

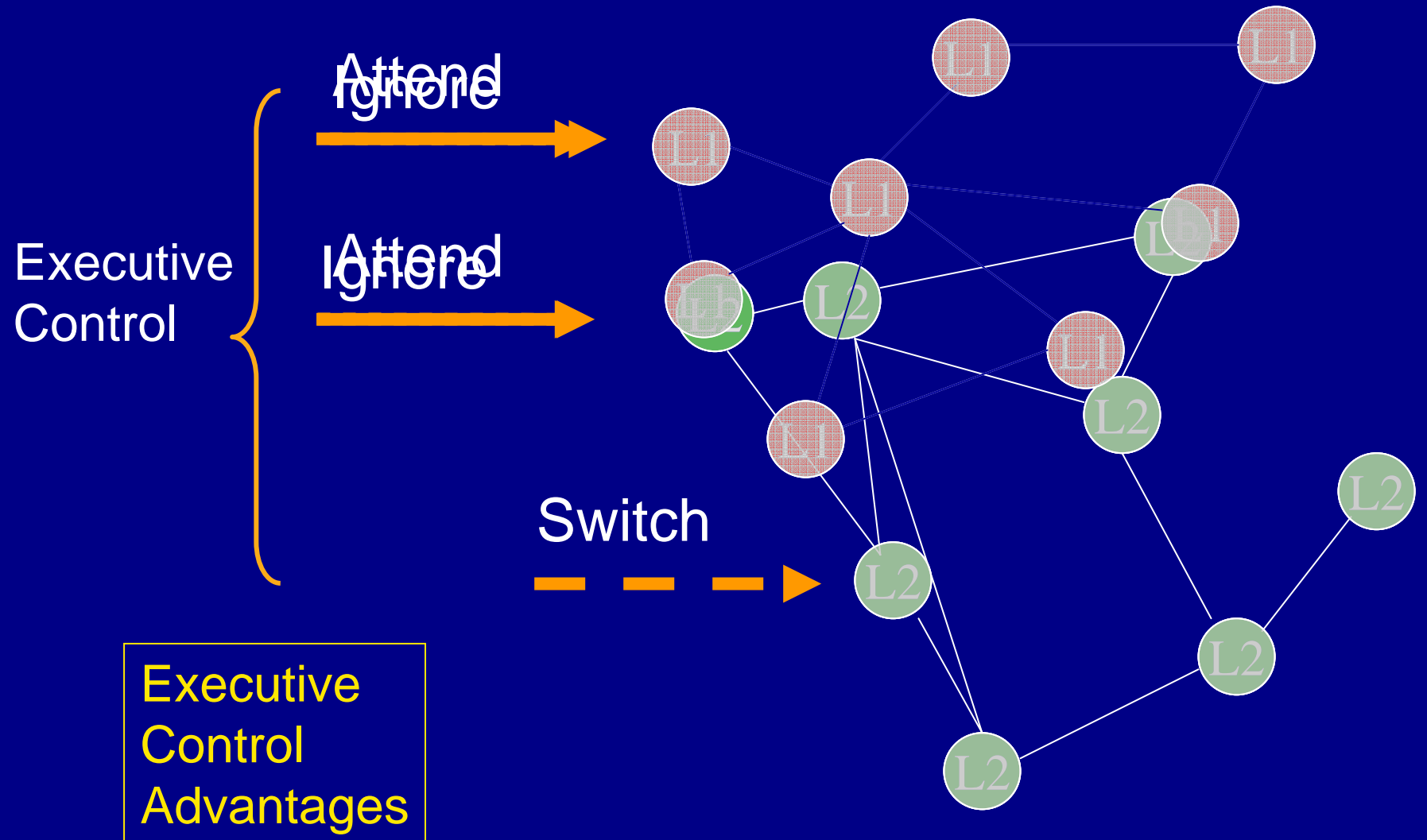


Bilingualism and Cognitive Development: Evidence for Changes in Attentional Control

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Language Representation in Bilinguals



Development of Executive Processes

- Last area of brain (frontal lobes) to mature
- Last cognitive skills to develop in childhood, first to decline with aging
- Children typically develop control over attention and inhibition at about 5 years
- Experience in managing two languages may promote this development

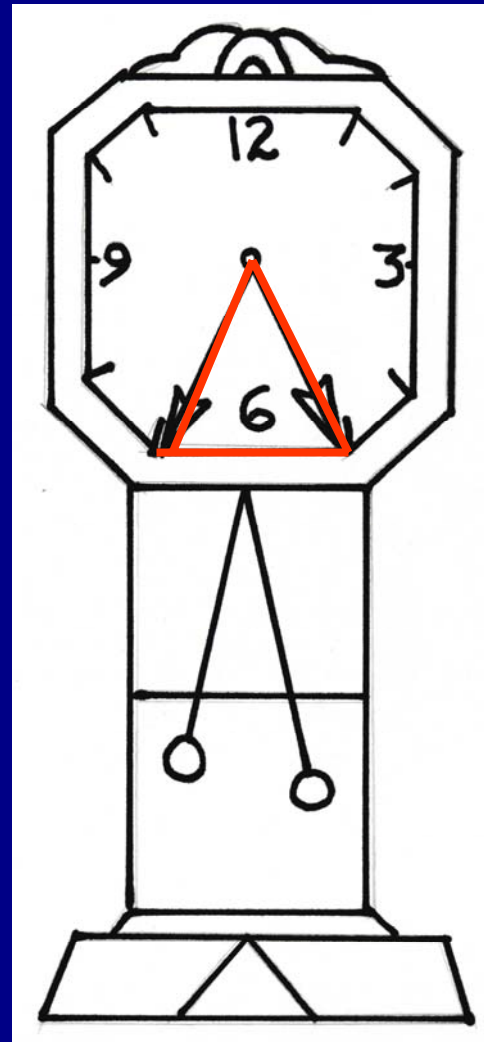
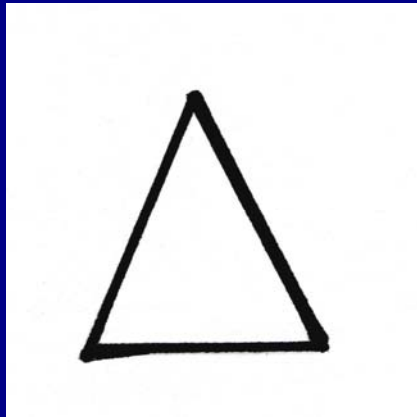
1. Perceptual Organization and Meaning

- Embedded Figures Test is test of field-dependence/field-independence and a measure of intelligence
- Compare to misleading context of ambiguous figures
- Participants – 5 ½ years olds
 - 27 Monolinguals
 - 26 Bilinguals

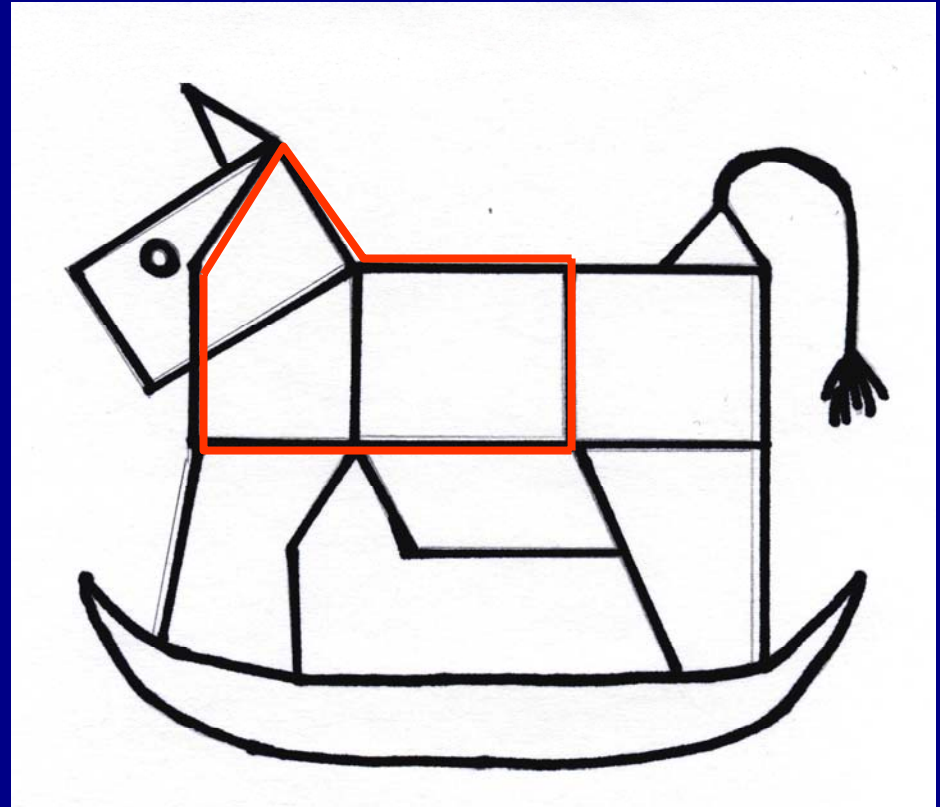
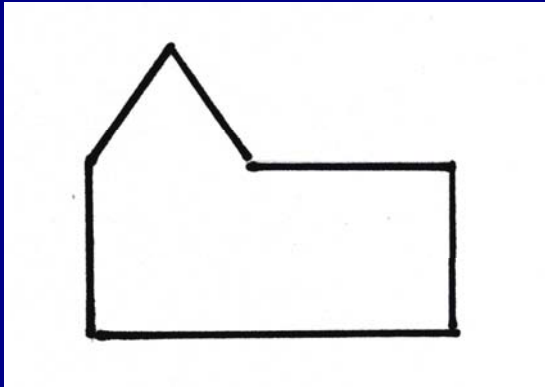
Children's Embedded Figures Test

