



Memory effects in acquisition: Age Effects via cognitive development

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Background

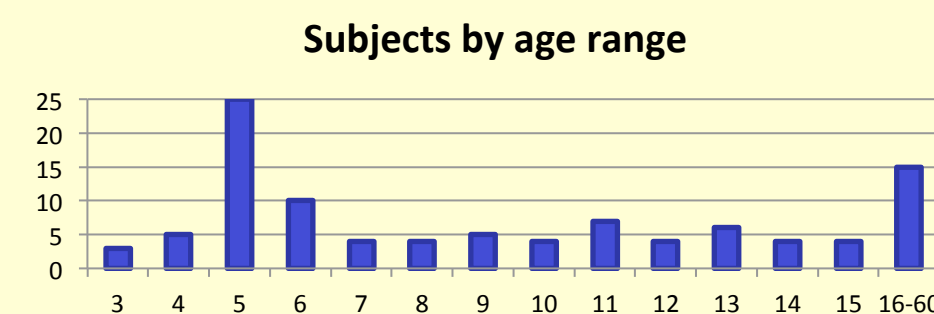
- Higher ultimate attainment in children (cf. Herschensohn 2007; inter alia).
- Similar age effects in second dialect acquisition (cf. Siegel 2010).
- Despite this, adults tend to outperform children and learn faster in linguistic experiments (cf. Krashen, Long & Scarcella 1979; inter alia), meaning that research on age effects is rarely real-time observation.
- Ullman's (2001, 2004) DP model suggests age effects are due to changes in two memory, and potentially competition between systems:
 - Declarative memory: responsible for remembering facts and events, learning new lexical items. Increases with age; dominant in adults.
 - Procedural memory: responsible for systematic routine behavior, including grammar. Most accessible for and dominant in children.
- The DP model is presented by Ullman as a dichotomy, and it has not yet been tested over a range of ages.

Research questions

- Can young participants have an advantage in a cross-sectional study?
- How does memory relate to age effects in language acquisition?

Participants

- 100 Spanish speakers in Ecuador, including children ages 3-15 and adults:

