SOM Thoughts on Bilingual Lexical Development

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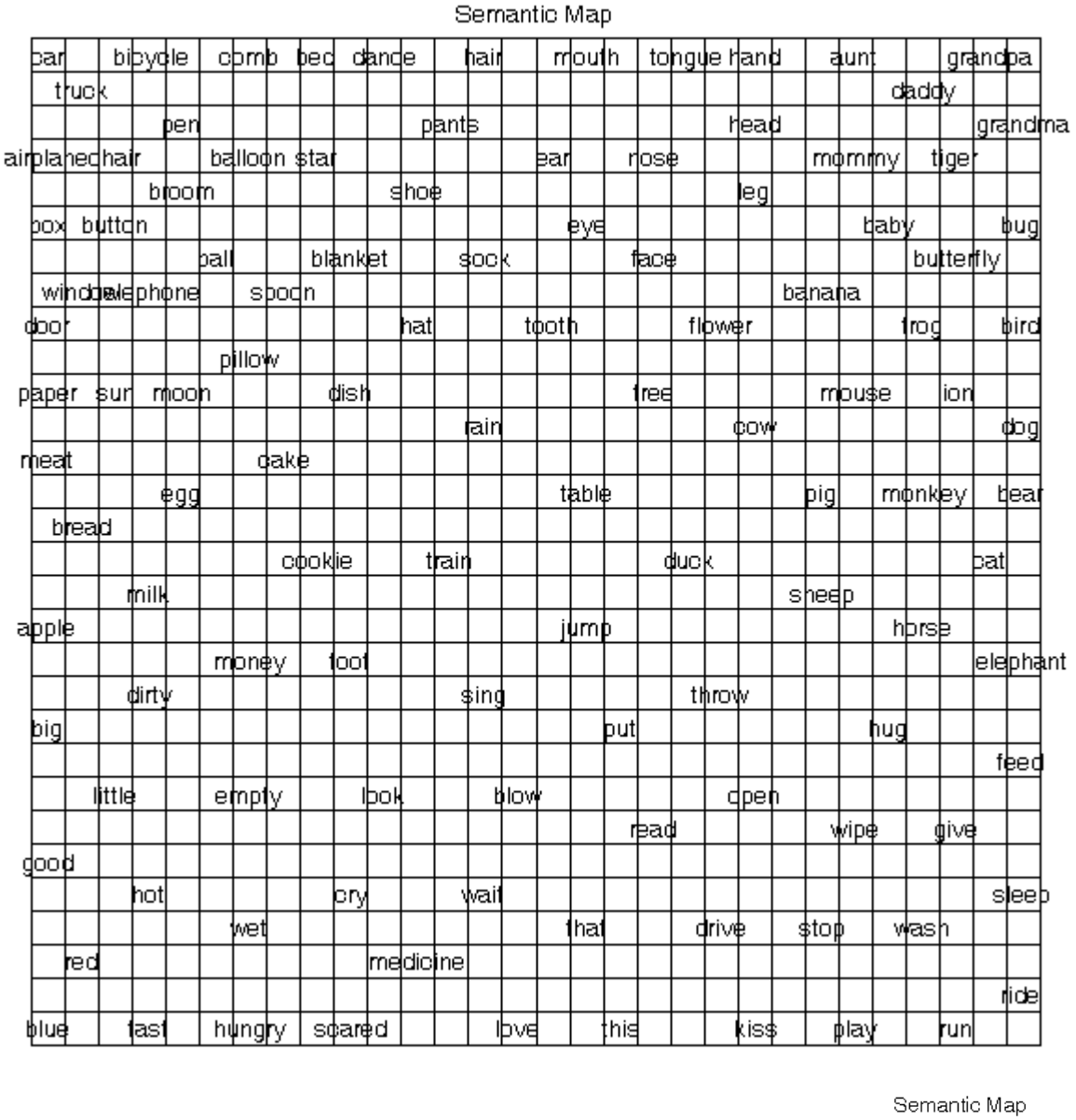
Brain, Language, and Computation Lab