- Perceptual analysis of complex figure to find simple component
- Requires inhibition of overall perceptual configuration and interpretation of parts
- Items divided into tent (triangle) and house shapes
- Score is total of two sections

Embedded Figures Test: Tent

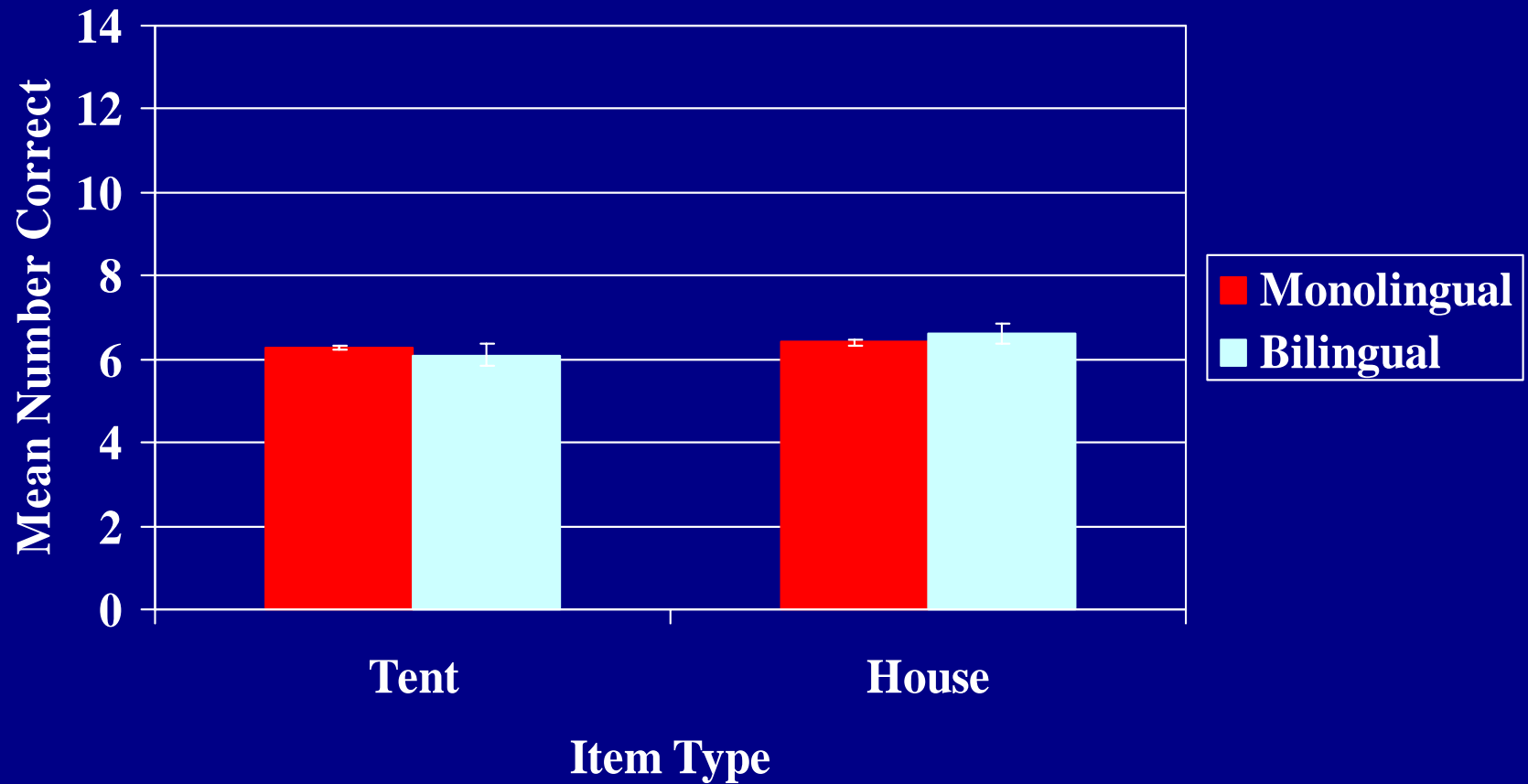


Embedded Figures Test: House



Embedded Figures Task

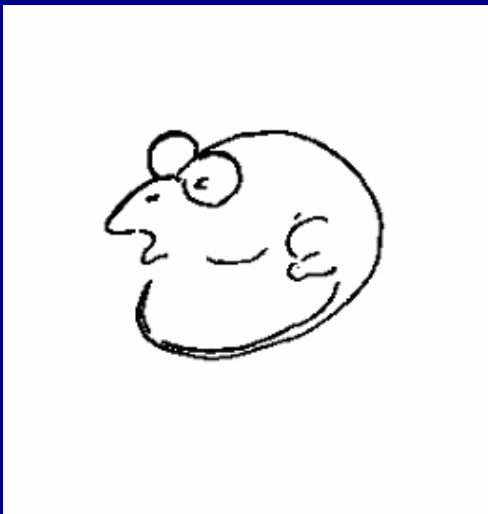
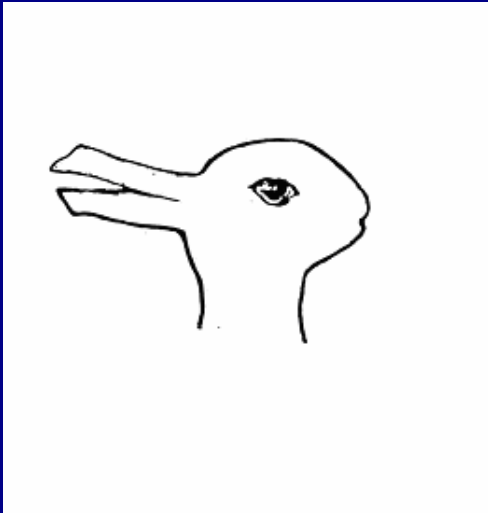
Bialystok & Shapero, 2005



Ambiguous Figure Reversals

- Ability to see an alternative interpretation of an ambiguous figure develops at around 6 years
- Need to assign new interpretation to perceptual stimulus → inhibit previous interpretation?
- Create a graduated scale for degree of ability

Ambiguous Images



Content

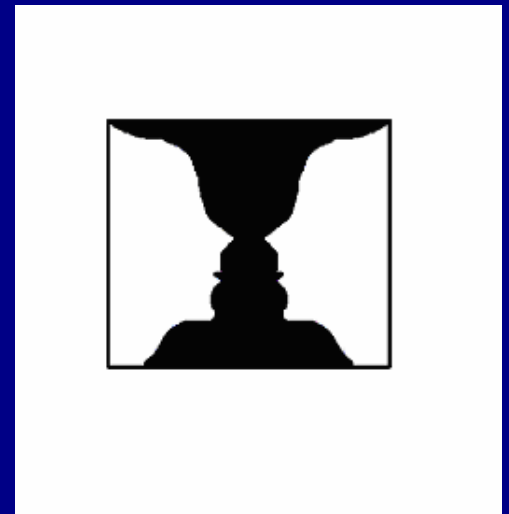
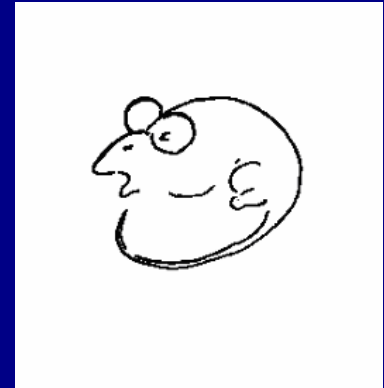


