

Bilingualism

How Do 2 Languages Share 1 Brain?



Sarah Callahan

How can we characterize a bilingual/multilingual?

- **For each language:**
 - Age of acquisition (AoA)
 - Context of acquisition
 - Proficiency
 - Language dominance
 - Ability to communicate
 - Mastery of social and cultural aspects of language

Individual differences are highlighted in bilinguals, but exist in monolinguals as well!

Major Issues in Bilingualism

- Is there a critical period for second language acquisition?
- How do bilinguals manage their two languages?
 - Is processing in one language affected by the other language?
- How are the languages represented in the brain?
- Does bilingualism impact other cognitive domains?

Age of Acquisition (AoA)

- **“Early” bilinguals:** learned both languages as child
- **“Late” bilinguals:** learned one language as child (Native language- L1) and acquired the second language (L2) later in life
- **Lenneberg’s Critical Period Hypothesis**
 - A biologically-determined period during which the child must be exposed to adequate linguistic input in order to learn language

Critical Period Effects in Phonology

- Foreign Accents
- Children begin to lose the ability to discriminate non-native phonemes by ~ 9-12 mos
- Late L2 learners show poor perception and production of L2 phonemic contrasts that do not exist in their L1
 - e.g. Native Japanese speakers have trouble with English /r/ and /l/ sounds

L1 and L2 Stop Production and AoA

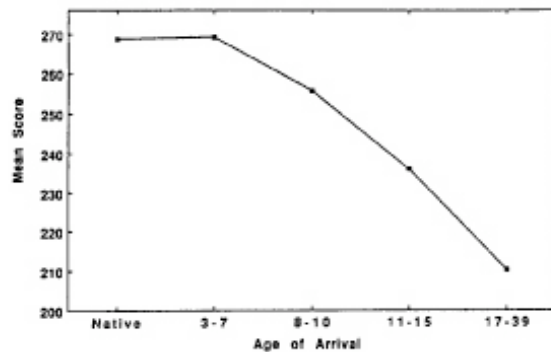
- Spanish: VOT of /t/ ~ 20 ms “todo”
- English: VOT of /t/ ~ 80 ms “total”

Flege (1991)

- Compared “Early” Spanish (L1)-English (L2) bilinguals with “Late” S-E bilinguals
- **“Early” bilinguals:**
 - VOT for Spanish /t/ matched native Spanish speakers
 - VOT for English /t/ matched native English speakers
- **“Late” bilinguals:**
 - VOT for English /t/ is a “compromise” between Spanish /t/ and English /t/

Critical Period Effects in Syntax

Johnson and Newport (1989)



Mastery of grammar declines when age of L2 acquisition is 7+ yrs

Critical Period Effects in Syntax

Weber-Fox and Neville (1996)

- **Subjects:**
 - Chinese (L1)-English (L2) bilinguals who learned English at different times (between 1 and 16+ yrs)
- **Task:**
 - Recorded event-related potentials (ERPs) while subjects made grammaticality judgments of sentences in English

Critical Period Effects in Syntax

Weber-Fox and Neville (1996)

- **Stimuli:**

- Grammatical and Ungrammatical sentences

- Semantic items

The scientist criticized Max's proof of the theorem.

vs.

The scientist criticized Max's **event** of the theorem.

- Syntactic items

The scientist criticized a proof of the theorem.

vs.

The scientist criticized Max's **of** proof the theorem.

Critical Period Effects in Syntax

Weber-Fox and Neville (1996)

- **Results:**

- Accuracy on Grammaticality Judgment Task

- *Semantic* items: Worse performance when AoA was 16+

- *Syntactic* items: Worse performance when AoA was 7+

- ERP Responses

- *Semantic* items: Differences from monolinguals when AoA was 10+

- *Syntactic* items: Differences from monolinguals when AoA was 4+

Syntactic processing is more affected by delays in AoA than semantic processing

Critical Period Effects in Semantics/the Lexicon

- Learning new vocabulary seems least subject to critical period effects even for first language
 - Genie acquired a large number of new words

- But words may be stored differently or accessed differently in a second language

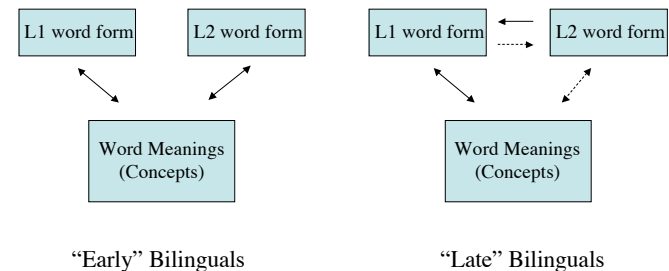
Critical Period Effects in Semantics/the Lexicon

Conceptual Mediation Model

(Potter et al., 1984)

Revised Hierarchical Model

(Kroll & Stewart, 1994)



Critical Period Effects in Semantics/the Lexicon

Potter et al. (1984)

- **Subjects:**
 - Highly fluent bilinguals
 - Second language learners
- **Tasks:**
 - Picture Naming in L2
 - Word Translation from L1 to L2
- **Results:**
 - Picture Naming and Translation similar
- But only tested in L2!