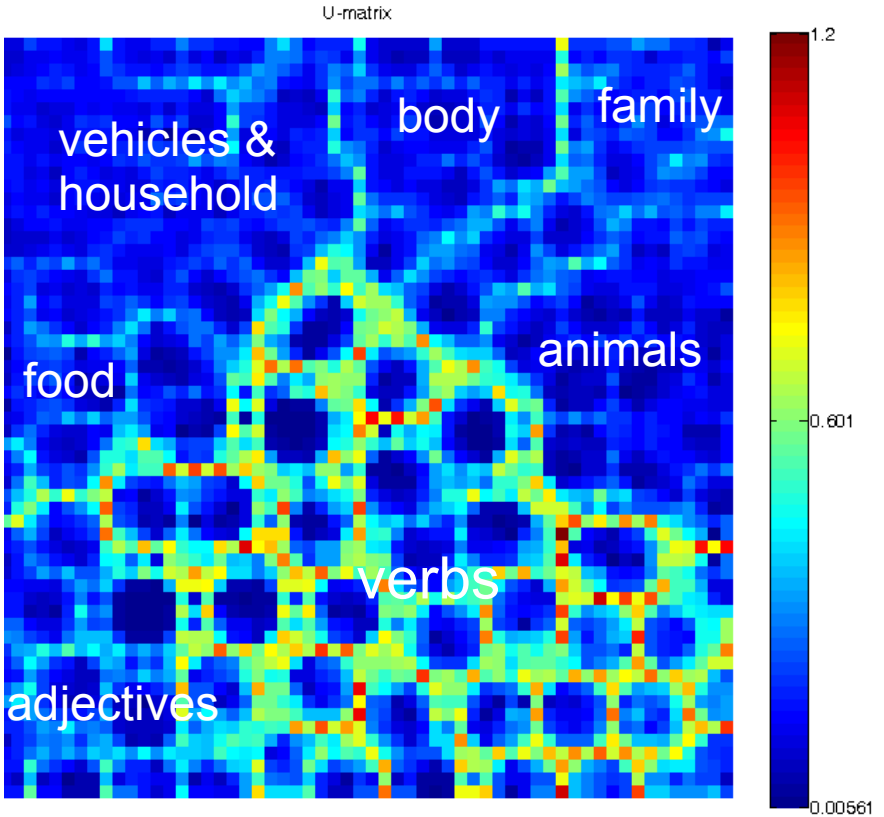
Cognitive and Neural correlates of language development, focusing on bilingualism:

- Behavioral Study
  - Picture Naming
  - L2 Acquisition Training
- Functional Neuroimaging
  - fMRI
  - fNIRS
- Computational Modeling 

