Application of Current Theoretical Models to Bilingual Aphasia Rehabilitation

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DISCLAIMER

- The authors have no relevant financial or nonfinancial relationships in the products or services described, reviewed, evaluated or compared in this presentation.

Your patient

- He is 63 years old, post-stroke, and multilingual.
- He was born in Colombia, South America, and spoke mostly Spanish as a child and young adult.
- He majored in French in college and spent a summer in France. He moved to North America when he was 22 and married an American who spoke only English. He had a stroke a year ago.
- You will have to decide in which language to provide therapy.
- Would you provide therapy in Spanish, the first acquired language, or in English, the language learned later but the one the client has been speaking with his immediate family?

Road Map

- The nature of bilingual language processing
- The nature of language impairment in bilingual aphasia
- Language therapy for bilingual aphasia

Road Map

- The nature of bilingual language processing
- The nature of language impairment in bilingual aphasia
- Different types of language therapy for bilingual aphasia

Research in bilingualism

1. Language processing in a bilingual individual is a dynamic process

2. Both language systems are active during language processing tasks

3. Language control: how the target language is activated

Research in bilingualism

1. Language processing in a bilingual individual is a dynamic process

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1. Language processing in a bilingual individual is a dynamic process

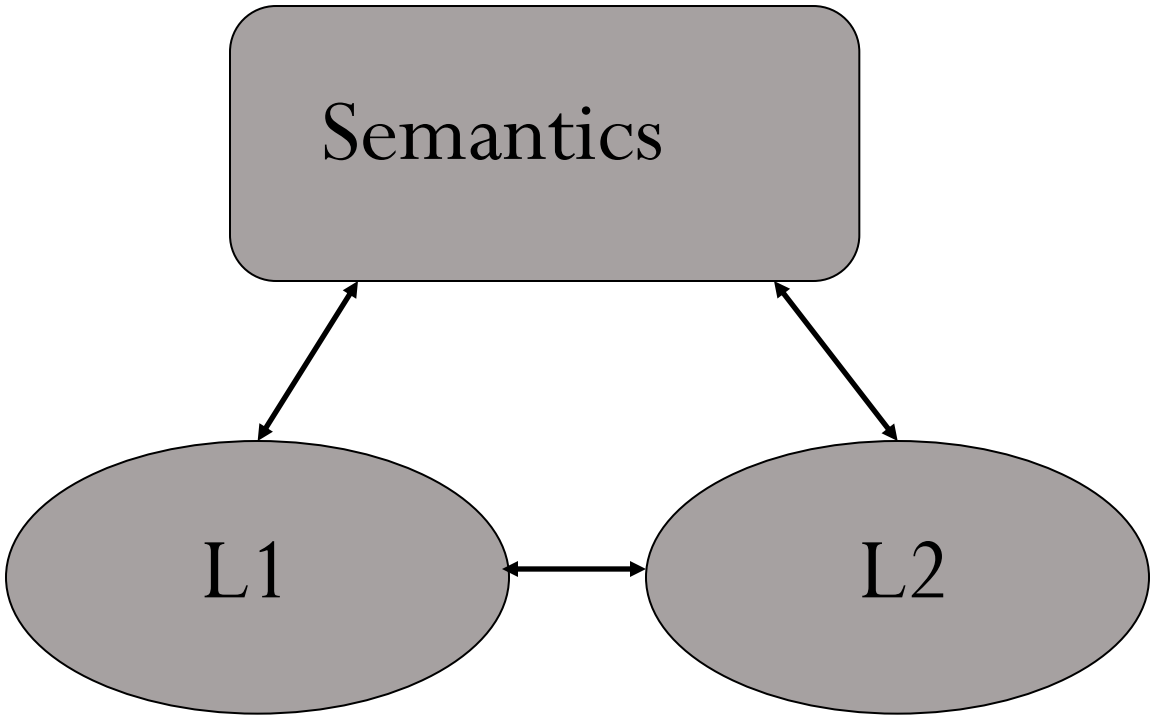
- Learning L2 not only changes representations and access for L2 but also for L1

- Mixing between the two languages poses a greater cost to L1 (more dominant) than to L2 (less dominant) (Christoffels, Kirk, & Schiller, 2007; Kroll, Dijkstra, Janssen, & Schriefers, 2000).

- Immersion experiences in L2 result in attentuation/attrition of L1 (Linck et al., 2009)

- Long term immersion can change the dominance, with L2 now becoming the L1

Model of Bilingual Lexical Access



(de Groot, 1992, 1994)

Asymmetrical Model
(Kroll & Stewart, 1994)

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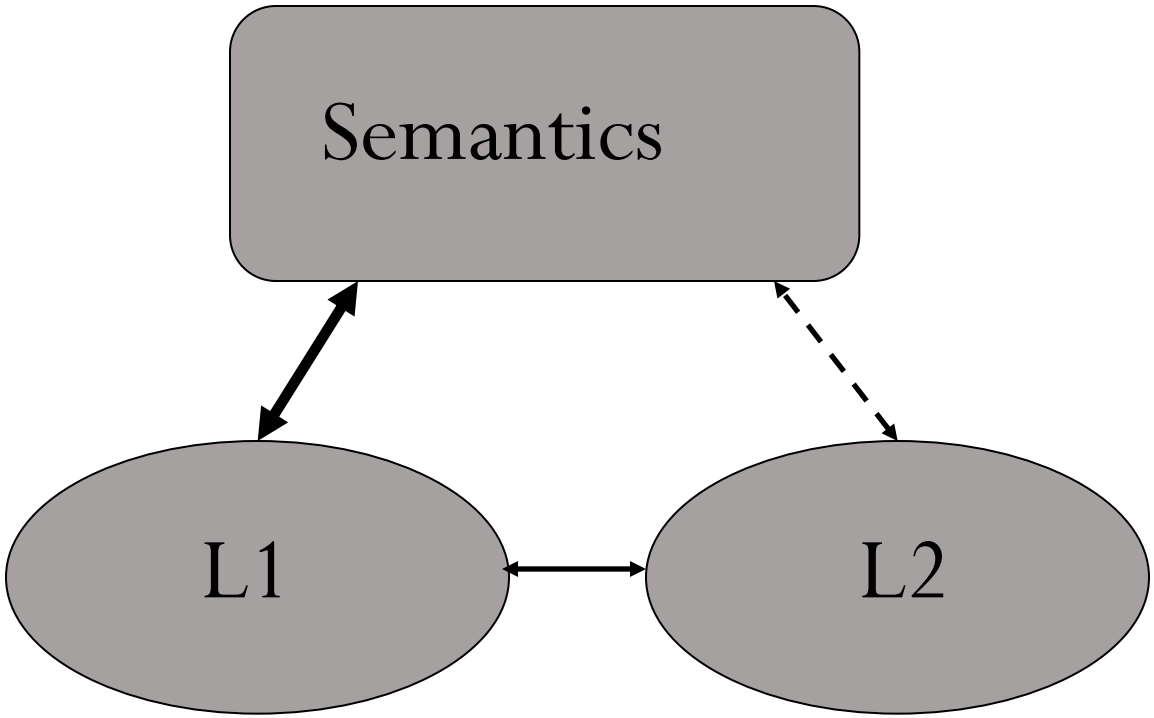

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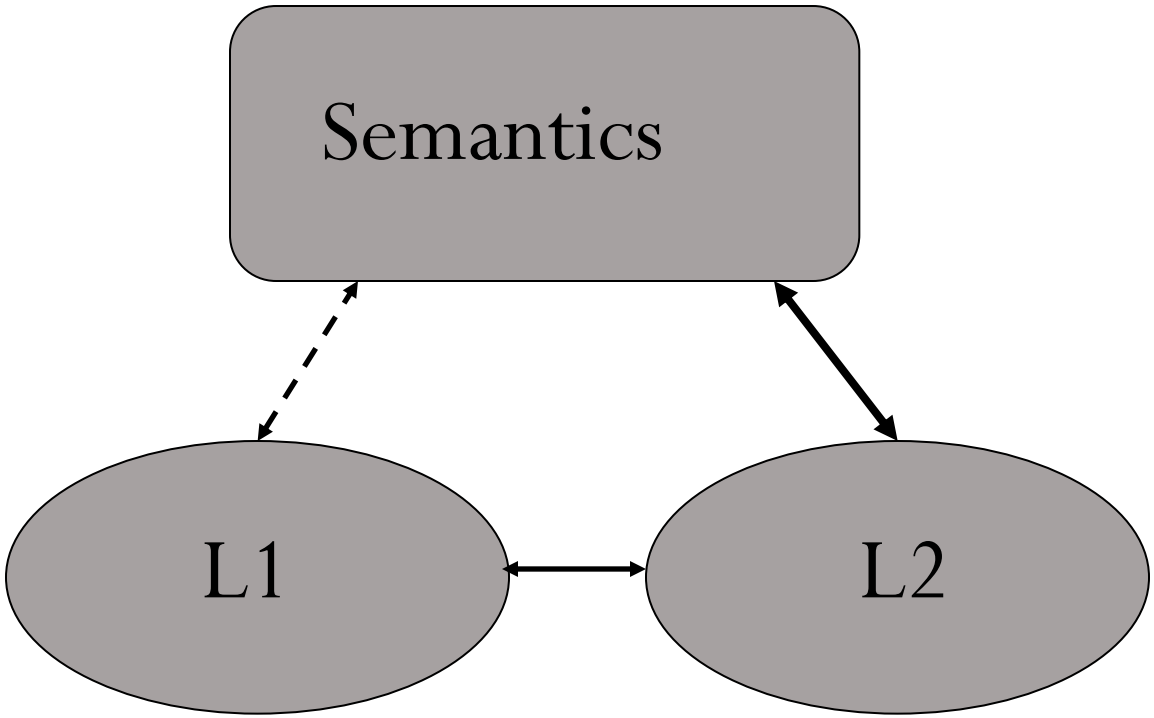