Figure-Ground

Scoring System

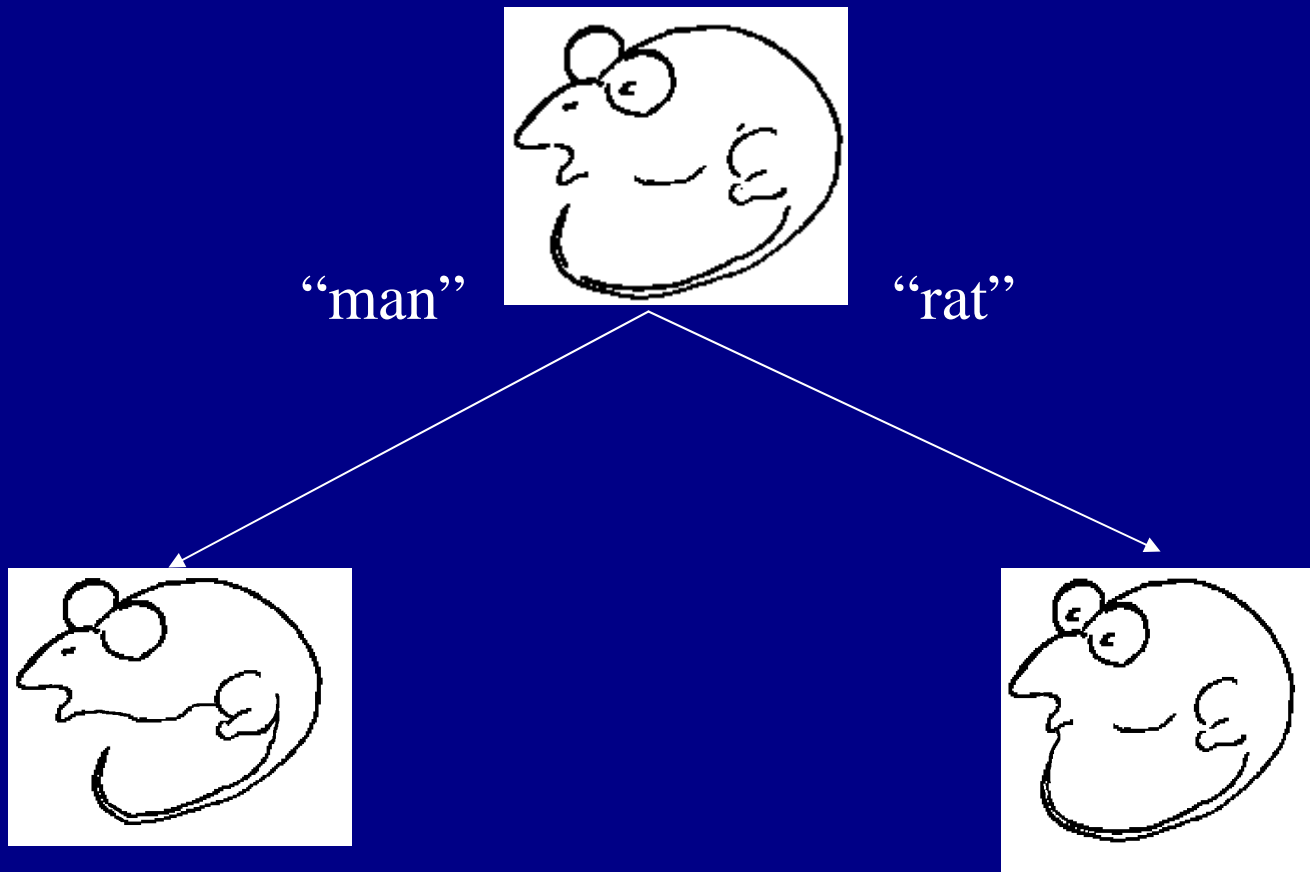


Points

- 5: Spontaneous identification
- 4: Identify one feature
- 3: Identify second feature
- 2: Name alternative image
- 1: Disambiguated image of alternative
- 0: No idea!

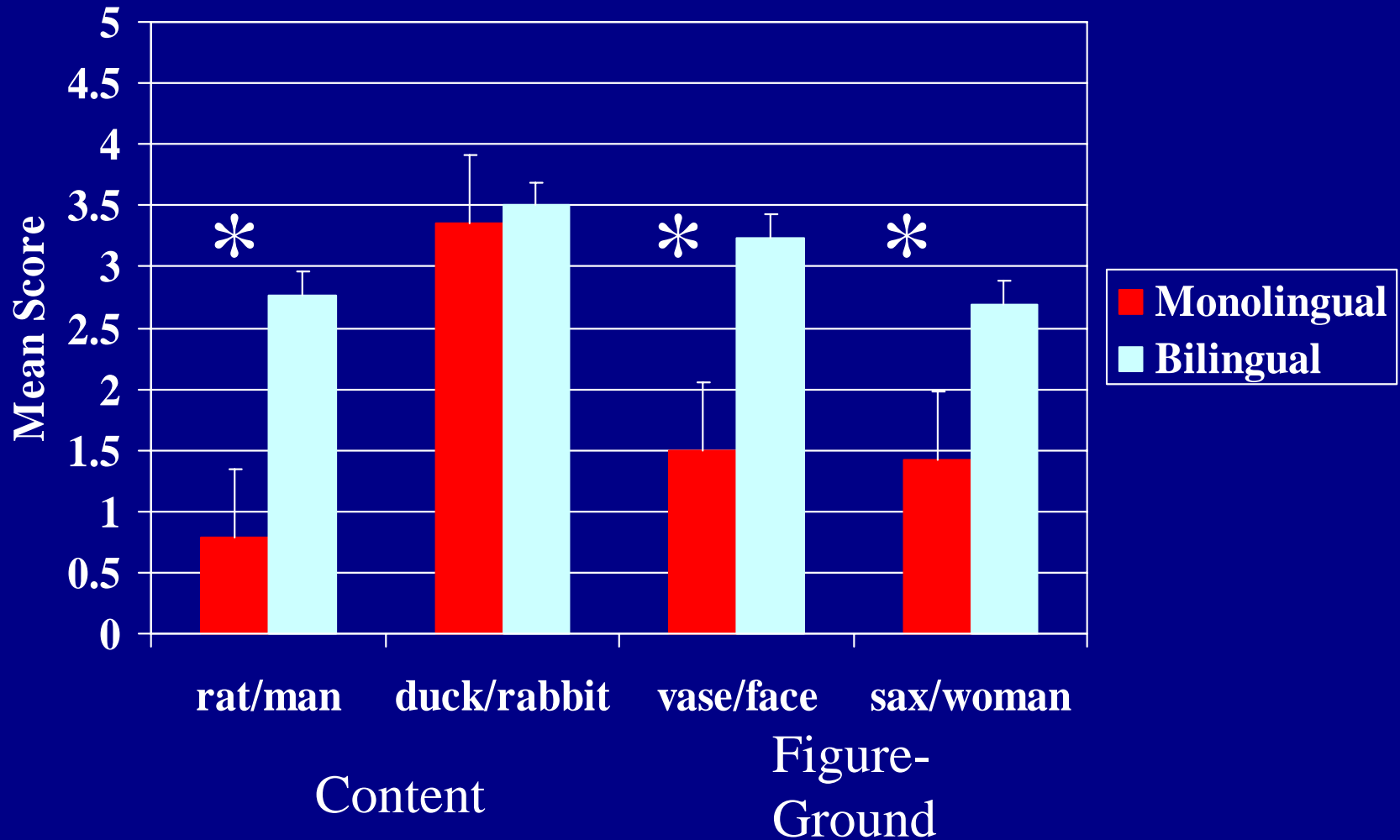
Criterion: Child indicates two features of alternative image

Disambiguated Images (1 point)



Reversibility Scores

Bialystok & Shapero, 2005



Embedded Figures vs Reversible Figures

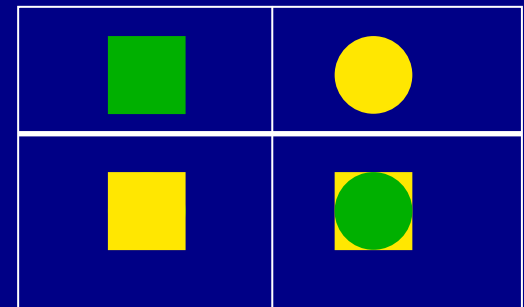
- EFT requires pattern analysis to find the hidden component. There is no conflict.
- Ambiguous figures requires re-assigning a meaning that conflicts with the current interpretation. It must stop being “a duck” for the image to reverse.
- Effect of bilingualism is in processing conflict

2. Dimension Change Card Sort Task

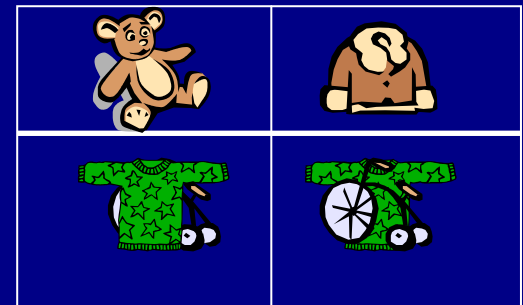
- Bidimensional stimuli sorted by one dimension, then other
- Young children fail to switch second time
- Perceptual: colour-shape
- Conceptual: function-location

Bialystok, 1999: N=60, 4 ½ yrs
Bialystok & Martin, 2004:
Study 1 N=67, 6 yrs;
Study 3 N=51, 5 ½ yrs

