011; adapted from Christoffels & De Groot, 2005)

Differential activation of input and output lexicons of source and target language
“There is obviously more to control in simultaneous interpreting than seeing to it that the output language differs from the input language” (De Groot, 2011; p. 326)

Control in simultaneous interpretation also involves performing the constituent tasks (comprehension, memory, production, and, plausibly, translation) and optimally dividing attention between the (attention-demanding) components of these tasks (coordination; Gile, 1995, 1997) (=processing control)

How do they manage, the interpreters?
Decompose the full, complex task into its hypothesized components

Two approaches:

Do simultaneous interpreters perform the constituent tasks differently from other groups of participants?

Does SI modulate performance on the constituent tasks as compared with the performance on these same tasks in regular language processing?

(An individual study may also combine the two approaches)
PADILLA ET AL. (1995); the Granada Group: do interpreters possess special working-memory skills?

Working-memory span and digit span of interpreters, control subjects, and two groups of interpreting students. The interpreters outperformed the other groups on both tasks.
What cognitive subskills are special in interpreters as compared with other bilinguals?
• Working memory?
• Word retrieval?
• Both?

Reading span: measures ability to concurrently comprehend and memorize linguistic materials

Speaking span: measures ability to concurrently produce and memorize linguistic materials
CHRISTOFFELS, DE GROOT, & WALDORP (2003); are such skills important for SI?

- Participants had no prior experience in SI; Weaker L2 was the source language, native Dutch the target language.
- Lexical-retrieval and working-memory skills both correlated with SI performance but the former more strongly so.

Table 2. Correlation between the performance on all tasks and two measures of performance on the interpreting task, SI-T and SI-A.

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<tr>
<th>Task</th>
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<th>SI-A</th>
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<tr>
<td>Translation English-Dutch</td>
<td>-.62***</td>
<td>-.37*</td>
</tr>
<tr>
<td>Translation Dutch-English</td>
<td>-.66***</td>
<td>-.54**</td>
</tr>
<tr>
<td>Picture naming English</td>
<td>-.62***</td>
<td>-.57**</td>
</tr>
<tr>
<td>Picture naming Dutch</td>
<td>-.41*</td>
<td>-.44**</td>
</tr>
<tr>
<td>Reading span English</td>
<td>.44*</td>
<td>.03</td>
</tr>
<tr>
<td>Reading span Dutch</td>
<td>.30~</td>
<td>.24</td>
</tr>
<tr>
<td>Digit span</td>
<td>.35*</td>
<td>.38*</td>
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* p < .05, ** p < .01, *** p < .001, ~ 0.1 < p < .05, one-tailed Z-test.
PADILLA ET AL. (1995); The effects of articulatory suppression (AS) on the free recall of words

AS condition: utter “bla”, “bla”, etc. while reading and memorizing words. Interpreters are not affected by AS
The recall scores of simultaneous interpreters are not negatively affected by AS, even not when AS involves the repetition of word triads (complex AS condition).
Also the recall scores of the interpreters are negatively affected by AS when AS involves the repetition of word triads.

Difference between word and pseudoword condition suggests that “coordinating comprehension and production processes in interpreters is mediated by the retrieval of lexical-semantic information”
RUIZ ET AL. (2008); READING FOR REPETITION VS. READING FOR TRANSLATION; (or: does comprehension during translation involve on-line transcoding?); professional translators

Left: word in SL text has low-frequent or high-frequent translation in TL
Right: grammatical structure in SL text translates into same or different structure in TL
Conclusion: during comprehension of SL transcoding takes place at both the lexical and syntactic level of processing
MACIZO & BAJOR (2006); READING FOR REPETITION VS. READING FOR TRANSLATION (or: does comprehension during translation involve on-line transcoding?)

Sentences in experimental condition contain an ambiguous word (a homograph). Ambiguity is resolved soon after (low load) or later (high load).

Hypothesis: if reading for translation involves on-line reformulation (transcoding) load in high-load condition is especially high in high-load condition.

Effect occurs in both professional and “ordinary” bilinguals.
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**Semantically related**

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Subjects: Chinese-English bilinguals and monolingual English controls
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Automatic activation of translation equivalents!
EXECUTIVE CONTROL IN SIMULTANEOUS INTERPRETERS; Yudes, Macizo, & Bajo (2011)

Exceptionally skilled performance of simultaneous interpreters on nonverbal executive-control tasks that tap components of actual SI performance?

Spanish monolinguals, bilinguals, and professional interpreters (matched on intelligence but with different WM spans)

**Wisconsin Card Sorting Task**: Participants must discover the rules according to which the cards must be sorted; the rule changes after every next 10 cards. The task measures mental flexibility, specifically, the ability to switch the mental set.

**Simon task**: Measures the ability to ignore/inhibit conflicting information.

Results WCST: Interpreters learned the new rule faster, less perseverance, more flexible. No difference on the Simon task.