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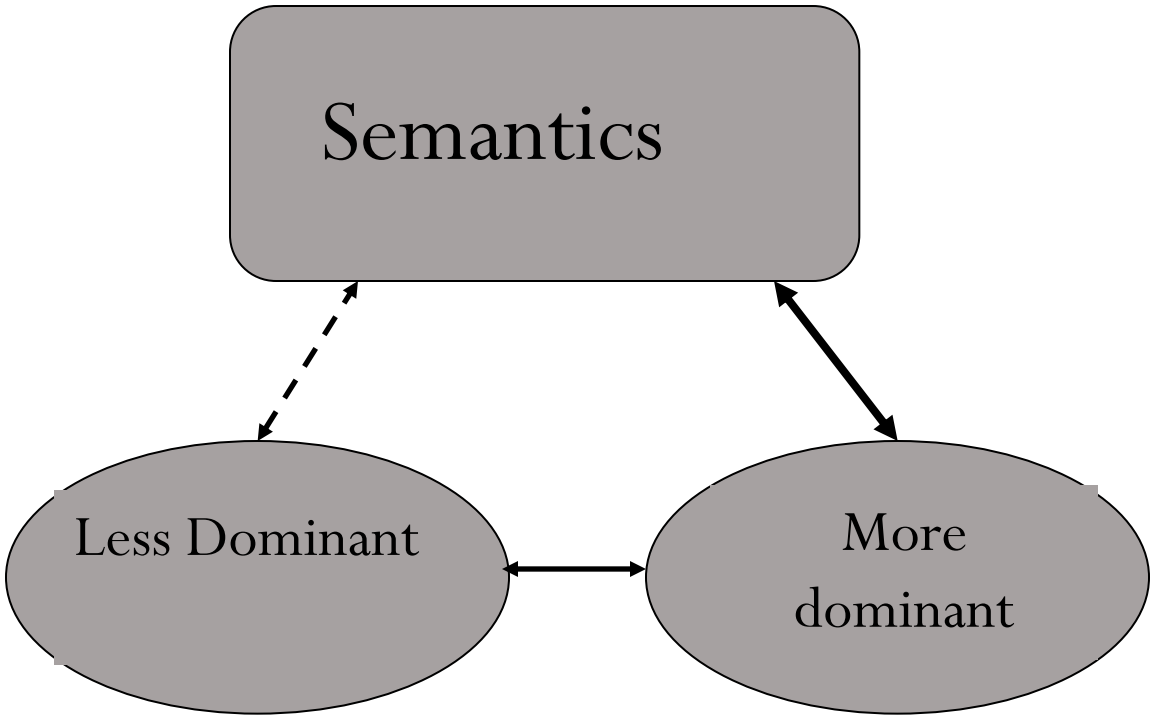

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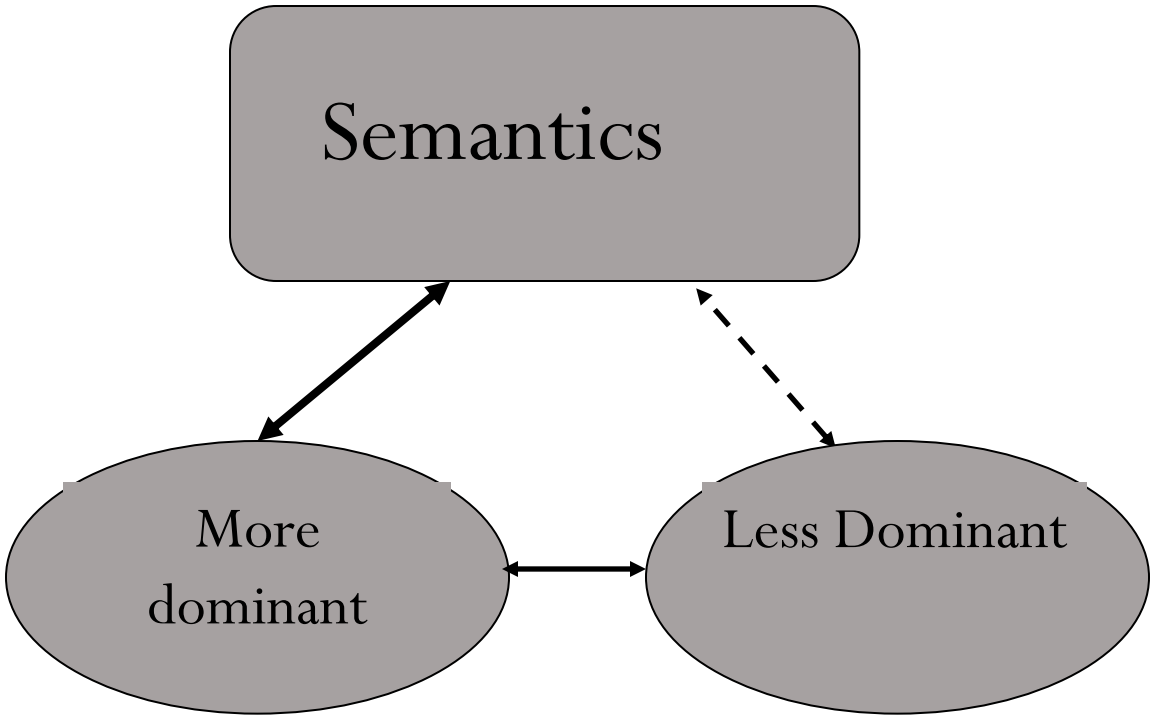

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Research in bilingualism

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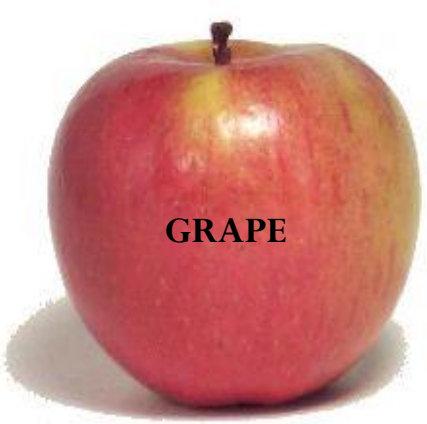
2. Both language systems are active during language processing tasks

3. Language control: how the target language is activated

2. Both language systems are active during language processing tasks

- Word recognition and production
  - Robust research evidence that parallel activation of a bilingual's two languages is observed during word recognition and production.
  - Selecting a word to speak in one language activates alternatives in the non-target language (e.g., Colomé, 2001; Costa, Miozzo, & Caramazza, 1999; Hermans, Bongaerts, De Bot, & Schreuder, 1998).
  - Parallel activation is also observed when languages differ in script (e.g., Chinese/English; Japanese/English)



Research in bilingualism

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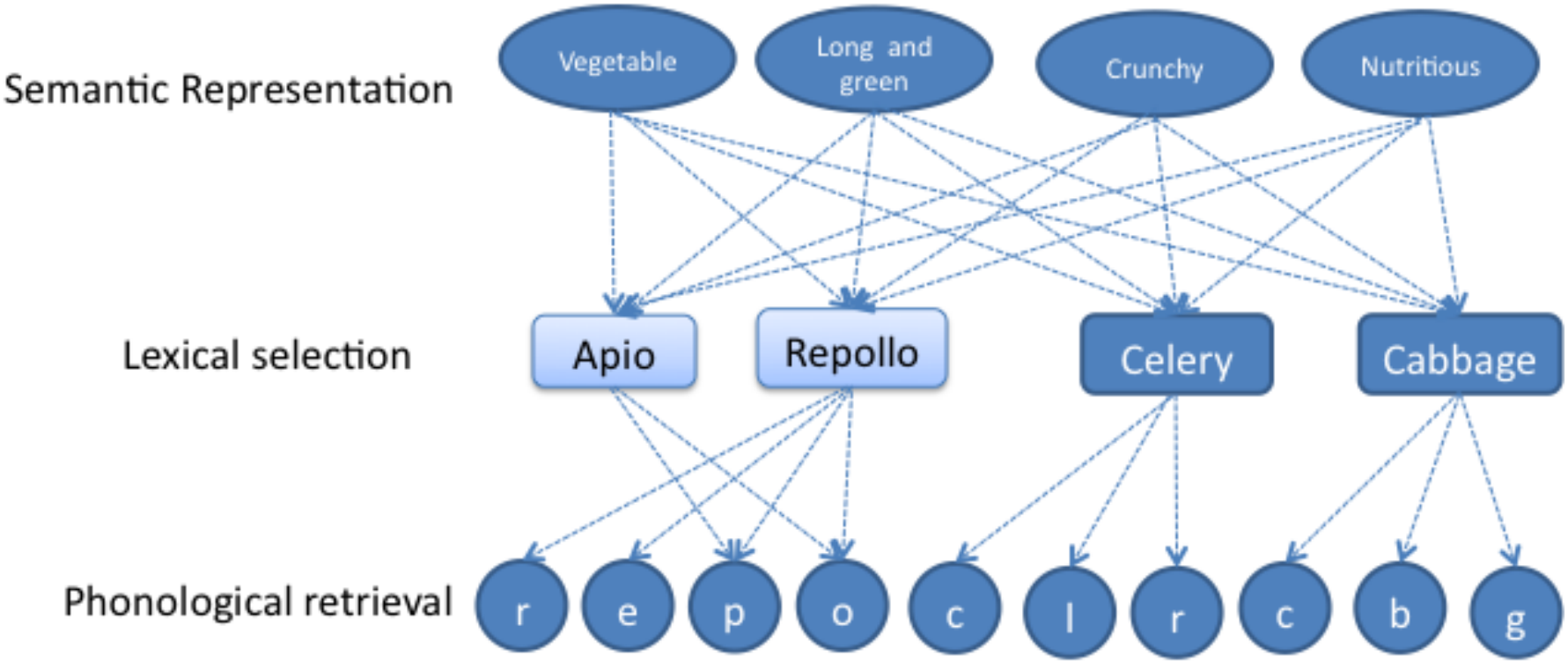
Models of language control

- Selective attention to the target language

- Inhibition of the non-target language

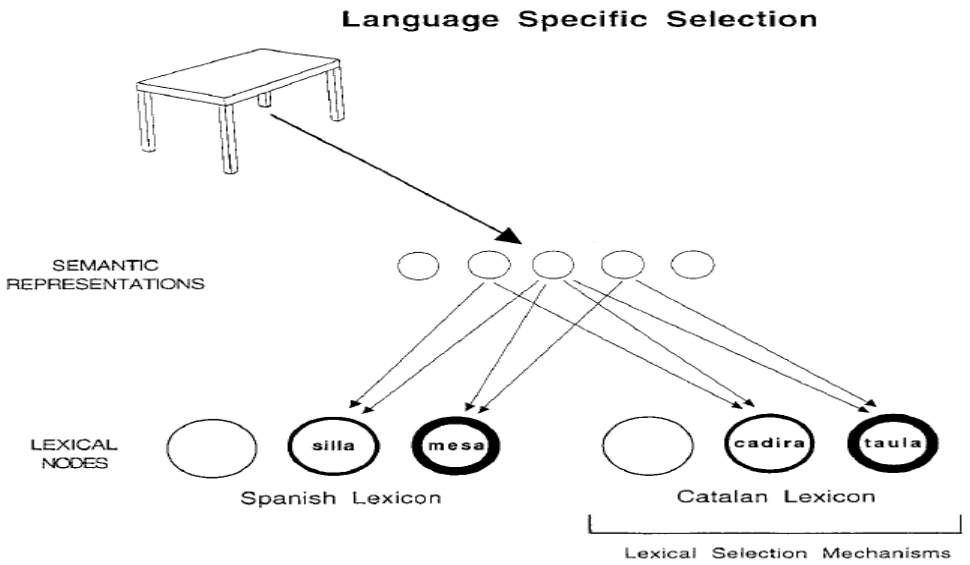
Bilingual lexical retrieval



Adapted from Costa, La Heij, & Navarette, 2006

Selective attention to the target language

- According to Costa et al., 1999; Finkbeiner et al., 2006; there is activation in the non-target language but this activation is controlled by an attentional mechanism that effectively ignores competitors that are not from the target language.