Shape-Colour



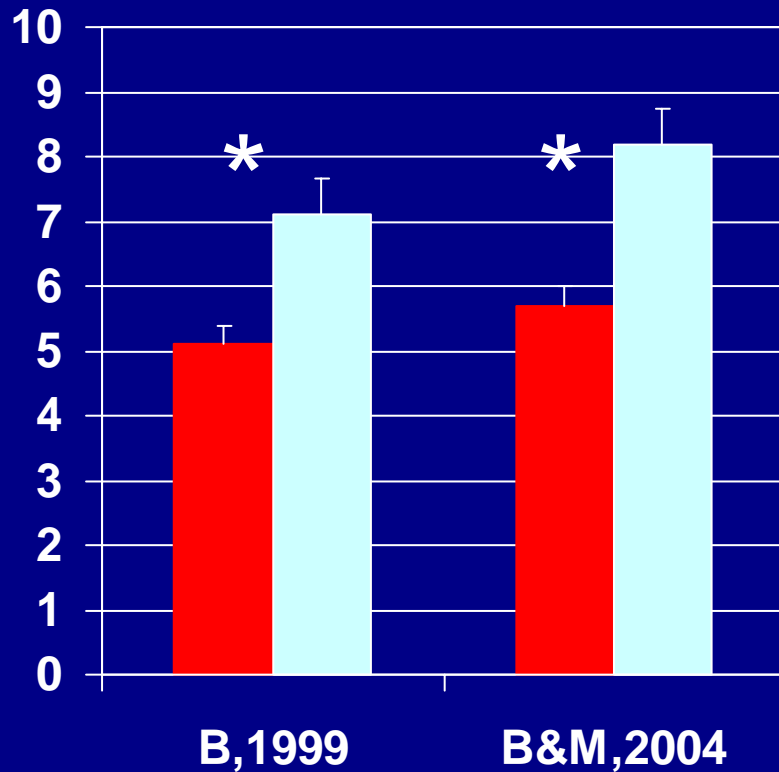
Function-Location



Post-Switch Scores in DCCS

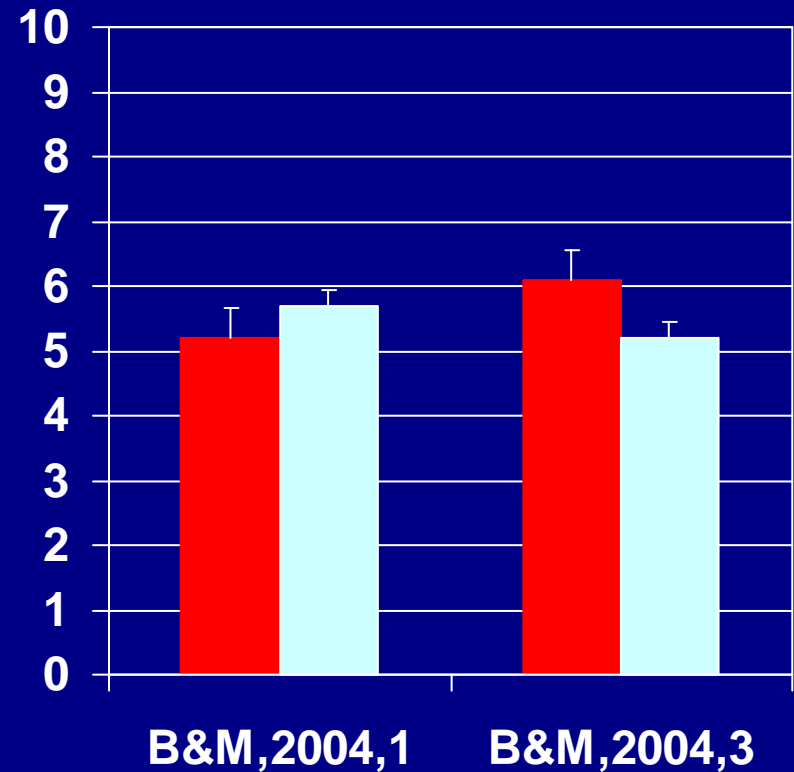
Bialystok, 1999; Bialystok & Martin, 2004

Perceptual Stimuli:
Colour-Shape



■ Monolingual ■ Bilingual

Conceptual Stimuli:
Function-Location



■ Monolingual ■ Bilingual

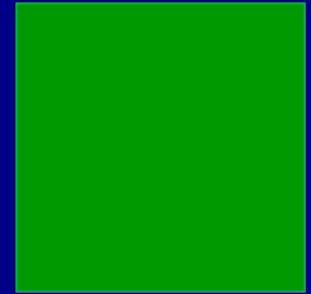
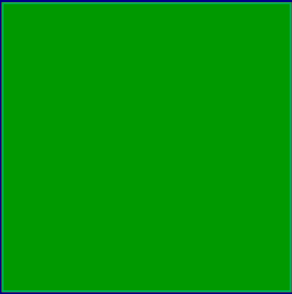
Perceptual vs. Conceptual Stimuli

- Perceptual feature salient – represented “round one”; Re-represent “yellow one”
- Conflict between representations (cf. Ambiguous Figures)
- Function-location stimuli have no perceptual conflict – stimulus interpreted individually (cf. Embedded Figures)
- Bilingual advantage for resolving perceptual conflict

3. Simon Effect

- Prepotent response to position cues
- Stimuli contain target and (irrelevant) position cues
 - Position consistent with R → congruent
 - Position conflicts with R → incongruent
- Simon effect (SE) is RT cost for incongruent trials
- Conflict resolution should be easier for bilinguals, so smaller SE