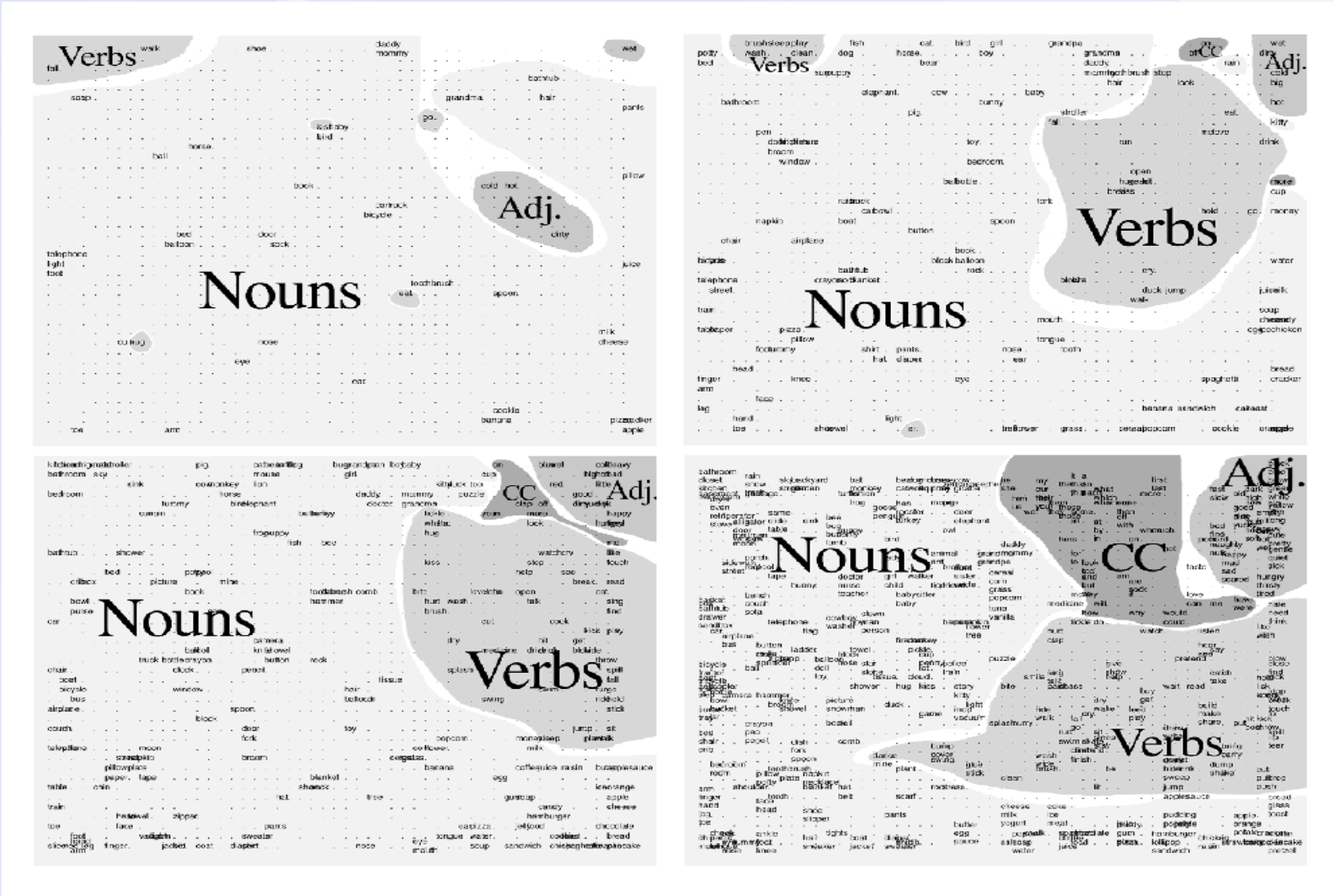
Self Organizing Feature Maps (SOM)



Semantic Map



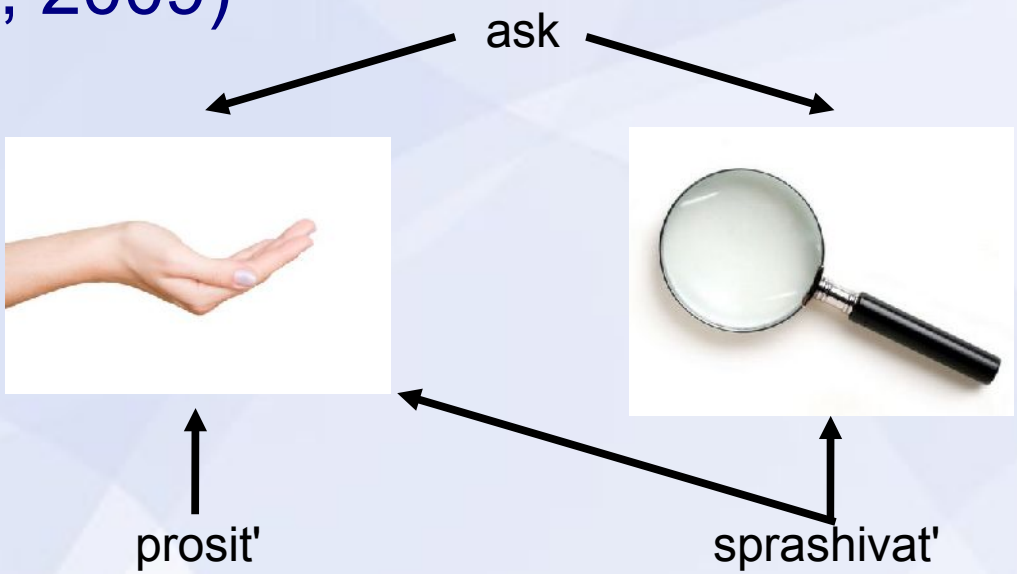
- SOM: DevLex & DevLex-II (Li, Zhao, & MacWhinney, 2007)