- Inhibitory control model
  - In contrast, the Control Activation and Resource Model (Green, 1986; 1998) assumes that all activated alternatives potentially compete for selection
  - A specified inhibitory mechanism eventually resolves the competition by inhibition of candidates in the non-target language.

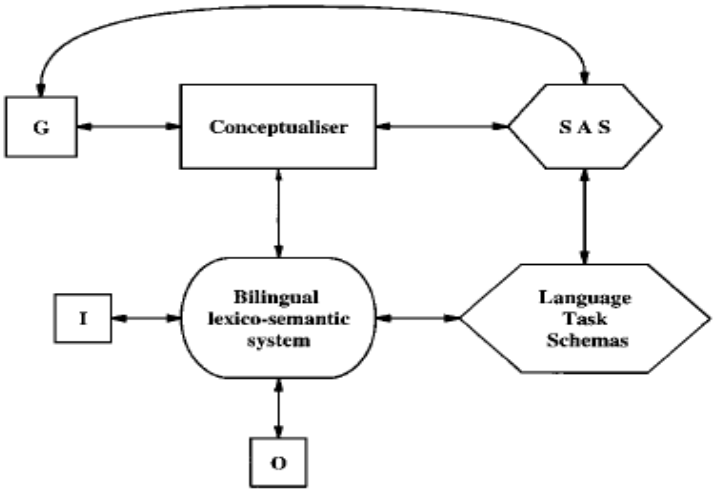


Figure 3. Inhibitory Control model. Reprinted from "Mental control of the bilingual lexico-semantic system," by D. Green, 1998, *Bilingualism: Language and Cognition 1*, p. 69. Copyright 1998 by Cambridge University Press.

Road Map

- ✓ Understand the nature of bilingual language processing
- Understand the nature of language impairment in bilingual aphasia
- Understand the different types of language therapy for bilingual aphasia

What does this mean for bilingual aphasia?

Studies that explore **language** impairment:

- Lexical access (Edmonds & Kiran, 2006; Kiran & Lebel, 2007; Kiran & Tuchtenhagen, 2005; Lalor & Kirsner, 2001),
- Syntactic processing (Hernandez et al., 2008; Kambanaros et al., 2012; Tschirren et al., 2011),
- Orthographic processing (Raman & Weekes, 2005; Weekes, 2005, 2012; Yin et al., 2005; Zhang et al., 2009).

Studies that explore **control** impairment:

- Pathological switching (Fabbro et al. 2000; Ansaldo et al. 1997),
- Green et al. (2010),
- Verreyt et al. (2013),
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Lexical semantic access in bilingual aphasia

Normal Bilingual Adults: N = 12; Bilingual Aphasia Adults N = 13
(all participants Spanish-English speakers)

- Task:
  - Boston Naming Test
  - Category Naming Test Picture set of 60 semantically related picture pairs
  - Category generation task (animals, food, clothing) (Spanish/English)
- Dependent measures
  - Percent naming accuracy- BNT
  - Average percent naming accuracy across two semantically related sets

- Results: bilingual patients with aphasia exhibit lexical retrieval deficits, but the underlying mechanism supporting lexical retrieval on naming tasks for bilingual patients with aphasia still mirrors bilingual language processing utilized by healthy bilinguals.

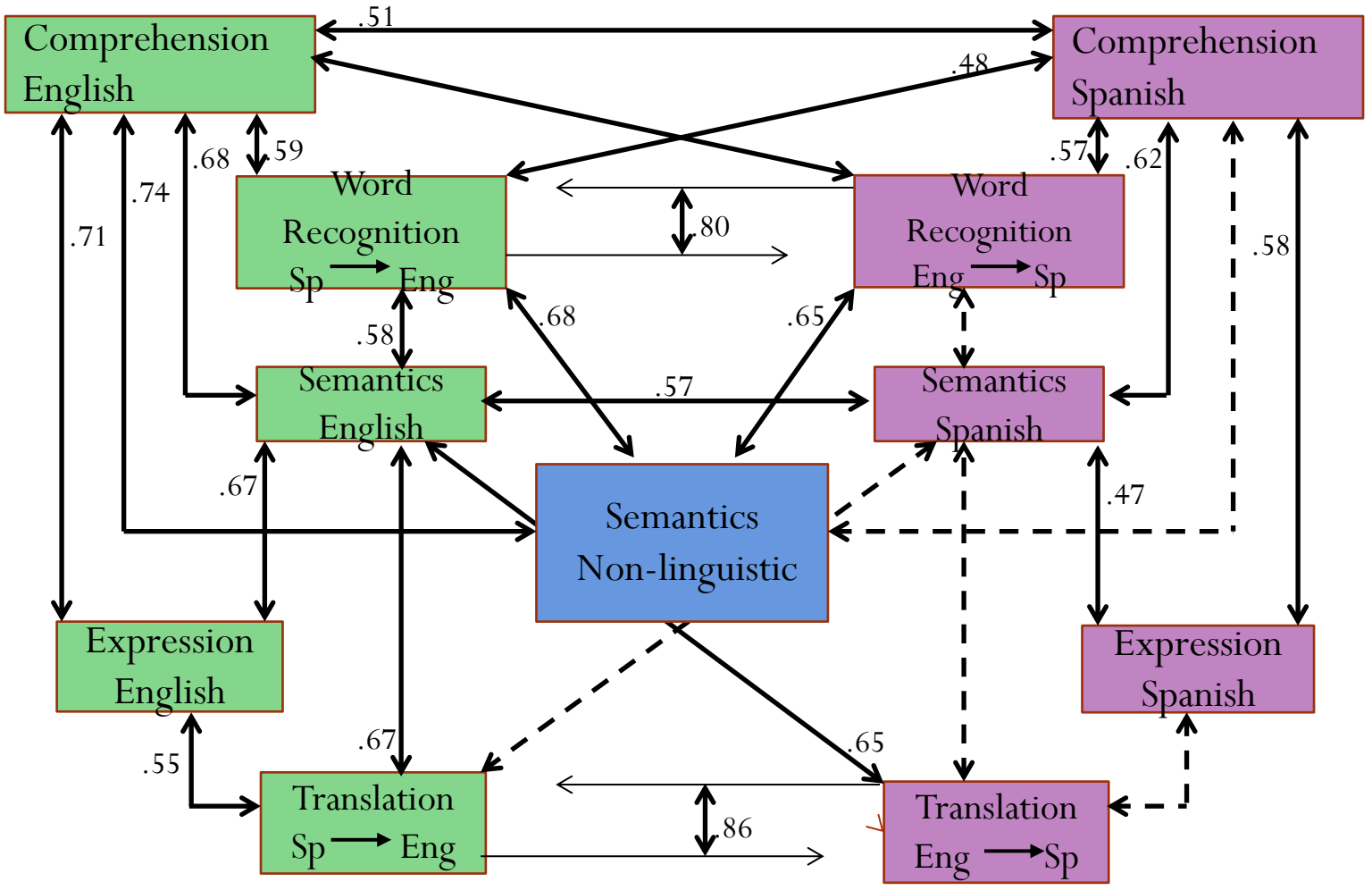
Kiran, Balachandran, & Lucas (2013)

Language impairment vs Proficiency

19 Spanish-English bilingual adults with aphasia (mean age 63.1, SD 17.82); 11 females

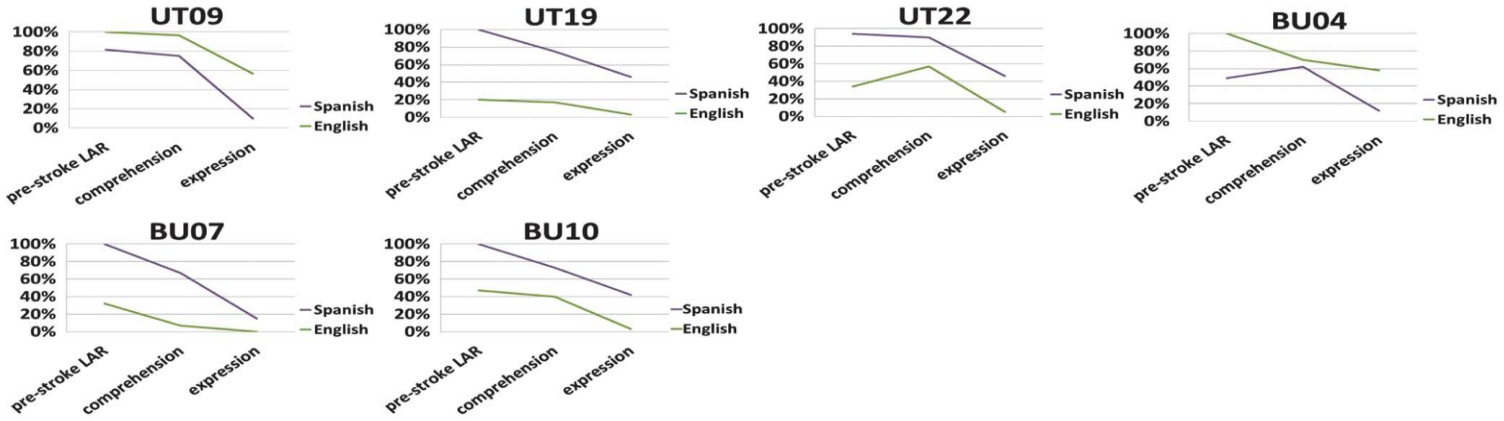
- Bilingual Aphasia Test (BAT): English and Spanish + Part C
- Boston Naming Test (BNT): English and Spanish
- Pyramids and Palm Trees (PPT): Picture Version
- Language Use Questionnaire (Kiran, Peña, Bedore, & Sheng, 2010)