Rule: red square \rightarrow left green square \rightarrow right

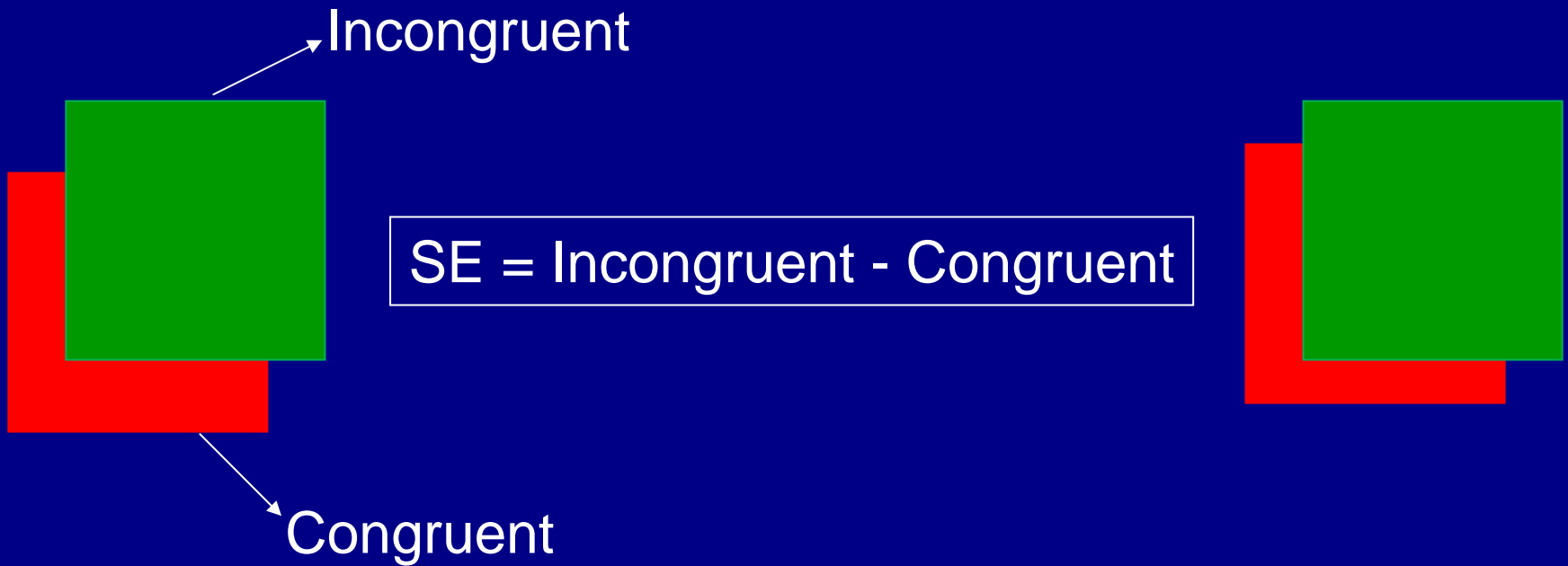


L

R

Simon Effect

Rule: red square → left green square → right

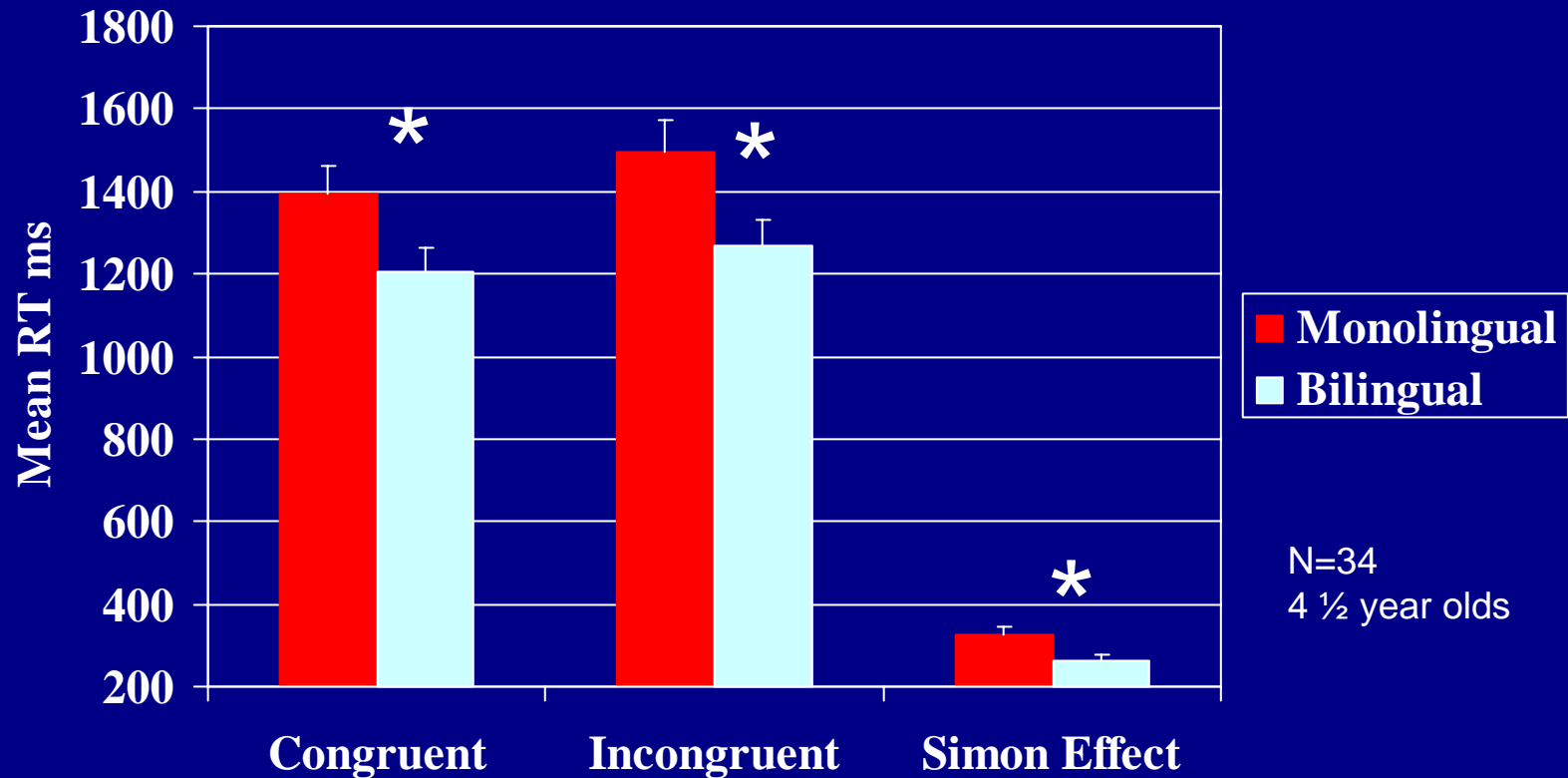


L

R

Simon Task by Language for Children

Martin & Bialystok, submitted



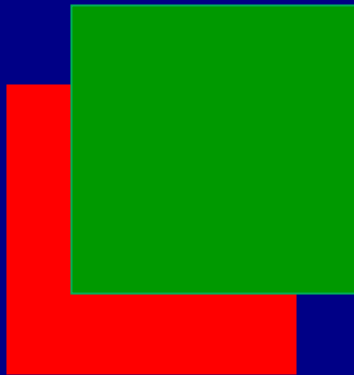
Adults and Aging: Simon Task

Bialystok, Craik, Klein, & Viswanathan, 2004

- 94 participants between 30 and 80 years
- Half bilingual matched by age
- Background measures of working memory, language proficiency, intelligence (Cattell)

Control

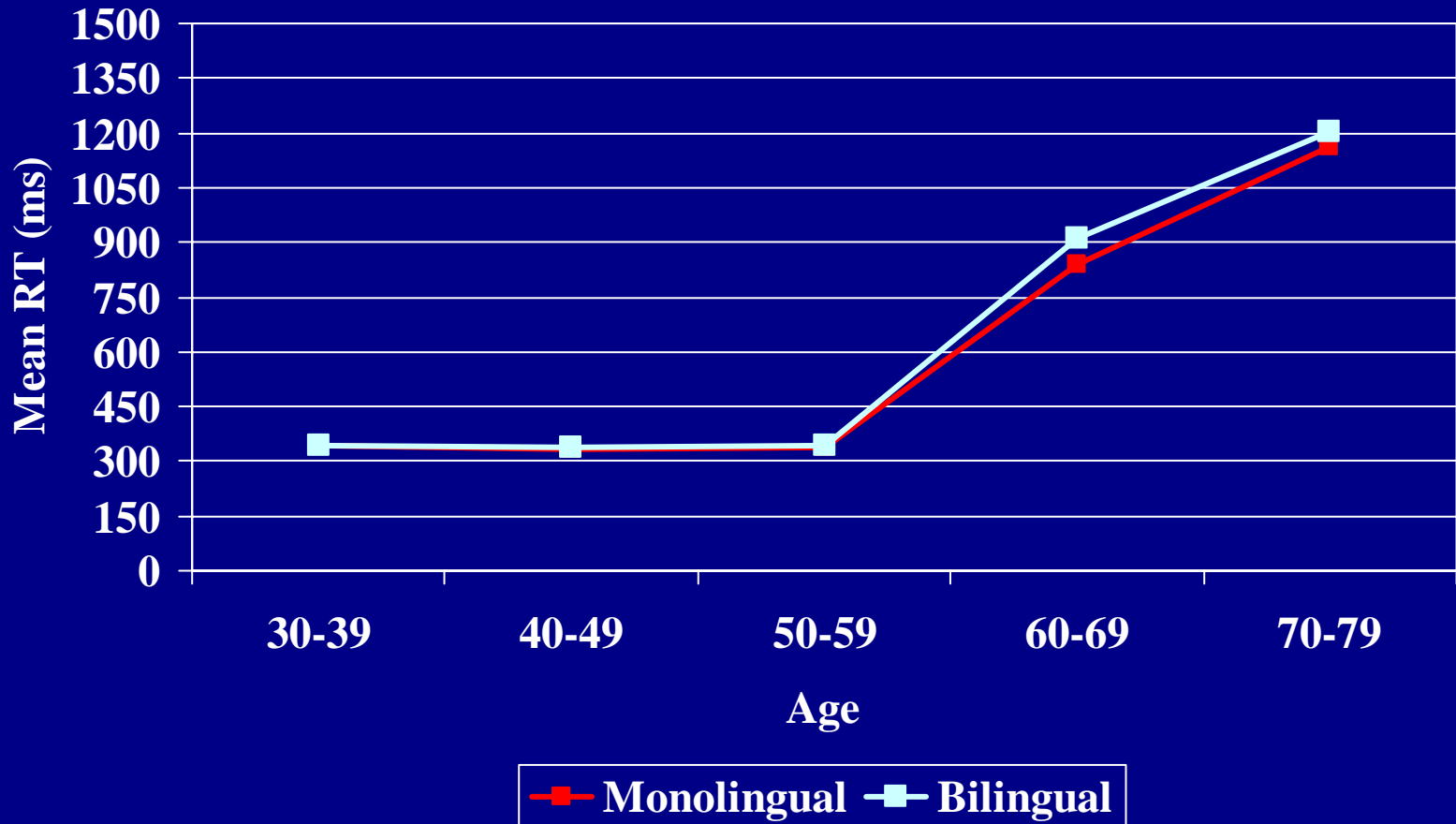
Rule: red square \rightarrow left green square \rightarrow right



L

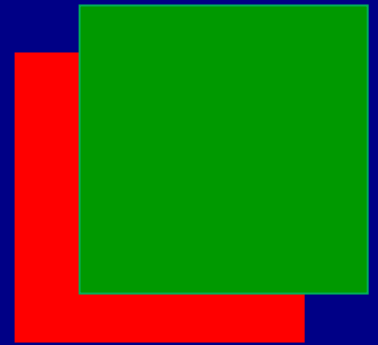
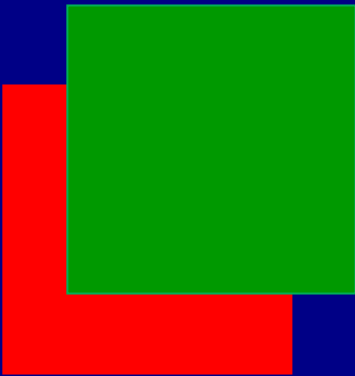
R