Monolingual lexical development

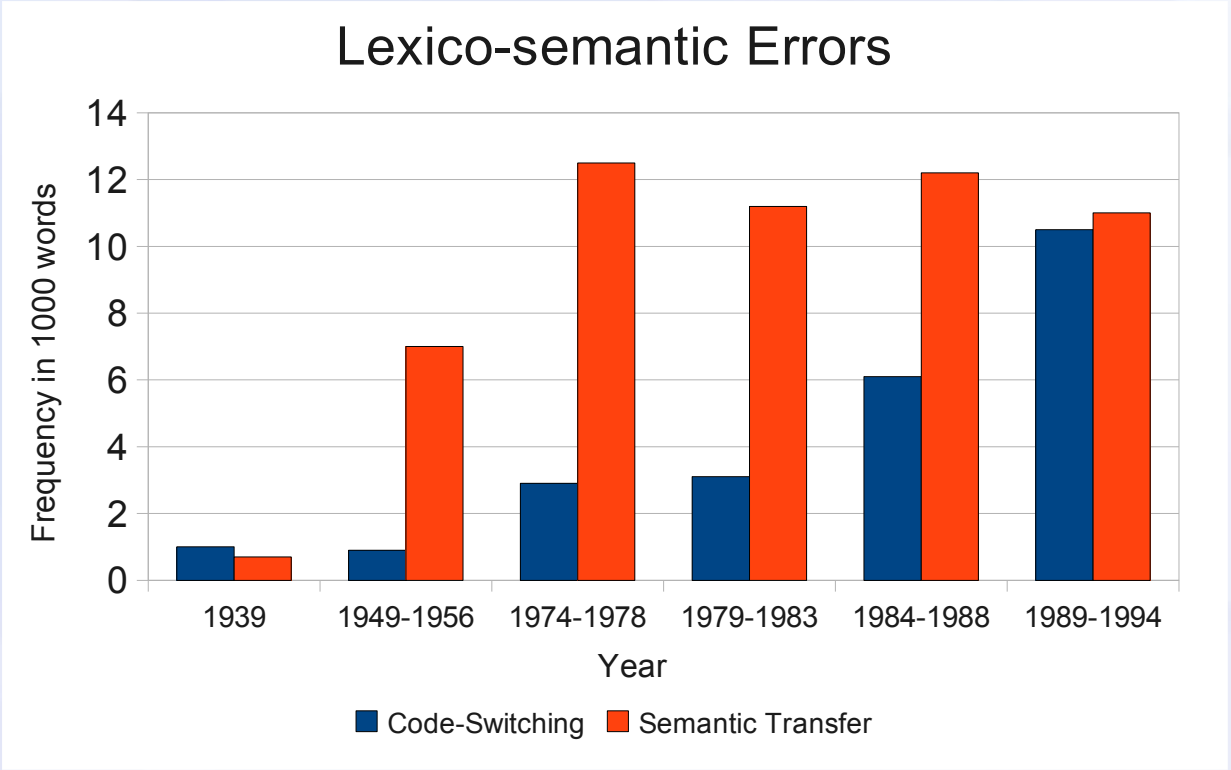
Observations in Lexical Attrition

- "*die* idea *der jungen Leute*" (Hutz, 2004)
- "*On chasto sprashivajet, chtoby ya gotovila.*" (Schmitt, 2009)