Framework of bilingual language procesing

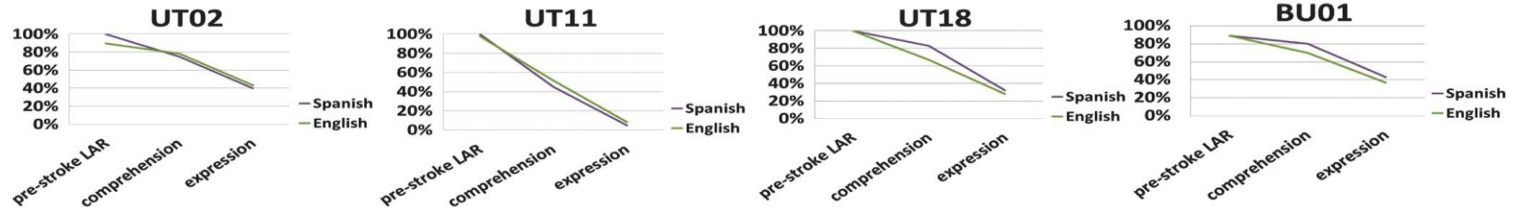


Language impairment vs. Proficiency

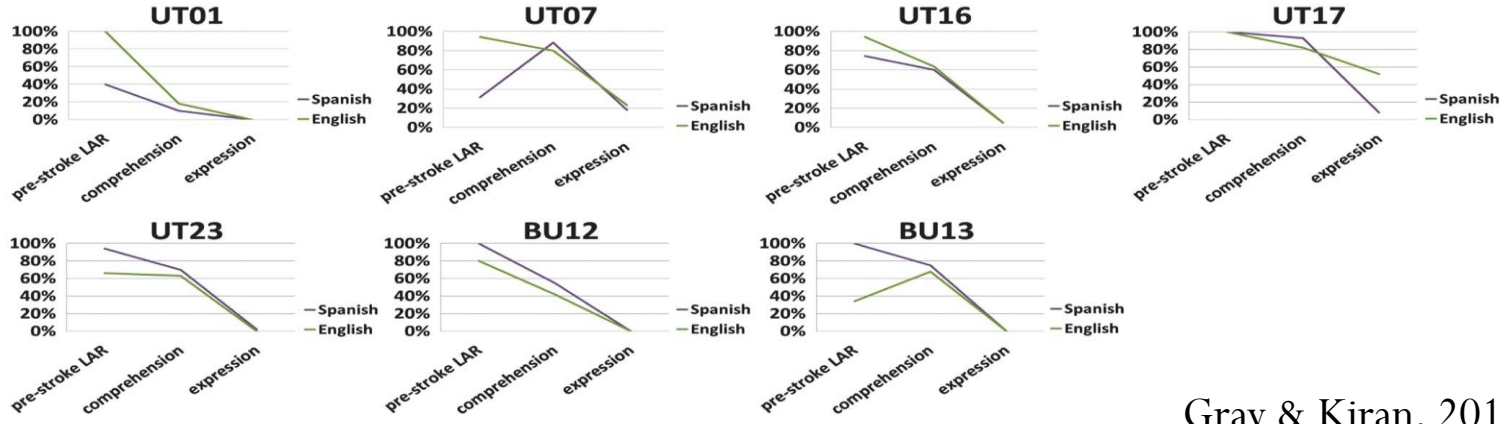
Group 1a: Differential pre-stroke language rating followed by similar levels of post-morbid language impairment for both comprehension and expression measures.



Group 1b: Equivalent pre-stroke language rating followed by similar levels of post-morbid language impairment for both comprehension and expression measures.



Group 2: Differential pre-stroke language rating followed by similar levels of post-morbid language.



Gray & Kiran, 2013, JSHLR

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Language control: pathological switching and mixing

- Language switching: e.g., I want water. Tengo sed. [I am thirsty]
- Language mixing:e.g., I want the hombre [man] to move.

(Adrover-Roig et al., 2011)

- In bilingual aphasia, it has been documented that patients can have problems controlling their two languages (Abutalebi, Miozzo, & Cappa, 2000; Aglioti & Fabbro, 1993; Aglioti, Beltramello, Girardi, & Fabbro, 1996; Ansaldo & Marcotte, 2007; Ansaldo, Saidi, & Ruiz, 2000; Fabbro, Peru, & Skrap, 1997; Fabbro, Skrap, & Aglioti, 2000; Goral et al., 2006; Keane & Kiran, in press; for a review see Ansaldo, Marcotte, Scherer, & Raboyeau, 2008).

Green et al. (2010)

- 2 bilingual adults with aphasia (L1 Spanish/L1 French, L2 English)
  - Parallel recovery/impairment
- 12 healthy non-native English bilingual controls
- 14 healthy native English monolingual controls

Tasks

Linguistic Task					Non-Linguistic Task
	Eng		L1	Eng	
lexical decision		Stroop			Flanker

Results

	Linguistic Task					Non-Linguistic Task
		Eng		L1	Eng	
Patient 1:	lexical decision	X	Stroop	X	X	Flanker ok
Patient 2:	lexical decision	X	Stroop	ok	ok	Flanker X

Verreyt et al. (2013)

- 1 French (L1) - Dutch (L2) bilingual adult with aphasia
  - Differential language impairment (L1 is stronger than L2)

Tasks

Task
General lexical decision
Selective French lexical decision
Selective Dutch lexical decision
Flanker

Stimuli in each lexical decision task:
30 Dutch-French cognates
30 Dutch noncognates
30 French noncognates
90 non-words

Results

Task	Result
General lexical decision	cognate facilitation
Selective French lexical decision	no effect of cognate facilitation
Selective Dutch lexical decision	cognates identified with less accuracy than Dutch non-cognates
Flanker	impaired control

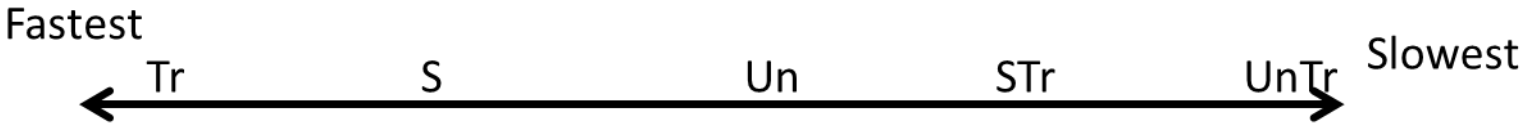
Gray & Kiran (under revision)

- 10 Spanish-English bilingual adults with aphasia
- 30 Spanish-English, age matched neurologically healthy bilingual adults

Experimental Paradigms:

Linguistic Task	Non-Linguistic Task
Semantic judgment	**Flanker**

Translation (Tr)
Semantic (S)
Unrelated (un)
Semantic Translation (STr)
Unrelated Translation (UnTr)



Road Map

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What does this have to do with Bilingual aphasia rehabilitation?

- What are the implications of this research?
  - Cross-language parallel activation = Cross-language generalization ?
  - Cross-language interference- Can competition be capitalized in therapy?
  - Cognitive control of the language system- Train language or cognition?

- A recent review of 13 studies on bilingual aphasia rehabilitation (Faroqi-Shah et al., 2010)
  - Except for one study with 30 participants (Junque et al., 1989), most studies were case studies.

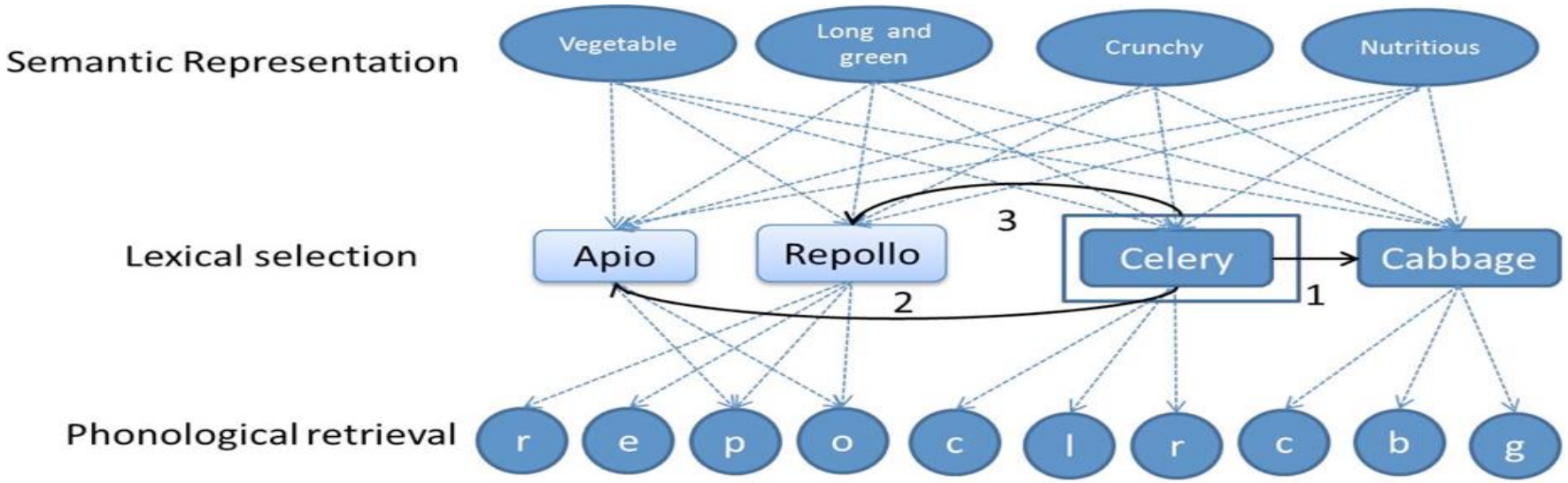
  The good news:

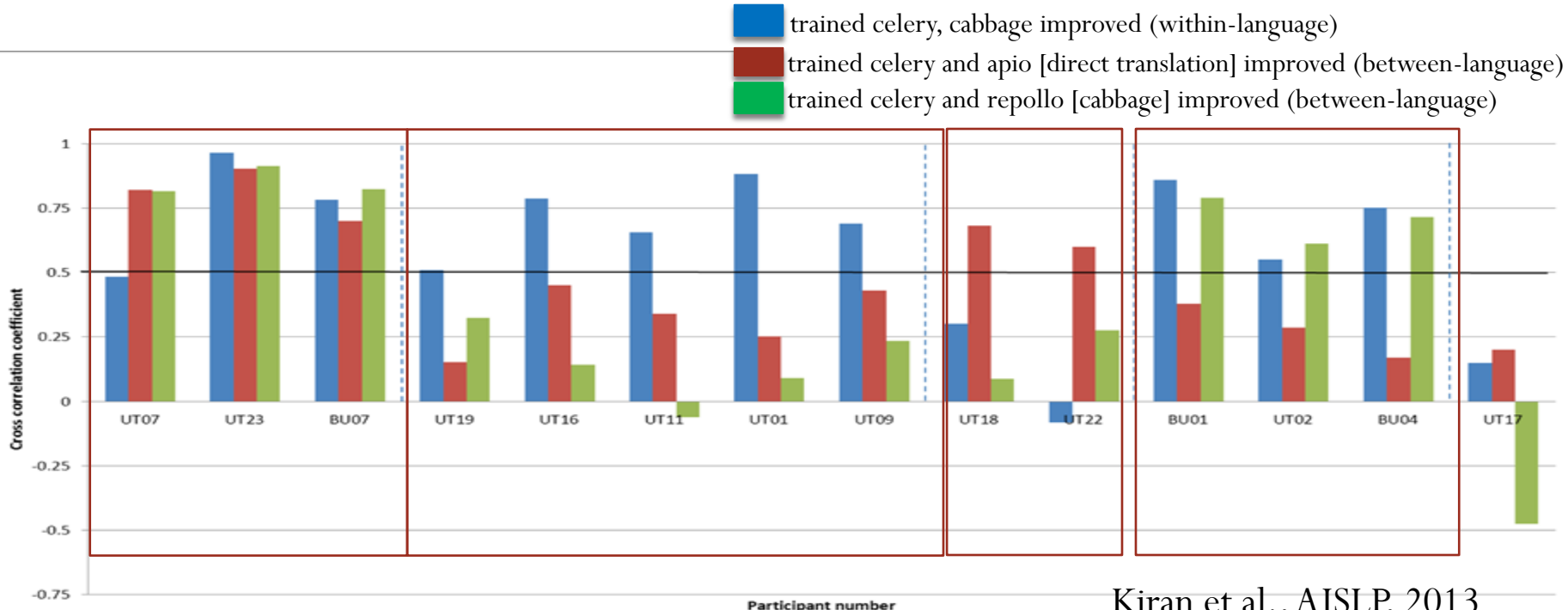
  - Therapy provided in the L2 results in improved treatment outcomes in the treated language.
  - Cross language transfer occurs in over half the participants.
  - Age of acquisition and language differences across studies do not specifically influence treatment outcomes.