Mean RT for Control by Decade



Simon Effect

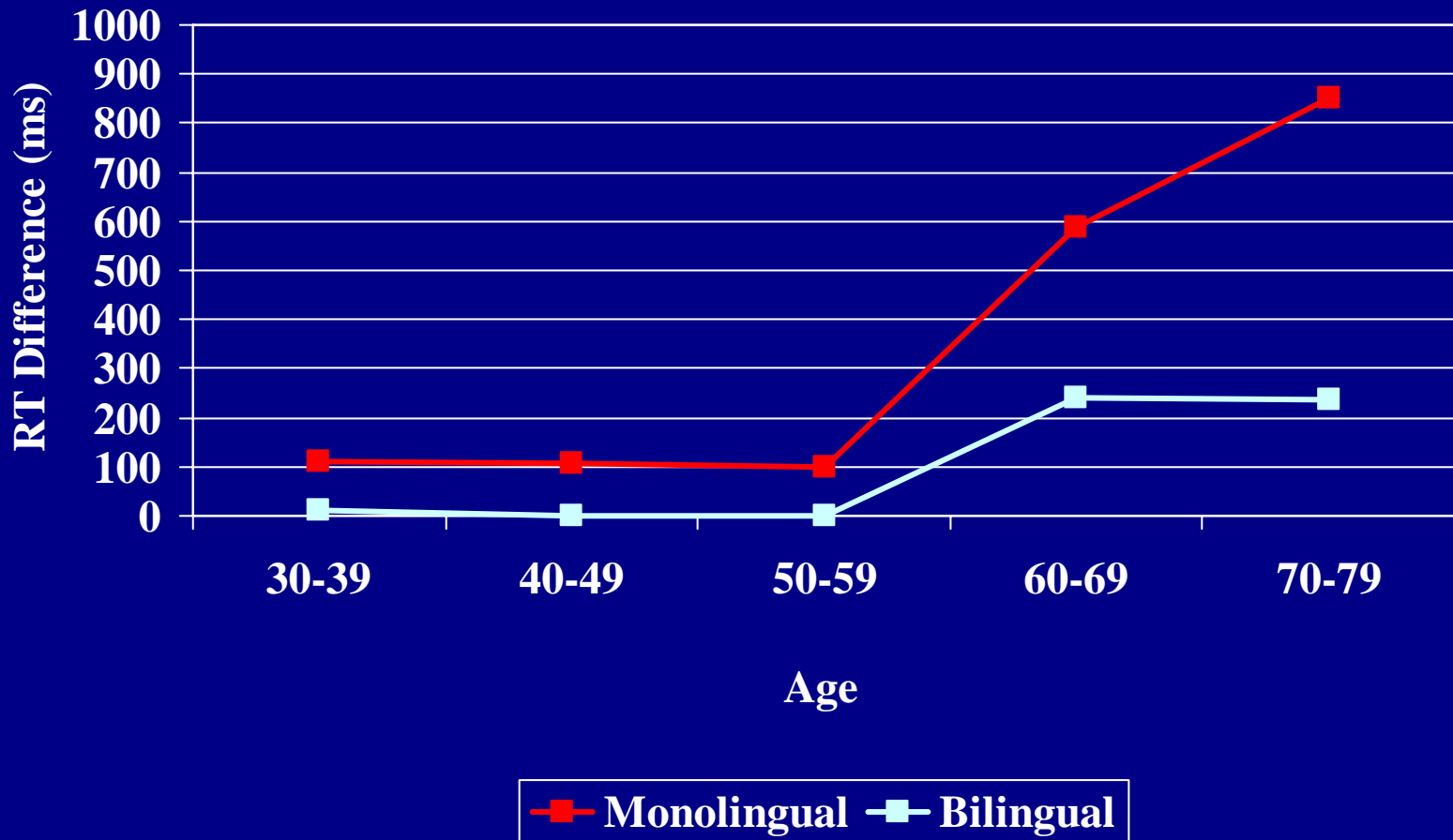
Rule: red square \rightarrow left green square \rightarrow right



L

R

Mean Simon Effect by Decade



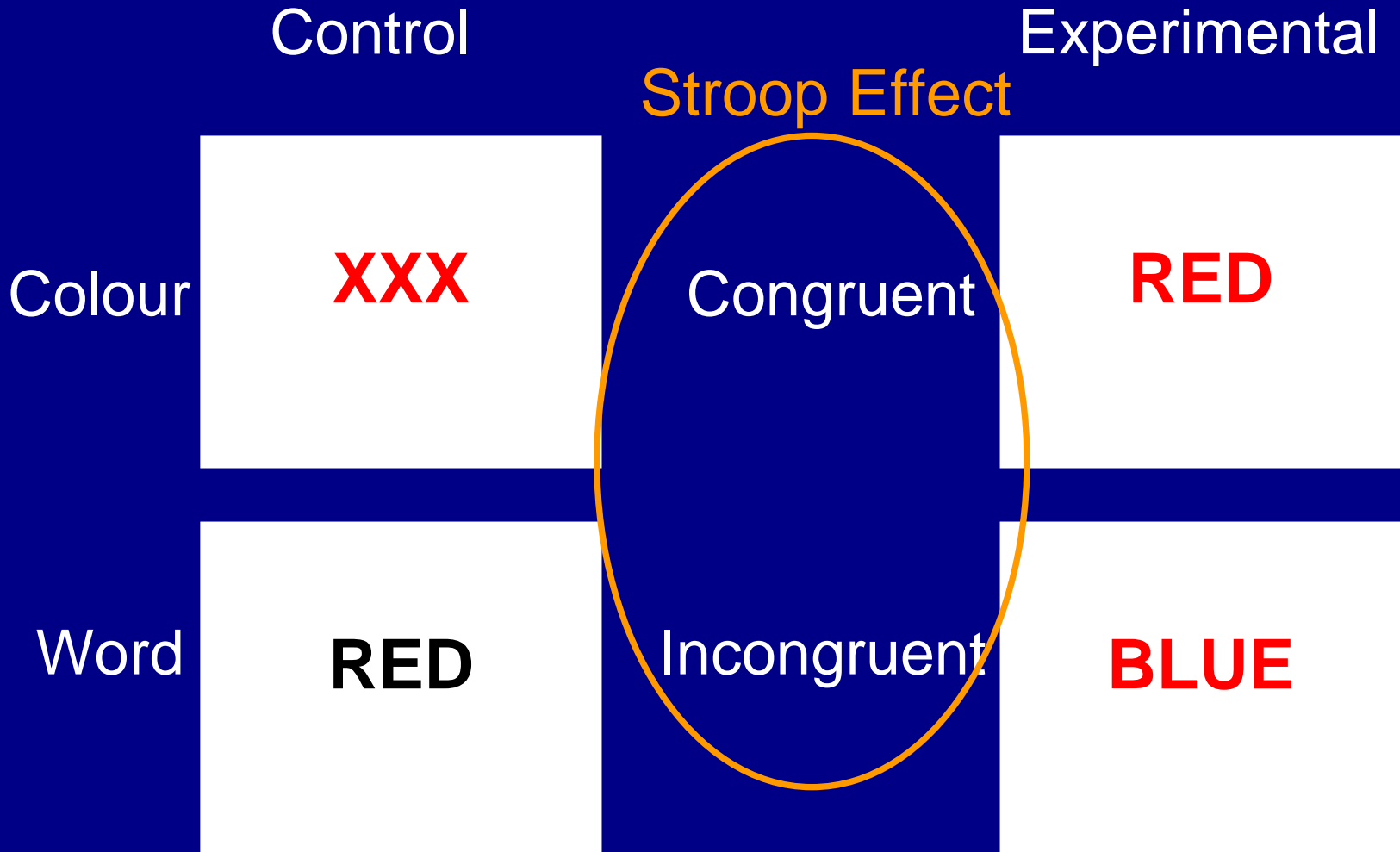
4. Stroop Task

- Prototypical task for frontal executive processing
- Bilingual Stroop effect: SE across languages = SE within languages
- (Almost) no research examining SE within a language comparing conflict resolution for monolinguals and bilinguals
- Bilinguals should resolve conflict more easily and show a smaller SE

Sample

- 96 participants:
 - 24 young monolinguals, 21 years
 - 24 young bilinguals, 20 years
 - 24 older monolinguals, 67 years
 - 24 older bilinguals, 68 years
- Bilinguals fully balanced lifelong bilinguals
- Variety of language pairs

Stroop Task



Correct answer: "Red"

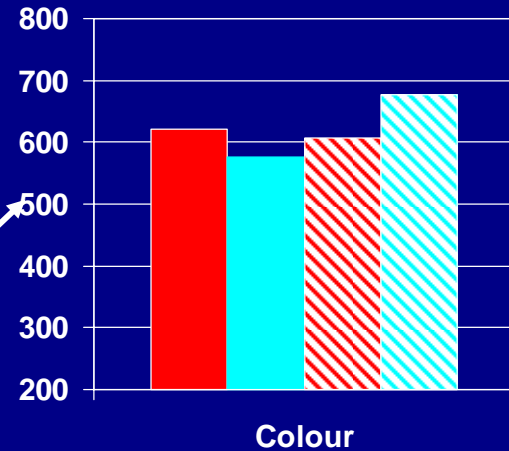
Stroop Control Conditions

Control

Colour

XXX

A white square containing the word 'XXX' written in red. An arrow points from the right side of this square to the top bar of the 'Colour' bar chart.