Critical Period Effects in Semantics/the Lexicon

Kroll et al. (1998)

- **Subjects:**
 - Late Second Language Learners (either Low or Med L2 proficiency)
 - Early Bilinguals (High L2 proficiency)
- **Tasks:**
 - Word naming in L1 and L2
 - Word translation from L1 to L2 and from L2 to L1

Critical Period Effects in Semantics/the Lexicon

Kroll et al. (1998)

- **Results:**
 - Word naming:
 - L2 slower than L1
 - As proficiency increases, naming times become more equal
 - Translation:
 - L1 to L2 translation slower than L2 to L1 translation
 - As proficiency increases, translation times become more equal

Summary of Critical Period Effects

- Delayed AoA of L2 affects:
 - Phonological processing
 - Syntactic processing
 - Semantic processing
- But phonological and syntactic processing are more sensitive to delayed acquisition than semantic processing

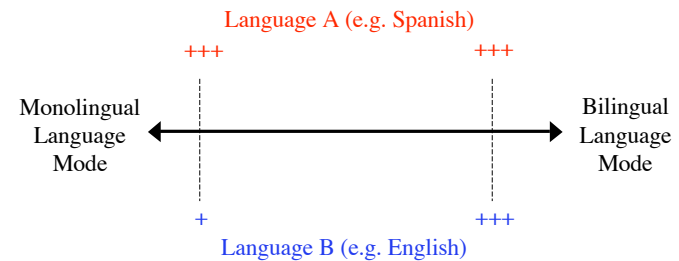
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Managing Two Languages

Grosjean (1998)

- **Language mode:** the state of activation of the bilingual's languages and language processing mechanisms



Managing Two Languages

Green (1998)

- **Inhibitory Control Model:**
 - In order to speak one language, the bilingual must inhibit (suppress) the other language
 - The dominant language is harder to inhibit because it receives more activation from the conceptual system

Managing Two Languages

Green (1998)

- **Supporting Evidence for Inhibitory Control Model:**
 - Word naming is slower in L2
 - Translation from L1 to L2 is slower
 - Bilingual aphasic patterns
- **Alternate antagonism:** The patient alternates between which language they can speak spontaneously on a given day
- **Paradoxical Translation:** Patient can translate into a language that they cannot speak spontaneously

Managing Two Languages

Rodriguez-Fornells (2002)

- **Subjects:**
 - “Early” Spanish-Catalan bilinguals
 - Spanish monolinguals
- **Task:** measured brain activation using ERPs and functional magnetic resonance imaging (fMRI) during lexical decision
- **Stimuli:**
 - High and Low frequency Spanish words
 - High and Low frequency Catalan words
 - Pseudowords
- Recall that frequency affects lexical access

Managing Two Languages

Rodriguez-Fornells (2002)

- **Results:**
 - Bilinguals slower to respond to words than monolinguals
 - Bilinguals do not show ERP effect of frequency for words in the non-target language (Spanish or Catalan)
 - Bilinguals show increased activation in brain areas related to phonological processing
- **Conclusions:**
 - Bilinguals can inhibit the other language so that they do not automatically process the meaning of words
 - They may do this by using a direct phonological route to the lexicon
- But they might be employing a strategy in this task!

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Representation of L1 and L2 in the Brain

Perani (1996)

- **Subjects:**
 - Low proficiency Late bilinguals
- **Task:**
 - Measured brain activity using positron emission tomography (PET) while subjects listened to stories in L1 and L2 and in a third unknown language
- **Results:**
 - More extensive activation pattern for L1 than L2
 - Similar activation pattern for L2 and the unknown language

But effects of proficiency and AoA cannot be separated!

Representation of L1 and L2 in the Brain

Perani (1996, 1998)

- **Subjects:**
 - High Proficiency Early bilinguals
 - High Proficiency Late bilinguals
 - Compare these groups to Low Proficiency Late bilinguals from previous study
- **Task:**
 - Measured brain activity using PET while subjects listened to stories in L1 and L2

Representation of L1 and L2 in the Brain

Perani (1996, 1998)

- **Results:**
 - HPE and HPL bilinguals showed similar areas of activation while listening to stories in L2
 - Only LPL bilinguals from previous study showed different activation patterns in L2
- **Conclusion:**
 - Proficiency not AoA is the important factor in brain representation

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(Possible) Positive Effects of Bilingualism

- Bilinguals may show enhanced inhibitory control processes due to their extensive practice managing their two languages
- So bilinguals may be better at tasks that involve inhibitory control
- Some evidence that bilingual children outperform monolingual children on these types of tasks

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Participate in a Study!

Bilingual Reading Study:

Eligibility: Native English speakers who learned Spanish after age 10 and are proficient in Spanish. Cannot have been exposed to or learned any other languages before 6.

Compensation: 1 Credit or \$7

Duration: Less than 1 hr. Days and times flexible.

ERP Listening Study:

Eligibility: Right-handed Native English speakers. Cannot have been exposed to or learned any other languages before 6. Sorry- no bilinguals!

Compensation: 2 Credits

Duration: 2 hrs

For more information or to make an appointment, please email or call Sarah at:
smcallahan@ucsd.edu 858-692-2873