  The bad news

  - Variability in treatment type and consequent treatment outcomes
  - Other confounding variables including time post onset and nature of aphasia influence outcomes.

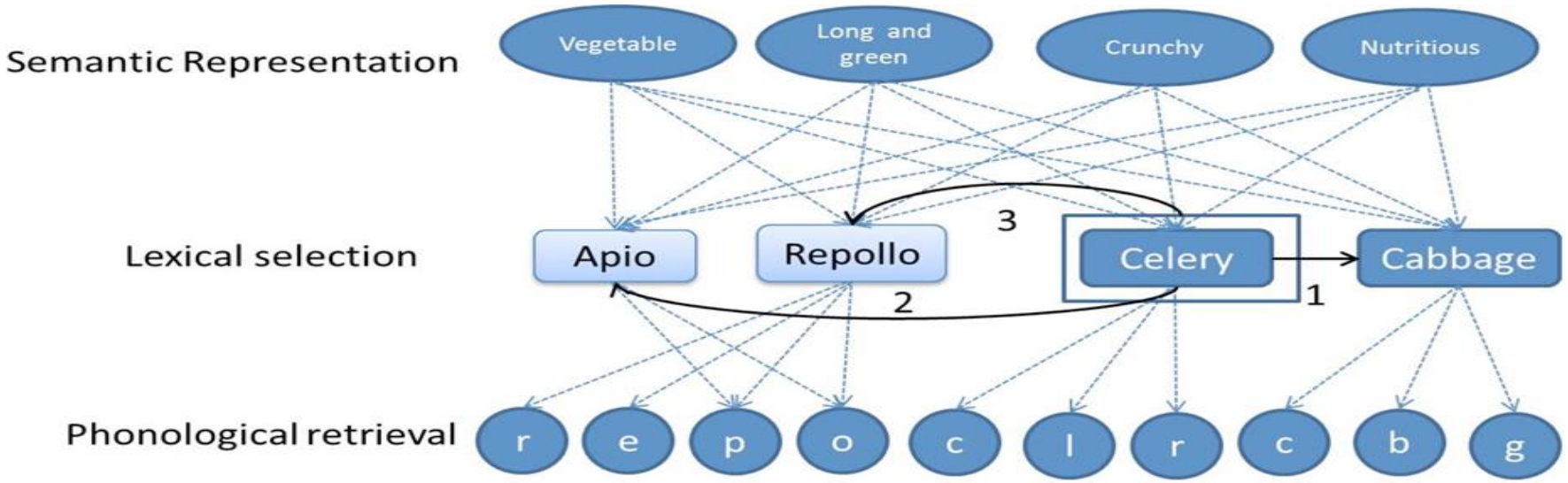
Between and within language generalization

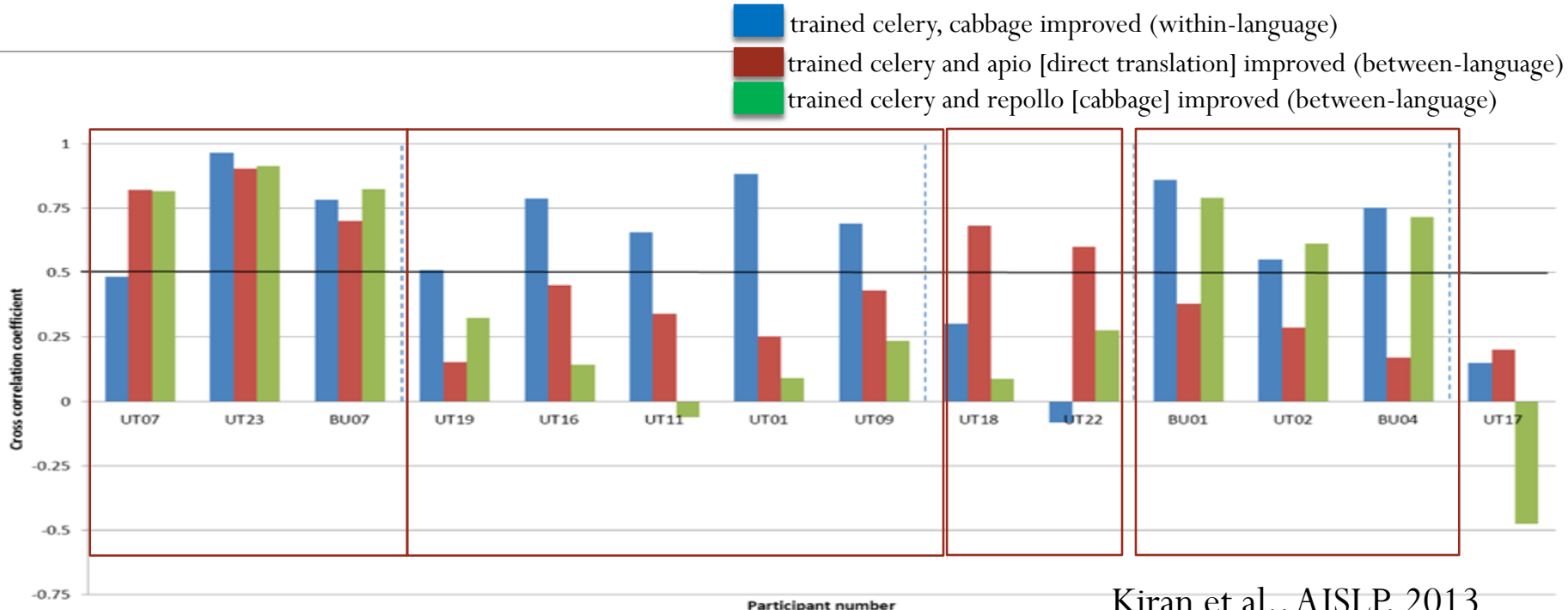




Kiran et al., AJSLP, 2013

Between and within language generalization





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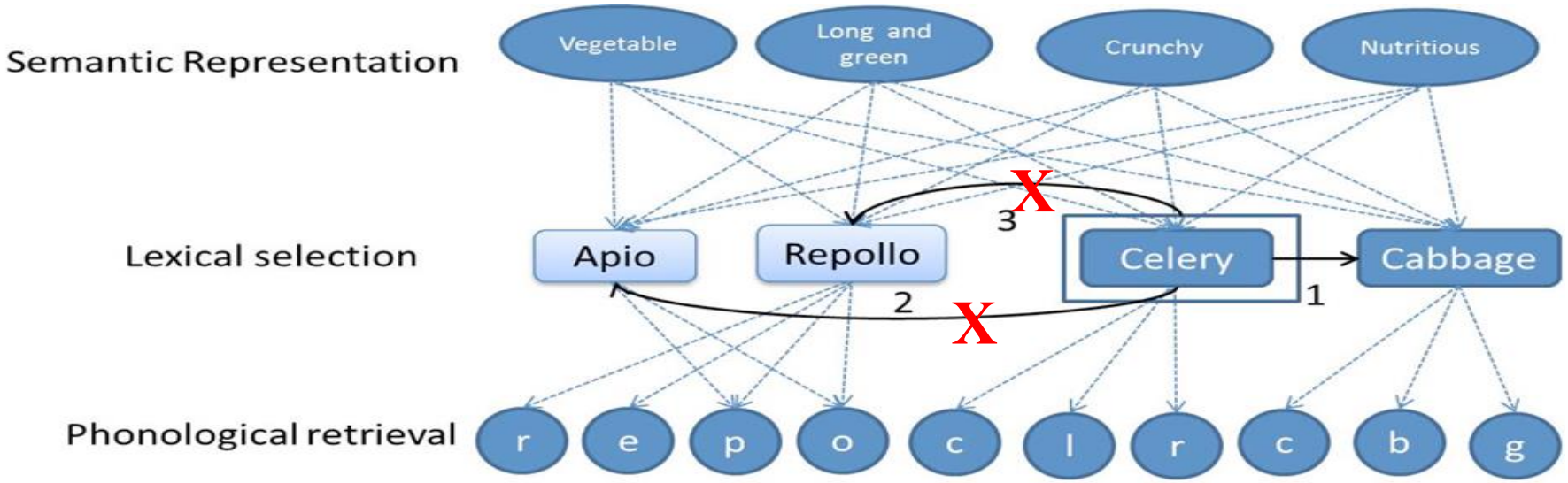
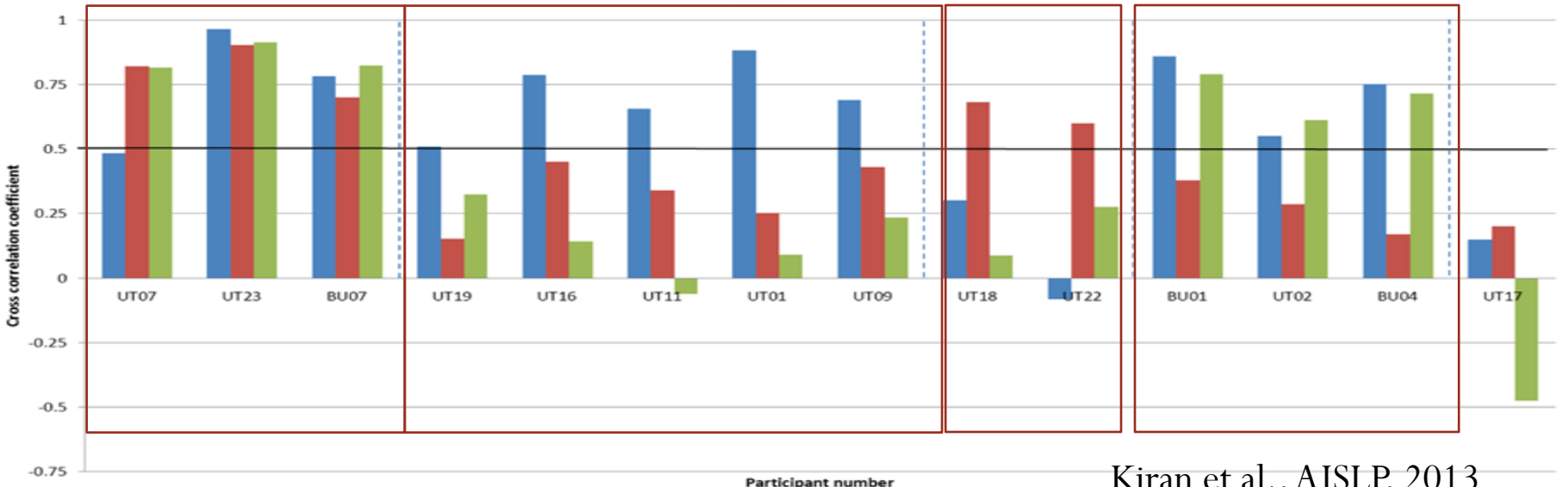
Between and within language generalization



trained celery, cabbage improved (within-language)

trained celery and apio [direct translation] improved (between-language)

trained celery and repollo [cabbage] improved (between-language)