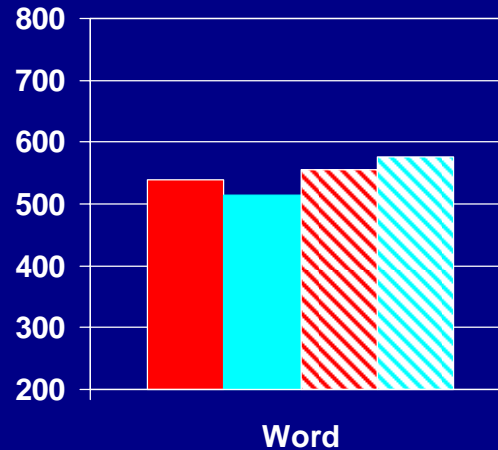


Age: n.s.
Lang: $F < 1$

Word

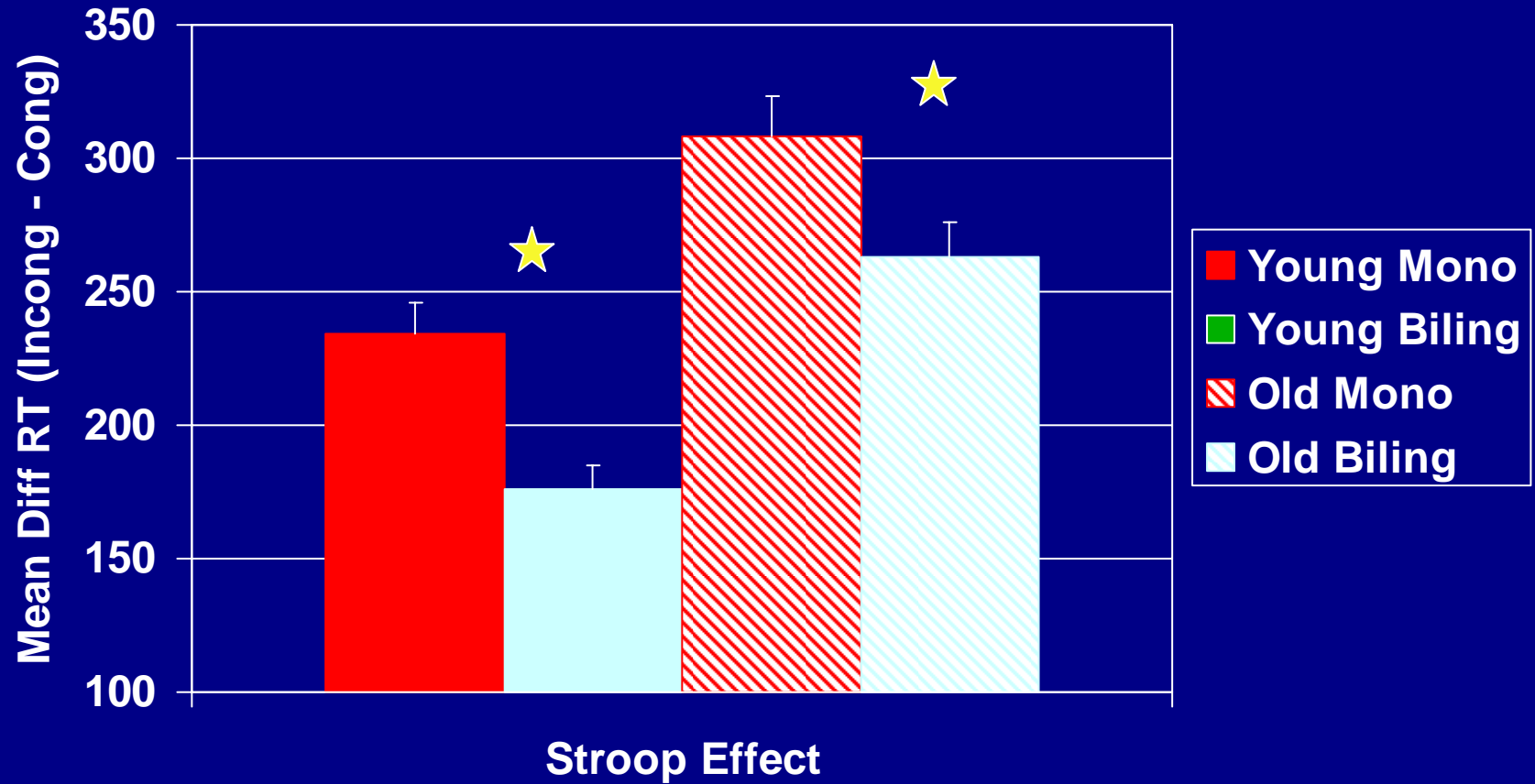
RED

A white square containing the word 'RED' written in black. An arrow points from the right side of this square to the top bar of the 'Word' bar chart.