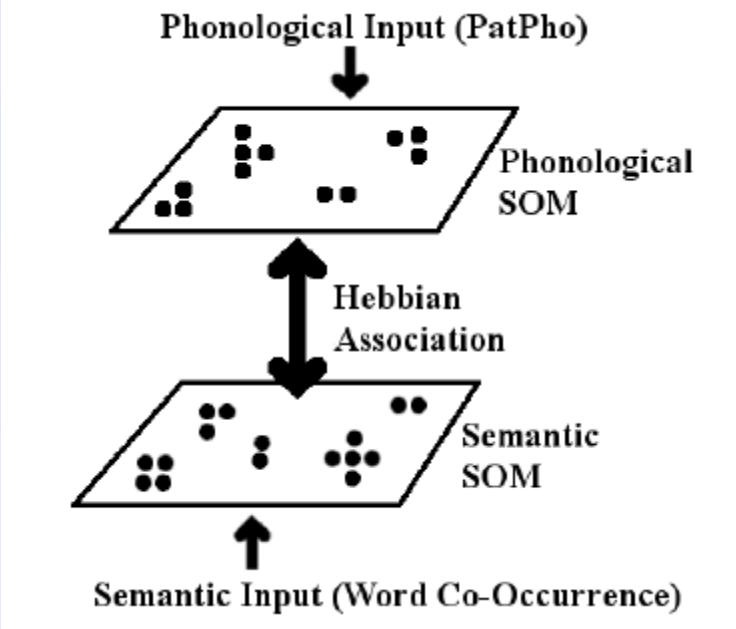
- "*Das ist feine mit mir.*" (Hutz, 2004) ("*Damit bin ich einverstanden.*")

Observations in Lexical Attrition



Hutz, 2004

The Model – Architecture & Parameters



- Phonological [40x40] & Semantic [30x30] SOMs
  - Gaussian neighborhoods
  - Dynamically decreasing radius (15 to 1)
  - Alpha 0.2 (constant)
- Two sets of saturating Hebbian connections
  - Every P-node to every S-node and vice versa (2.88 million)
  - Beta 0.1 (constant)
  - Saturation at 100 (constant)

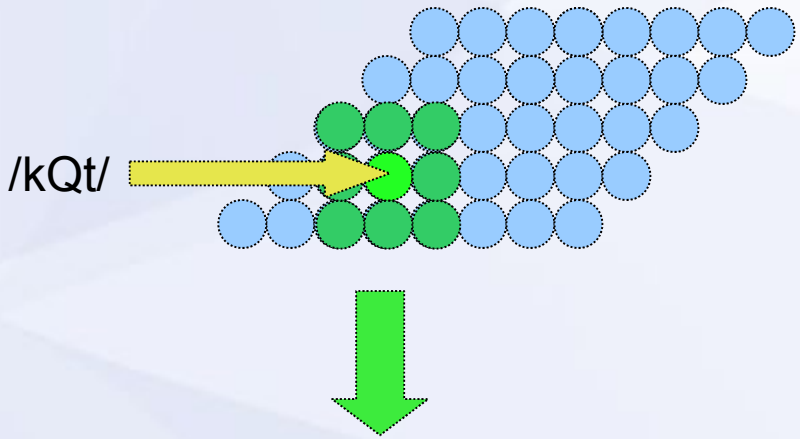
The Model – Training

- Stimuli – 116 English & Chinese translation equivalents
  - 63-dimensional phonological vector (PatPho)
  - 200-dimensional semantic vector (CTM)