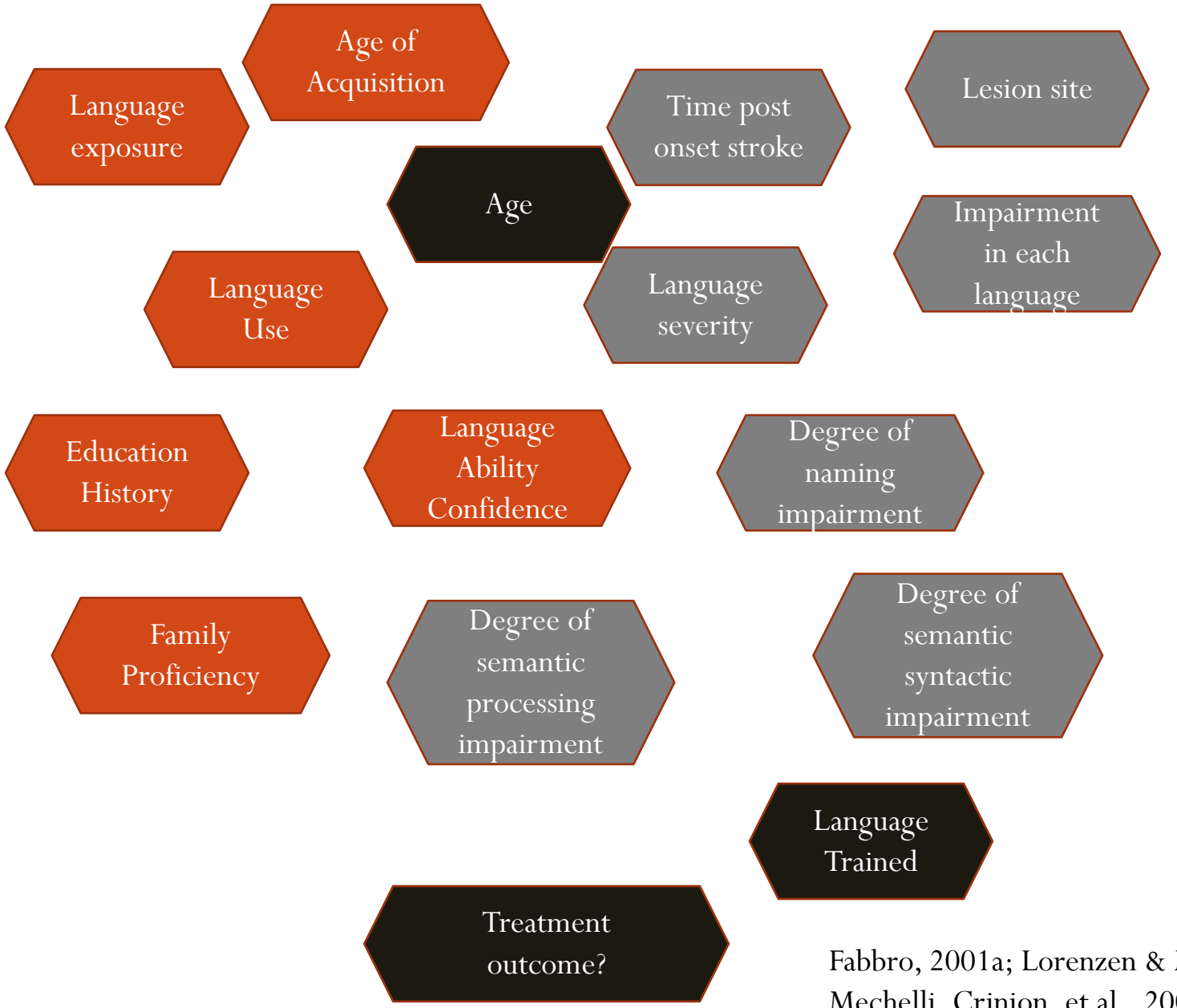


Kiran et al., AJSLP, 2013

- What is the ultimate goal?

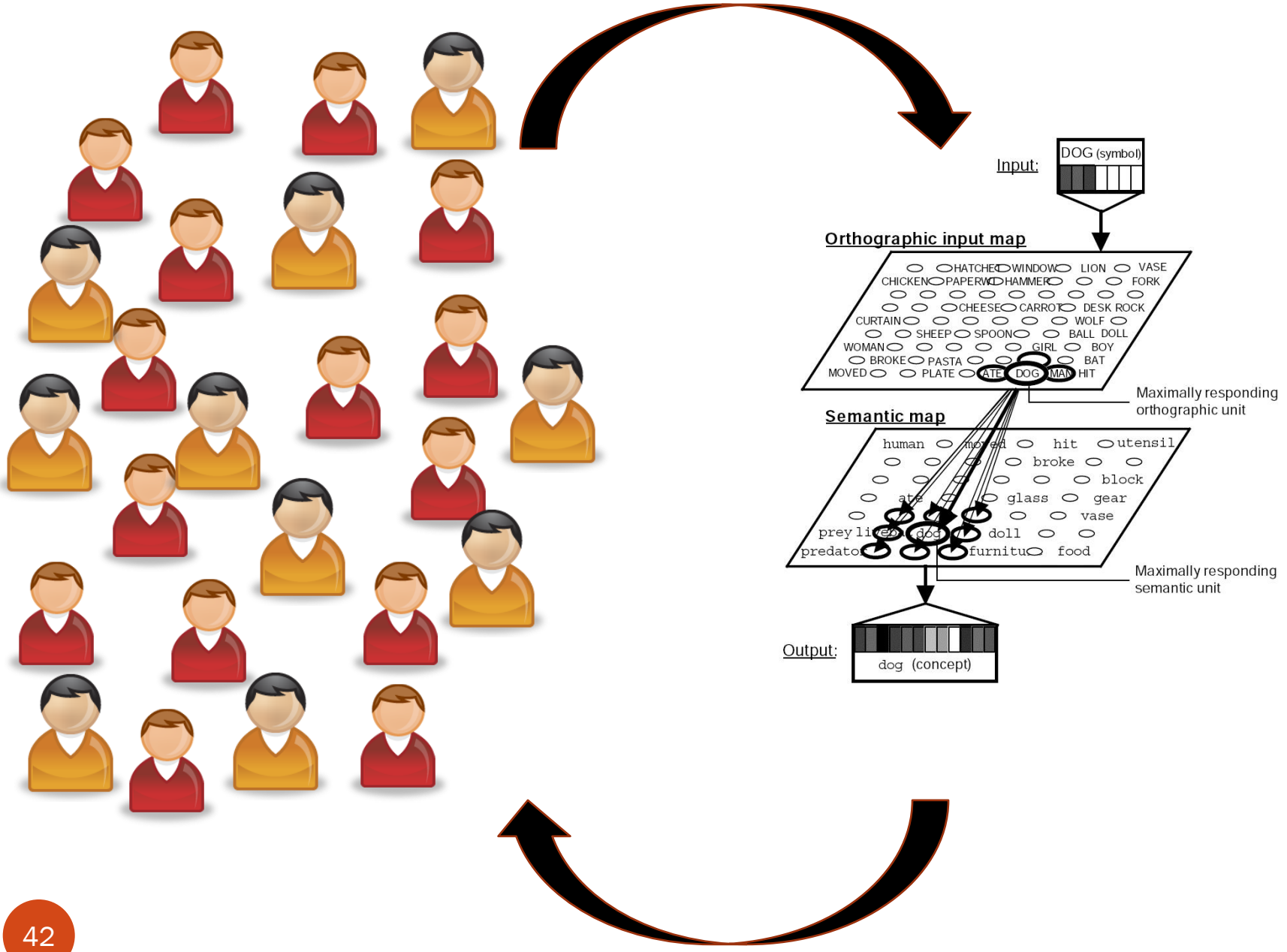
- Predict treatment outcomes, between-language generalization after rehabilitation in individuals with naming deficits

- Simulation of language deficits (Keidel et al., 2010), modeling rehabilitation of alexia (Welbourne & Lambon-Ralph, 2005, 2007), naming deficits (Plaut, 1996)



Fabbro, 2001a; Lorenzen & Murray, 2009; Mechelli, Crinion, et al., 2004

Hernandez & Li, 2007;
Li, Zhao, & McWhinney, 2007; Abutalebi, 2008


Input:
DOG (symbol)
Orthographic input map
HATCHET WINDOW LION VASE
CHICKEN PAPERWT HAMMER FORK
CHEESE CARROT DESK ROCK
CURTAIN WOLF
SHEEP SPOON BALL DOLL
WOMAN GIRL BOY
BROKE PASTA BAT
MOVED PLATE ATE DOG MAN HIT
Maximally responding orthographic unit
Semantic map
human hit utensil
broke
block
glass gear
vase
doll
food
Maximally responding semantic unit
Output:
dog (concept)