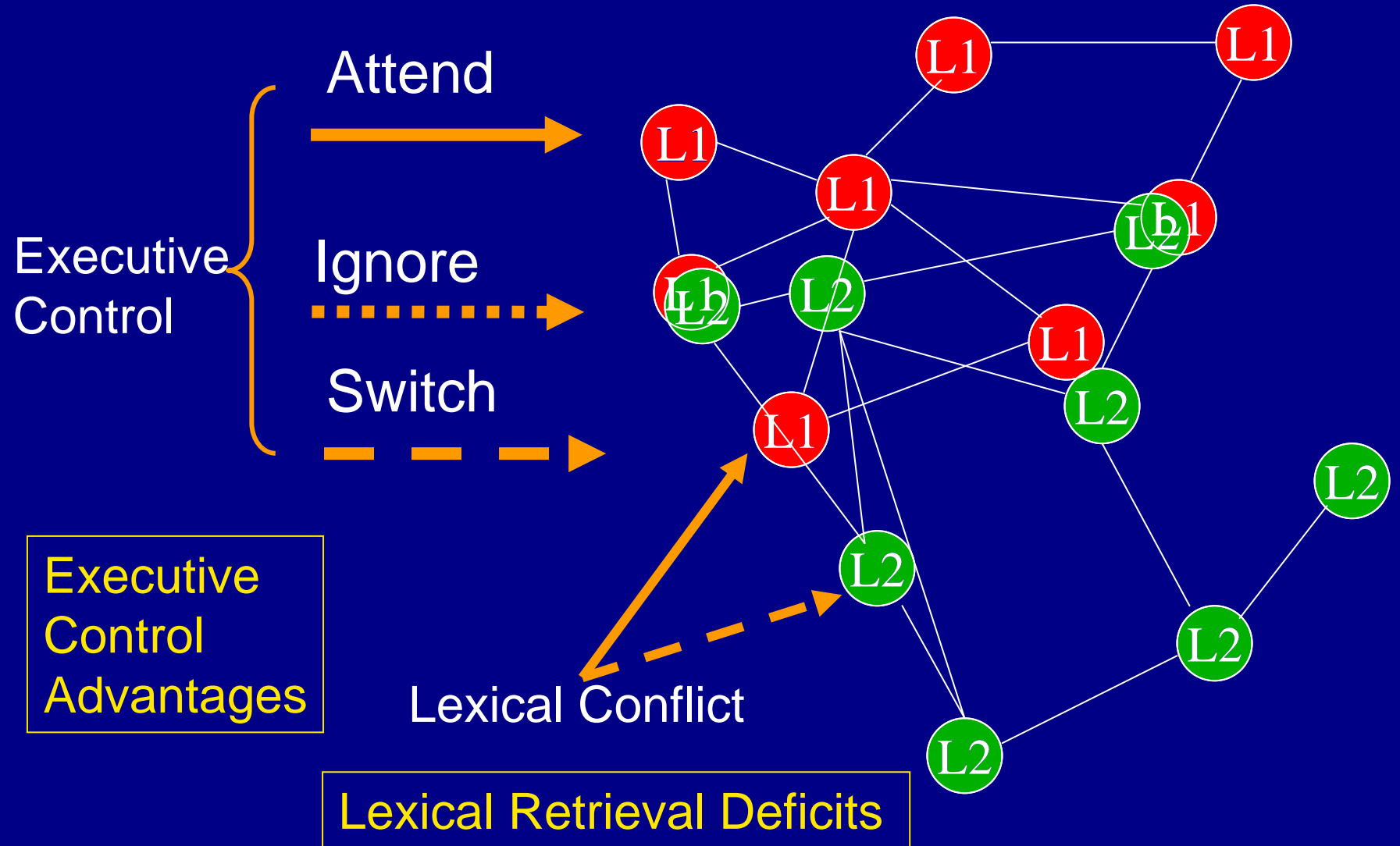


Age: n.s.
Lang: $F < 1$

Stroop Effect by Group



Language Representation in Bilinguals

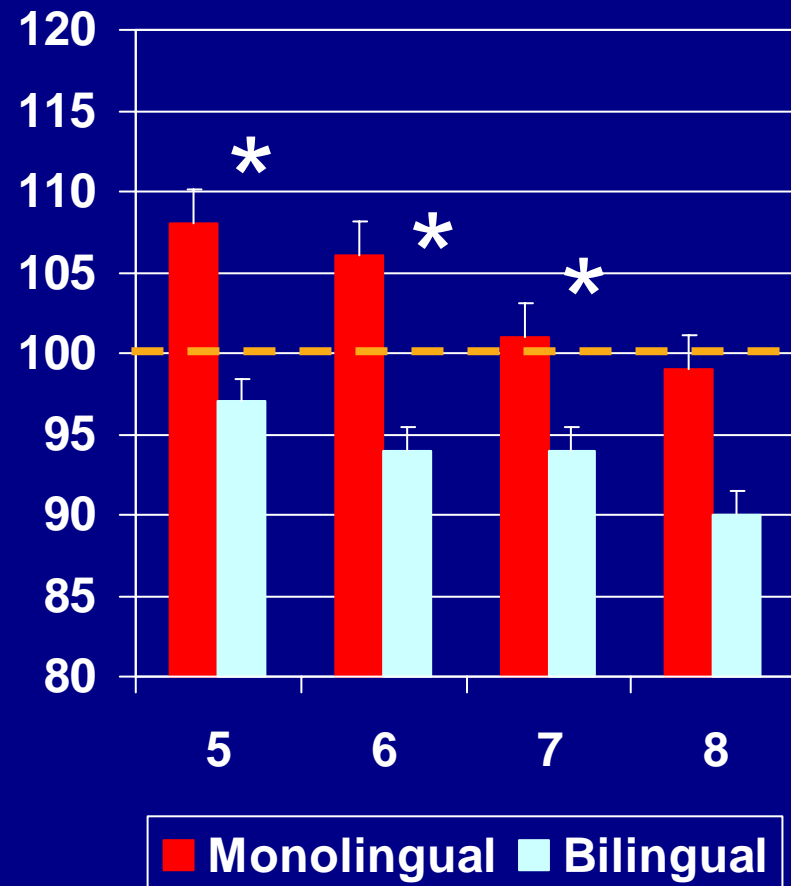


Bilingualism and Lexical Access

- Control advantages and EF processing differences come from linguistic conflict
- Need to resolve linguistic conflict beneficial to these processes
- But the problem of linguistic conflict remains
- Are there group differences in lexical access?

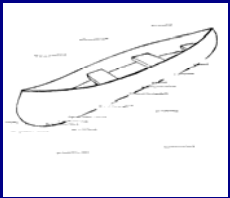
Receptive Vocabulary

- PPVT scores as rough vocabulary size
- Frequent reports of bilingual deficits
- Combined data: N=528
 - 5 yrs: N=97
 - 6 yrs: N=341
 - 7 yrs: N=56
 - 8 yrs: N=34



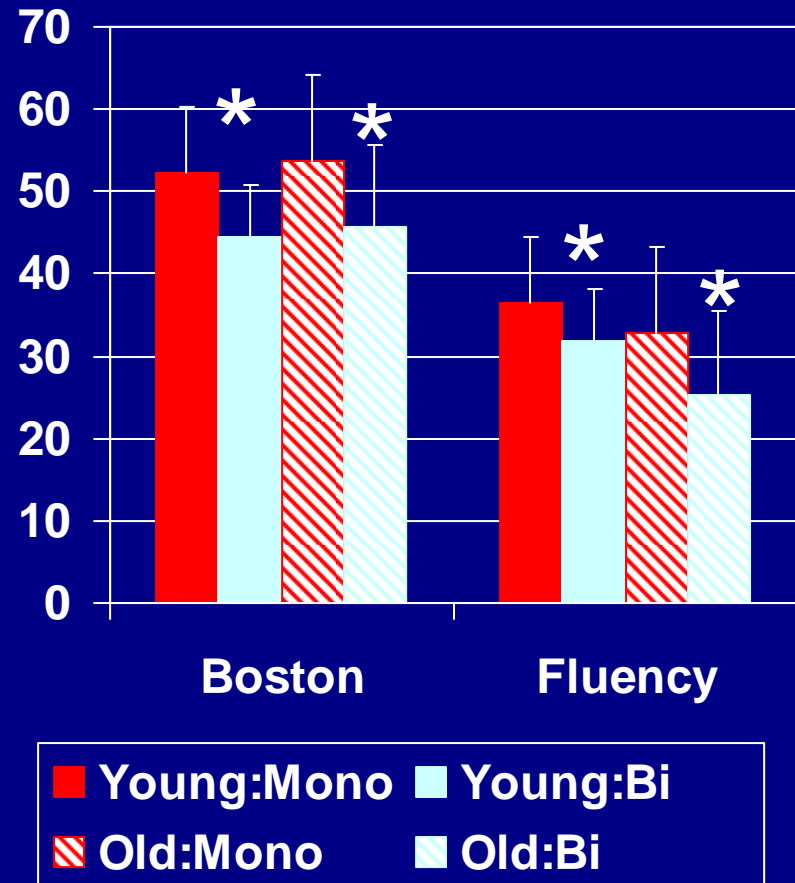
Lexical Retrieval

- Younger & older adults (from Stroop), N=96
- Boston Picture Naming

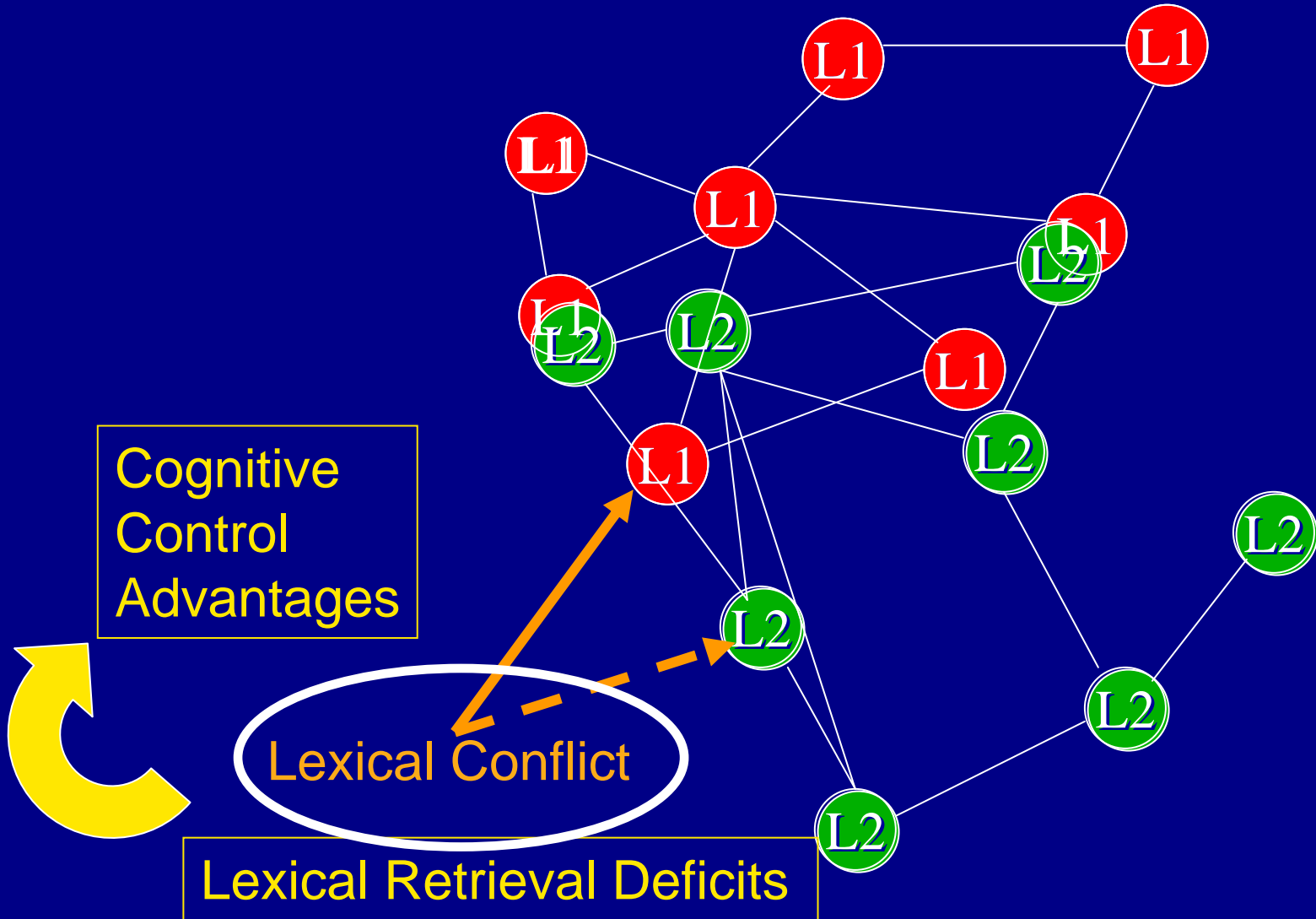


- Letter and category fluency

“F” “A” “S” “Animals”



Bilingual Effects on Cognition



Summary of Bilingual Effects

Advantages to executive function

- Control of attention
 - Simon task, Stroop task
- Switching
 - Embedded figures, DCCS

Disadvantages to lexical retrieval

- Vocabulary
 - PPVT
- Fluency
 - Fluency and Boston Naming

Credits

- Fergus Craik
- Ray Klein
- Gigi Luk
- Michelle Martin
- Jeni Pathman
- Dana Shapero
- Mythili Viswanathan

Funding



Thank you!