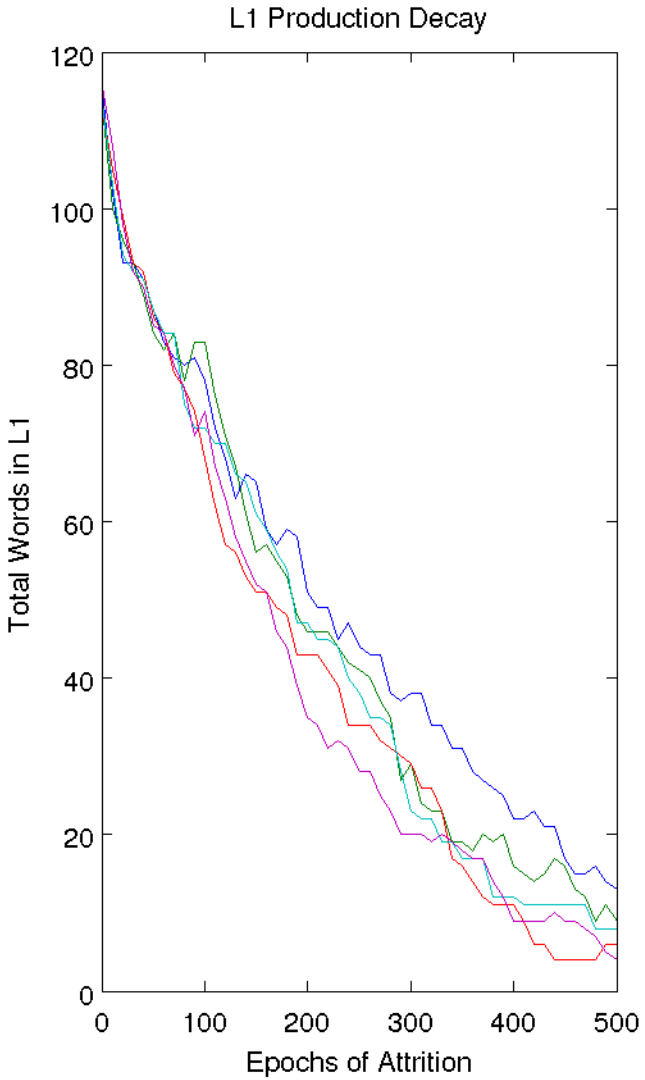
- Age of Onset (AoO) conditions: 50, 150, 250, 350
- 500 epochs of attrition for all models

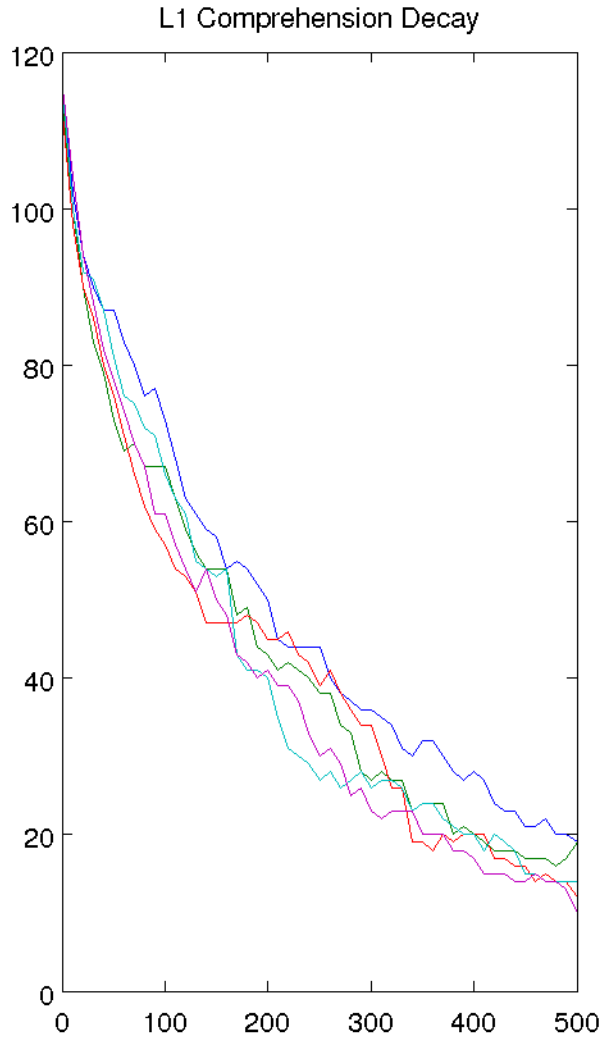
The Model – Testing

- 1st map activated with a stimulus
- Activation propagated via Hebbian connections
- Activation measured on 2nd map
- Comprehension: P-Map → S-Map
- Production: S-Map → P-Map