Patient study

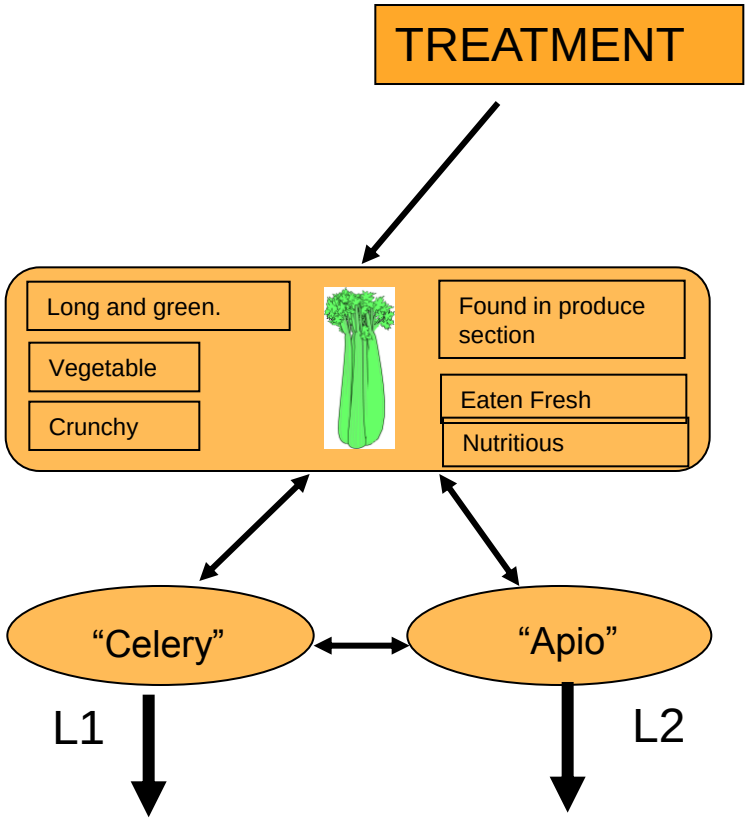
- 17 Spanish-English adults with aphasia
- Battery of standardized tests that examined receptive/expressive language in Spanish and English
- Language use questionnaire

- 10 weeks of naming therapy was administered.
  - 2x/week, 2 hours

Treatment protocol in behavioral study

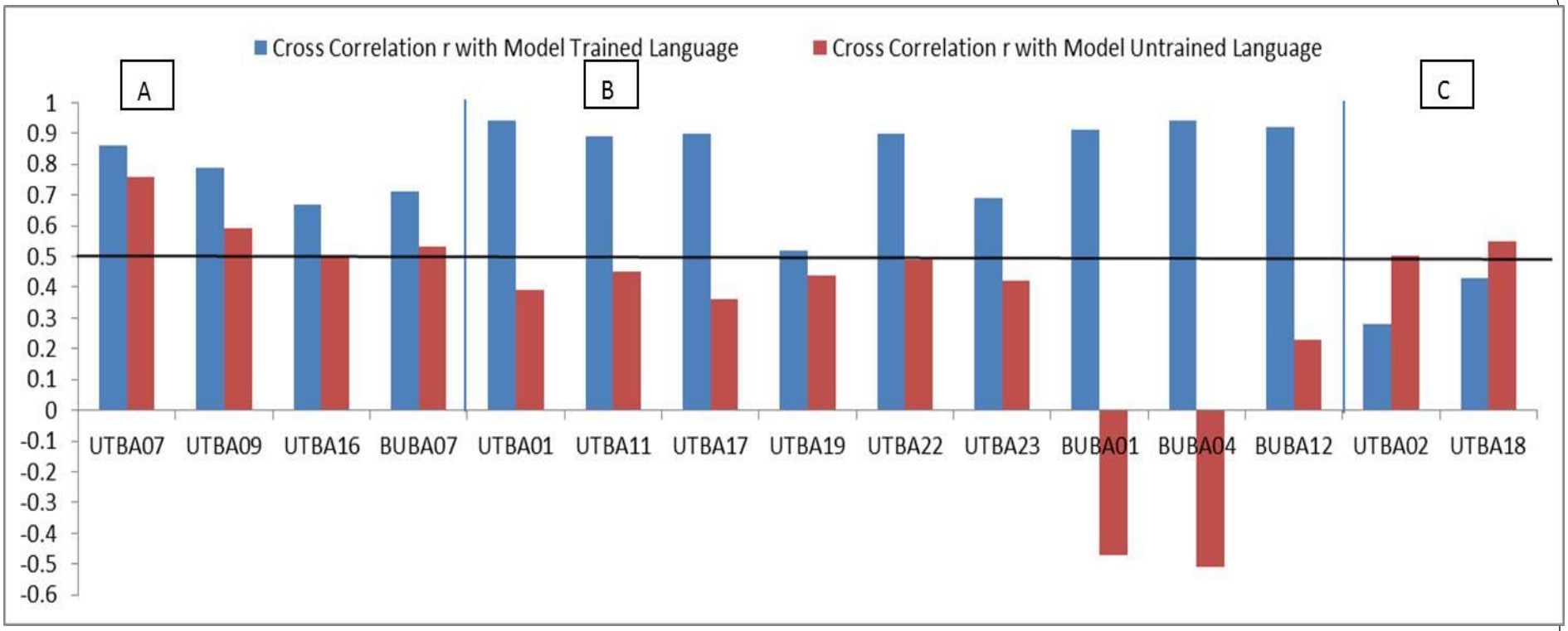
1. Name picture
2. If incorrect, told correct name
3. Choose 6 correct features from 12 cards
4. Answer 15 yes/no questions about the item
5. Named item again with feedback

- Treatment always provided only in one language (either English/Spanish) and amount of improvement examined:
  - Within language: trained items & semantically related words,
  - Between Language: direct translations and semantic relations



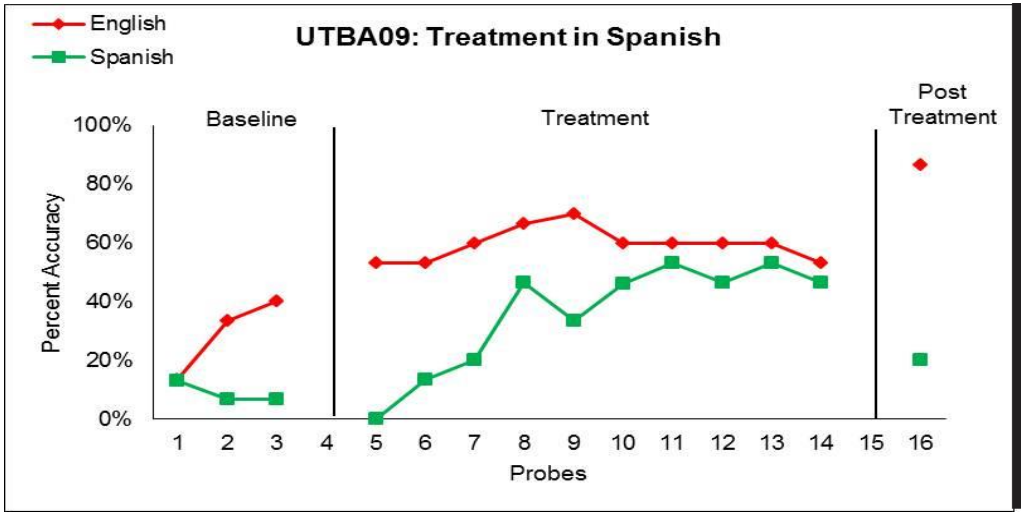
Edmonds & Kiran, 2006; Kiran & Roberts, 2009

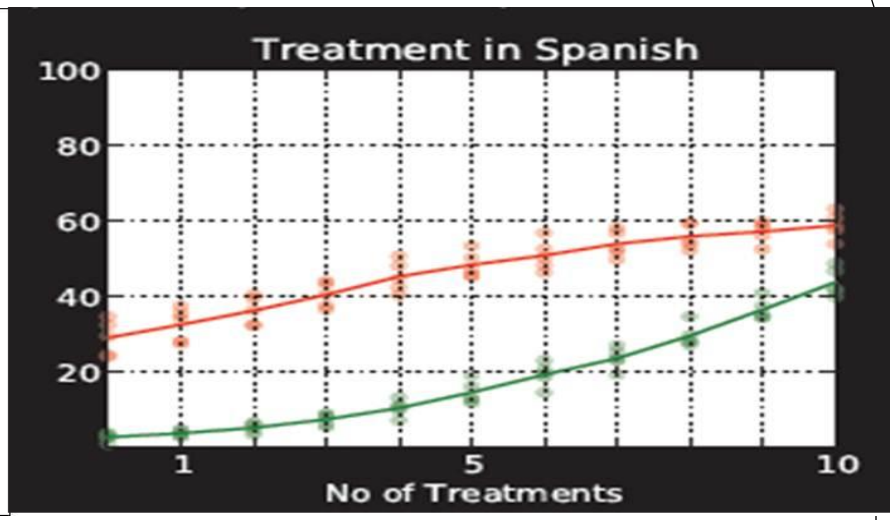
Therapy video here

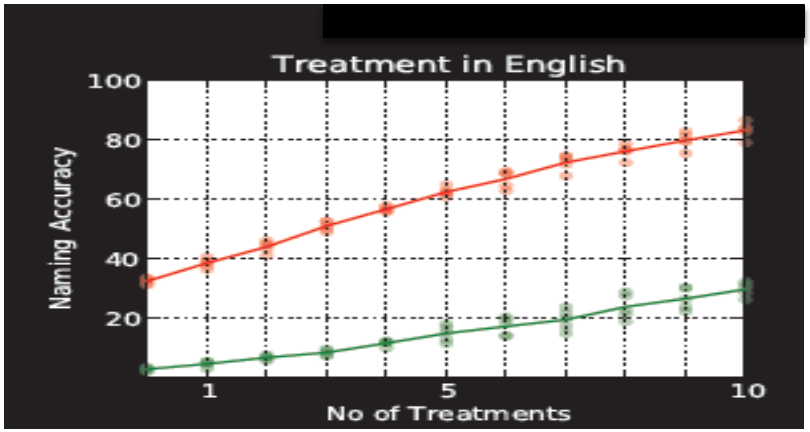


- Three distinct groups of participants emerged:
- Group 1 (A): model matched patient performance for both the trained and untrained language
- Group 2 (B): model matched patient performance for the trained language only
- Group 3 (C): model matched patient performance for untrained language better than the trained language.

Kiran et al., 2012, BLC

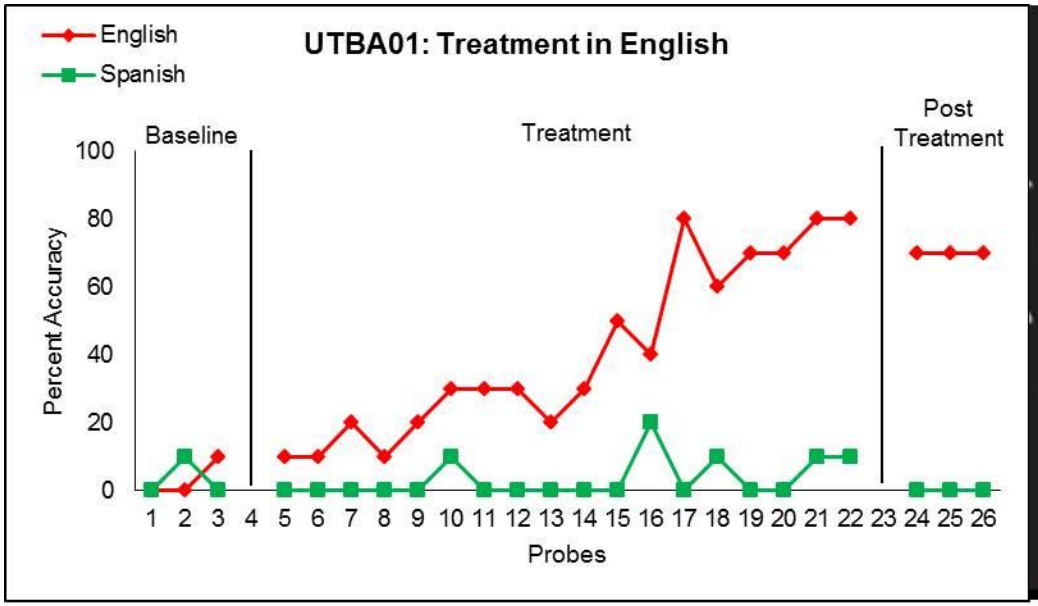


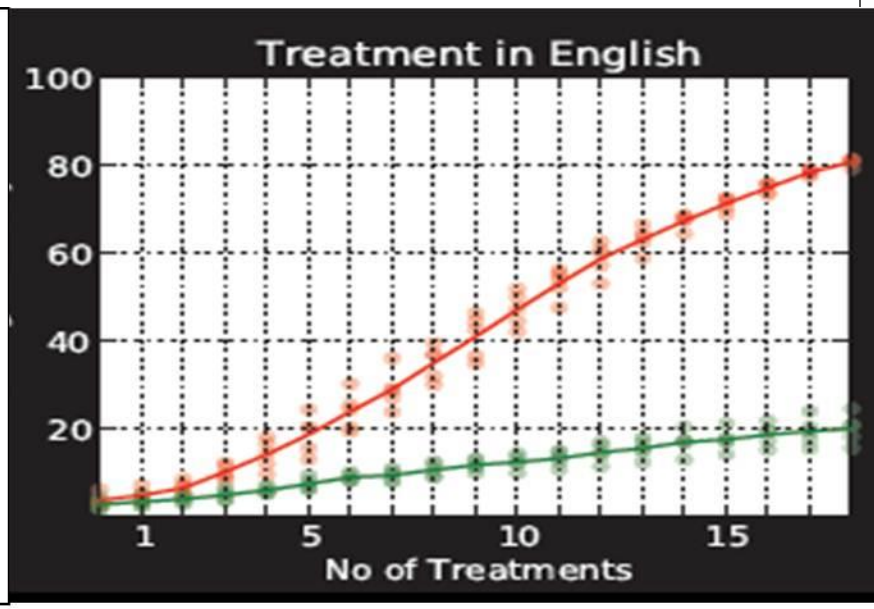




Group 1 (A): Model matched patient performance for both the trained and untrained language

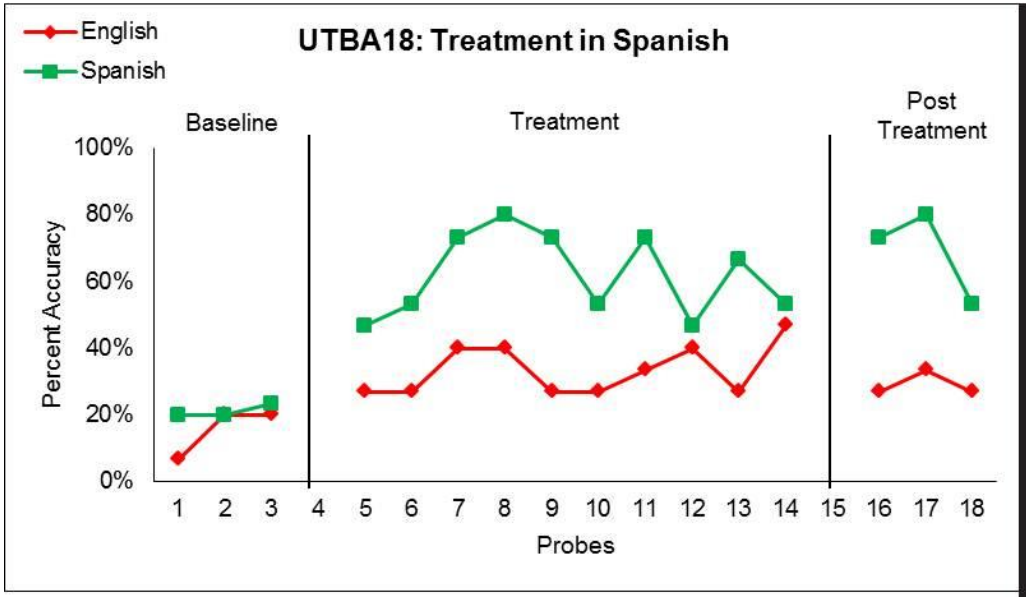
Kiran et al., 2012, BLC

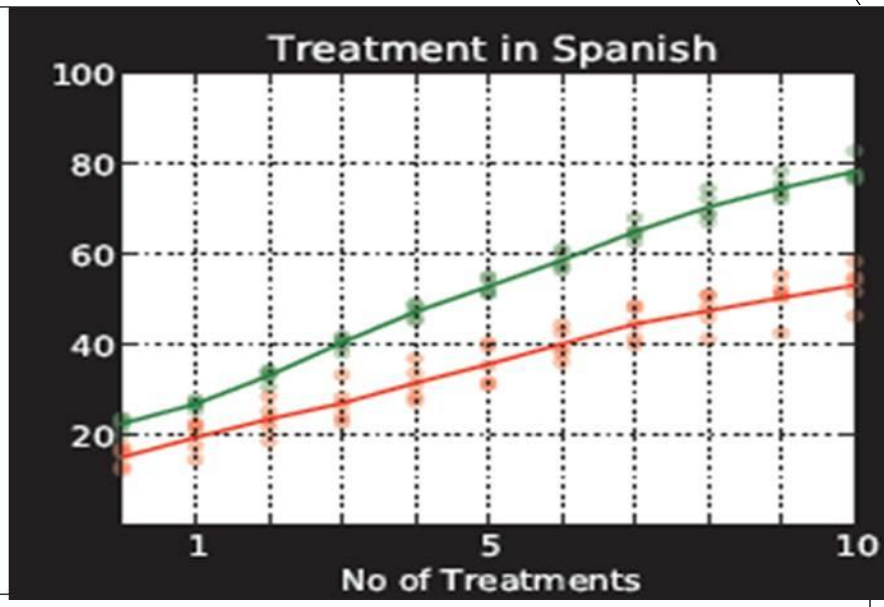




Group 2 (B): Model matched patient performance for the trained language only

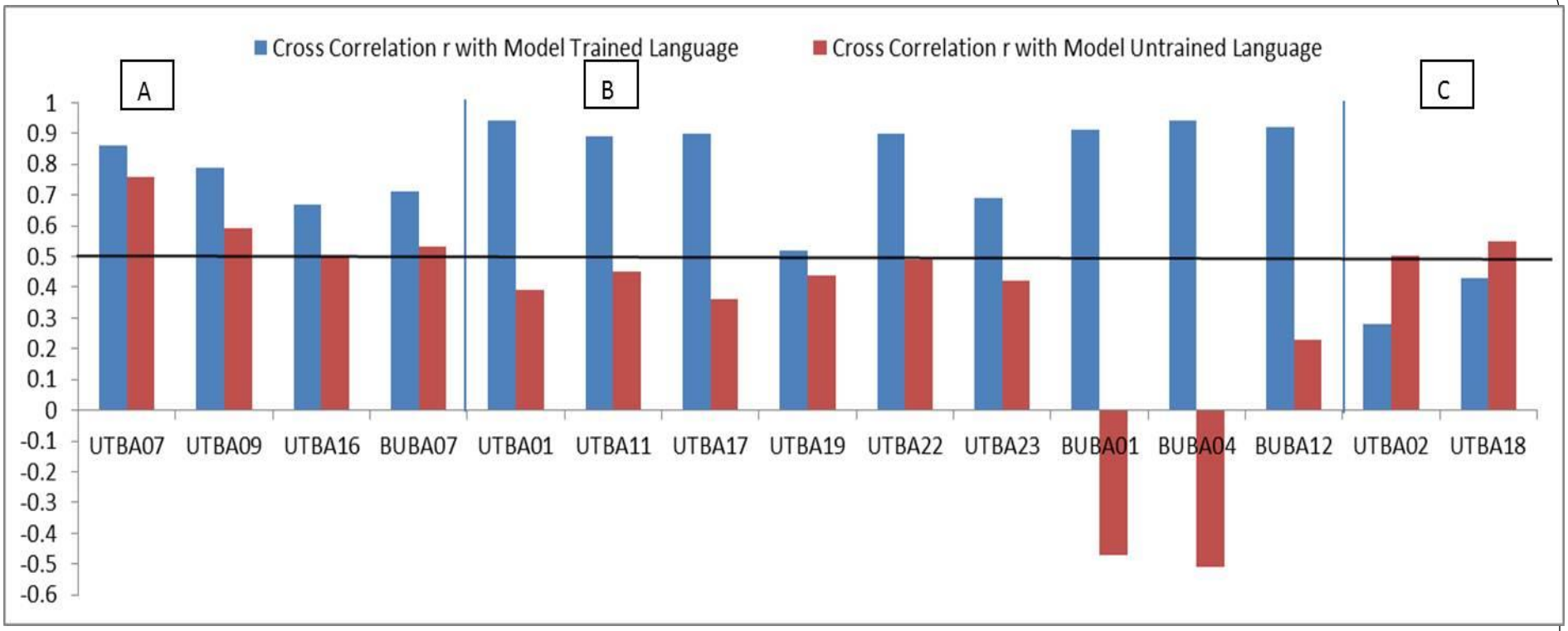
Kiran et al., 2012, BLC





Group 3 (C): model matched patient performance for untrained language better than the trained language.

Kiran et al., 2012, BLC



- Three distinct groups of participants emerged:
- Group 1 (A): model matched patient performance for both the trained and untrained language
- Group 2 (B): model matched patient performance for the trained language only
- Group 3 (C): model matched patient performance for untrained language better than the trained language.

Kiran et al., 2012, BLC

Conclusions

- Bilingual language processing is dynamic
- Both languages are active in parallel
- Language impairment in bilingual aphasia is influenced by pre-stroke language proficiency and language control may be affected.
- In terms of therapy:

1. Better understand the interaction between facilitation and interference across a range of patients
2. We need to better understand the interaction between language and cognitive control
3. Extend the computational model that accounts for facilitation and interference to predict treatment outcomes

Thank you!

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