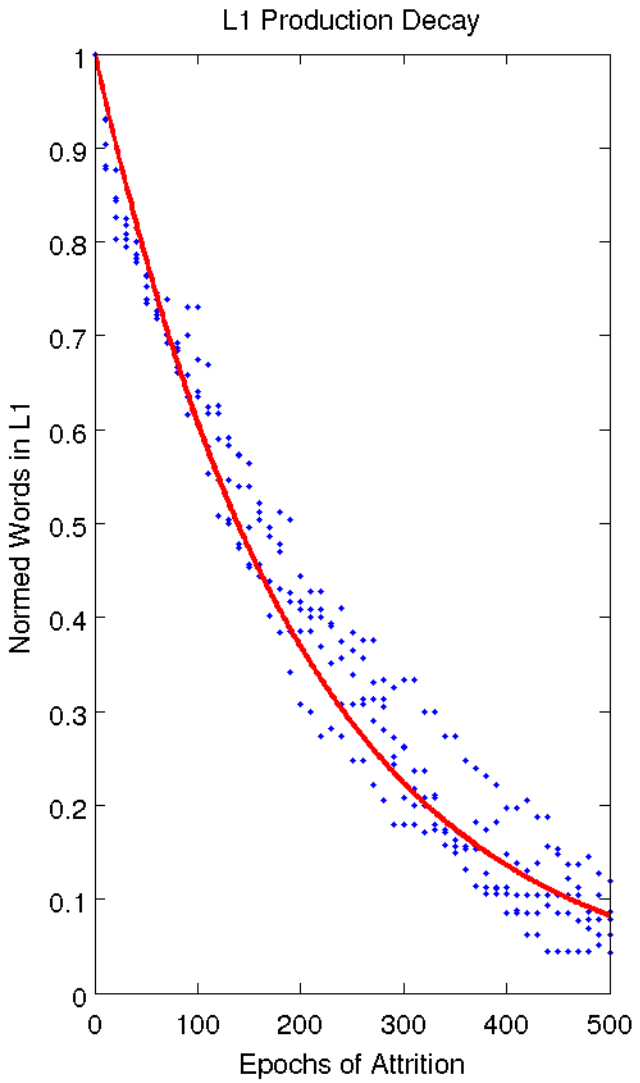
The Model – Results

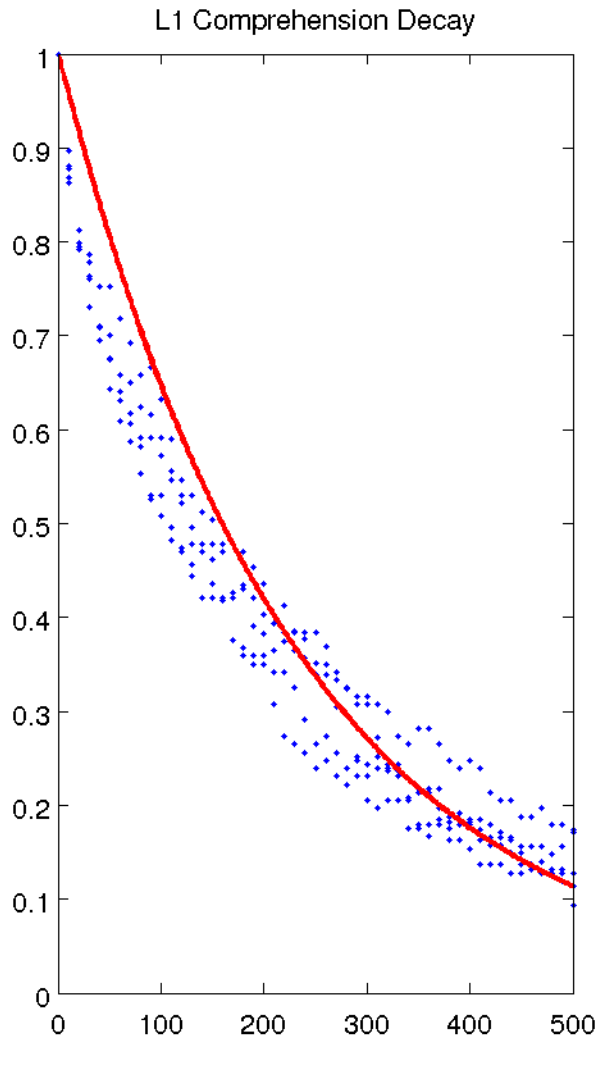




AoO 350

The Model – Results

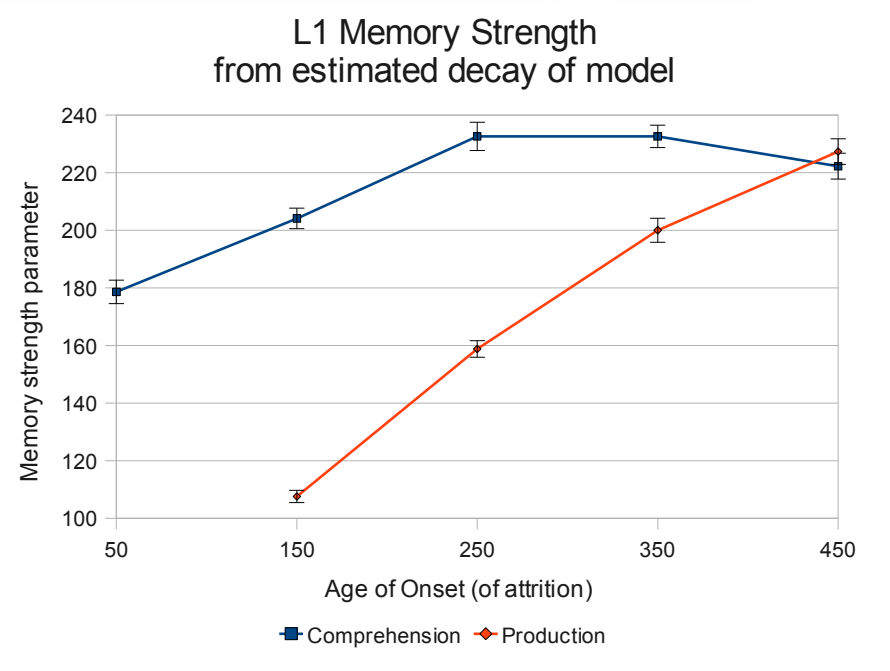




AoO 350

The Model – Results

	Production		Comprehension	
AoO	R	p	R	p
50	-0.59	<0.001	-0.95	<0.001
150	-0.95	<0.001	-0.98	<0.001
250	-0.96	<0.001	-0.95	<0.001
350	-0.96	<0.001	-0.97	<0.001
450	-0.95	<0.001	-0.96	<0.001



Discussion

- Dissociated comprehension and production performance
- L1 lexical decay is plausible & orderly
- Domain-general exponential decay may describe change in lexical performance
- Acquisition-like (see Johnson & Newport, 1989) AoA effects in L1 attrition

Opportunities for Collaboration

- Behavioral Validation
  - Identifying and studying bilinguals undergoing L1 change
  - Longitudinal corpora needed for developmental accounts
- Model Elaboration
  - More complex language behaviors than naming (e.g., syntax and morphology)
  - Rich contextual learning and testing

Thanks

The Center for Language Science