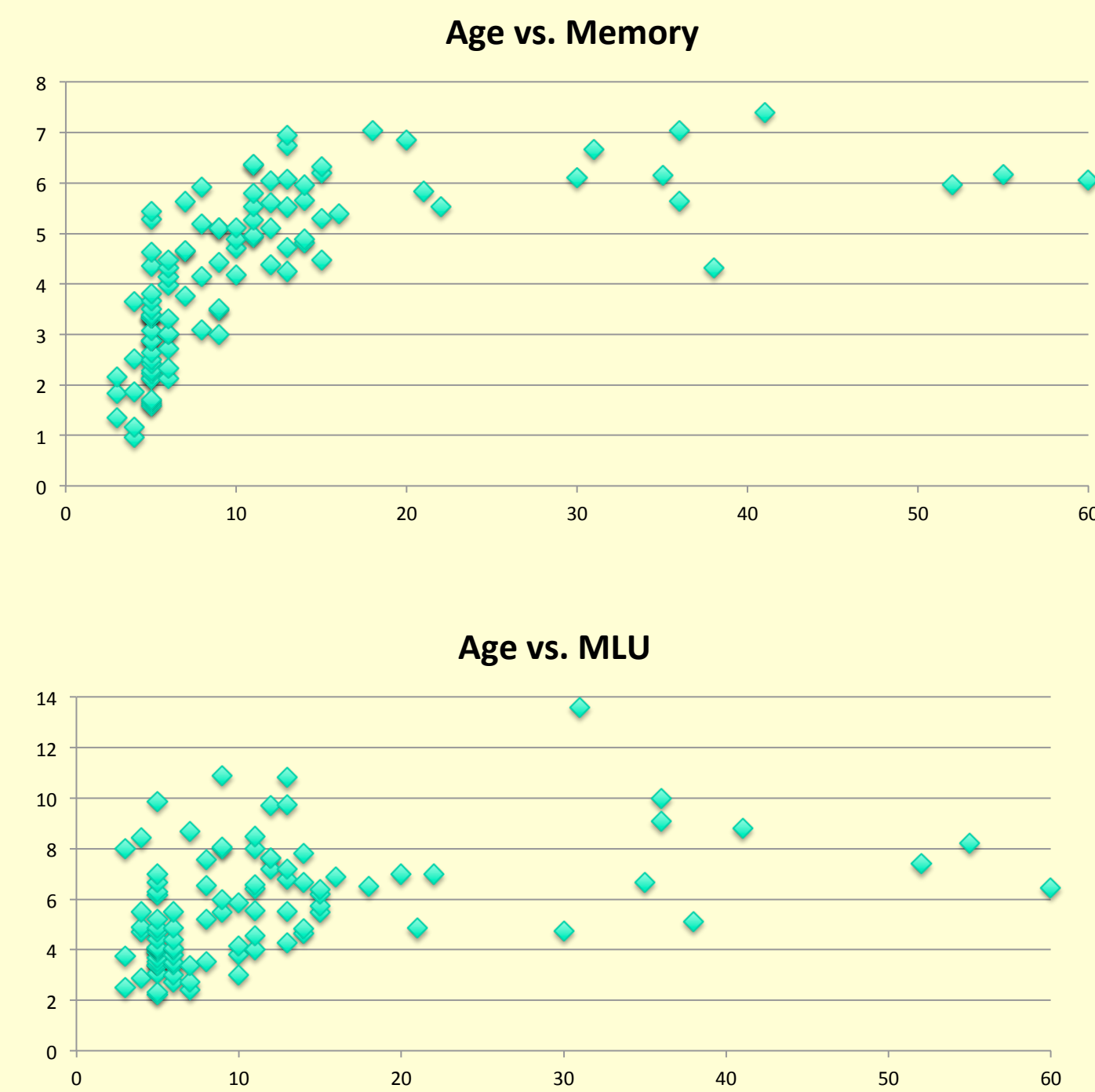


Methods

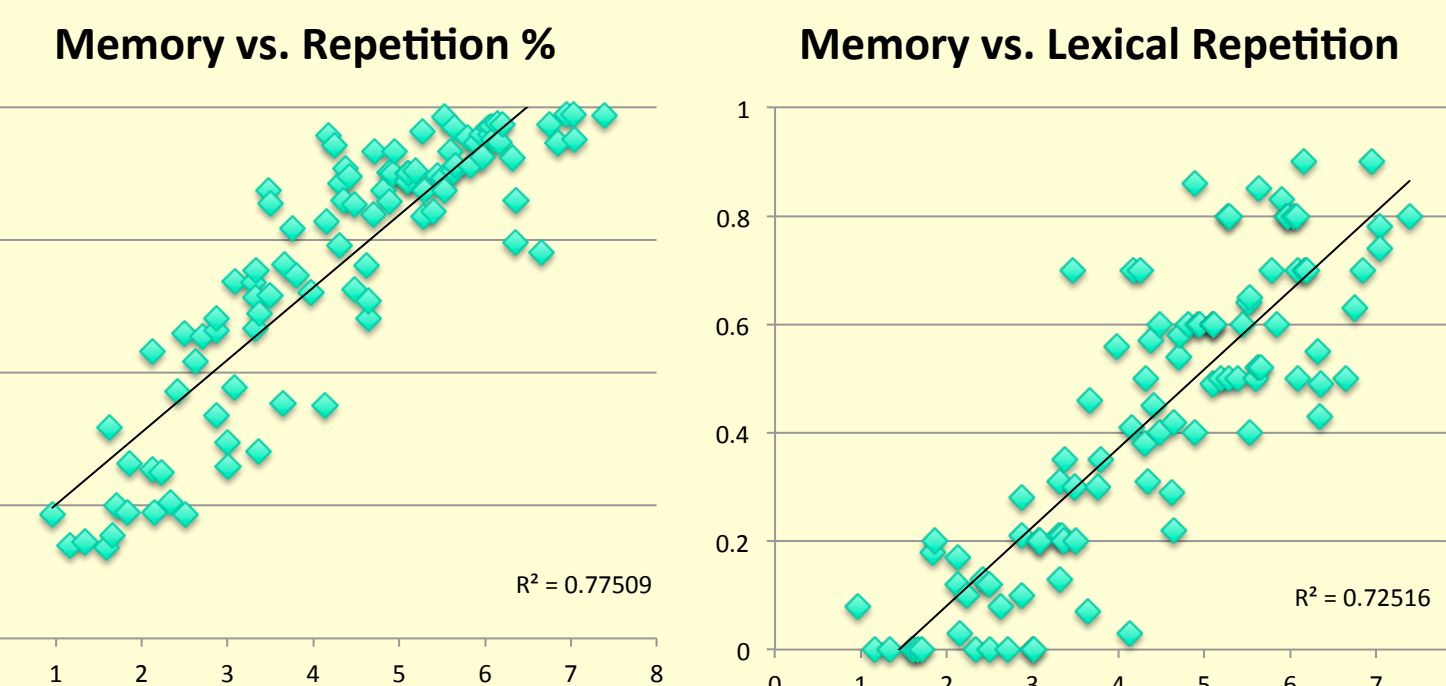
- 30-45 minute experiment, including:
 - Background interview, language sample (for MLU, speech rate)
 - Memory tasks (digit span repetition, Swahili syllable repetition)
- **Artificial Spanish Dialect repetition**
Listen to and repeat short stories presented in an artificial dialect of Spanish made by making 10 systematic grammatical manipulations (below) and adding 10 novel lexical items:

#	Domain	Description	Example	Source
1	Phonetics	Palatalization of [h~x] to [ç] [j~ʎ] to [j].	<i>alli</i> [aʎi] 'there' <i>girafa</i> [çirafa] 'giraffe'	Argentinian Sp & Br. Portuguese
2	Phonetics	Diphthongs [ie, ue] → [e, o].	<i>fuerte</i> [forte] strong <i>miedo</i> [medo] fear	Latin, other Romance lgs.
3	Phonology (prosody)	Rising F0 for emphasis.	<i>Es solamente un es>PEjo.</i> 'It's only a >MIRROR.'	(For example, English surprise.)
4	Phonology	Final /o/ raises to [u]	<i>miro</i> [miru] 'I see'	Br. Portuguese
5	Phonology	Dental fricative from Spain	<i>cinco</i> [θinco] 'five'	Peninsular Span.
6	Morphology	Adverbial suffix <i>-mente</i> truncated to <i>-mén</i> .	<i>solamente</i> → <i>solamén</i> 'only'	From Catalan & Old French
7	Morphology	Irregular verbs regularized based on normal patterns.	<i>Dijo</i> → <i>deció</i> 'said' <i>soy</i> → <i>so</i> 'am'	(For example, in creolization.)
8	Morphology	Regularized masculine singular articles.	<i>un</i> → <i>uno</i> 'a(n)' <i>el</i> → <i>lo</i> 'the'	Analogy to Portuguese
9	Syntax	All non-article noun modifiers are post-nominal.	<i>idioma este</i> 'language this'	Swahili, etc.
10	Syntax	A secondary verb goes at the end of a sentence.	<i>Podemos el río cruzar</i> 'We can the river cross'	German

Results

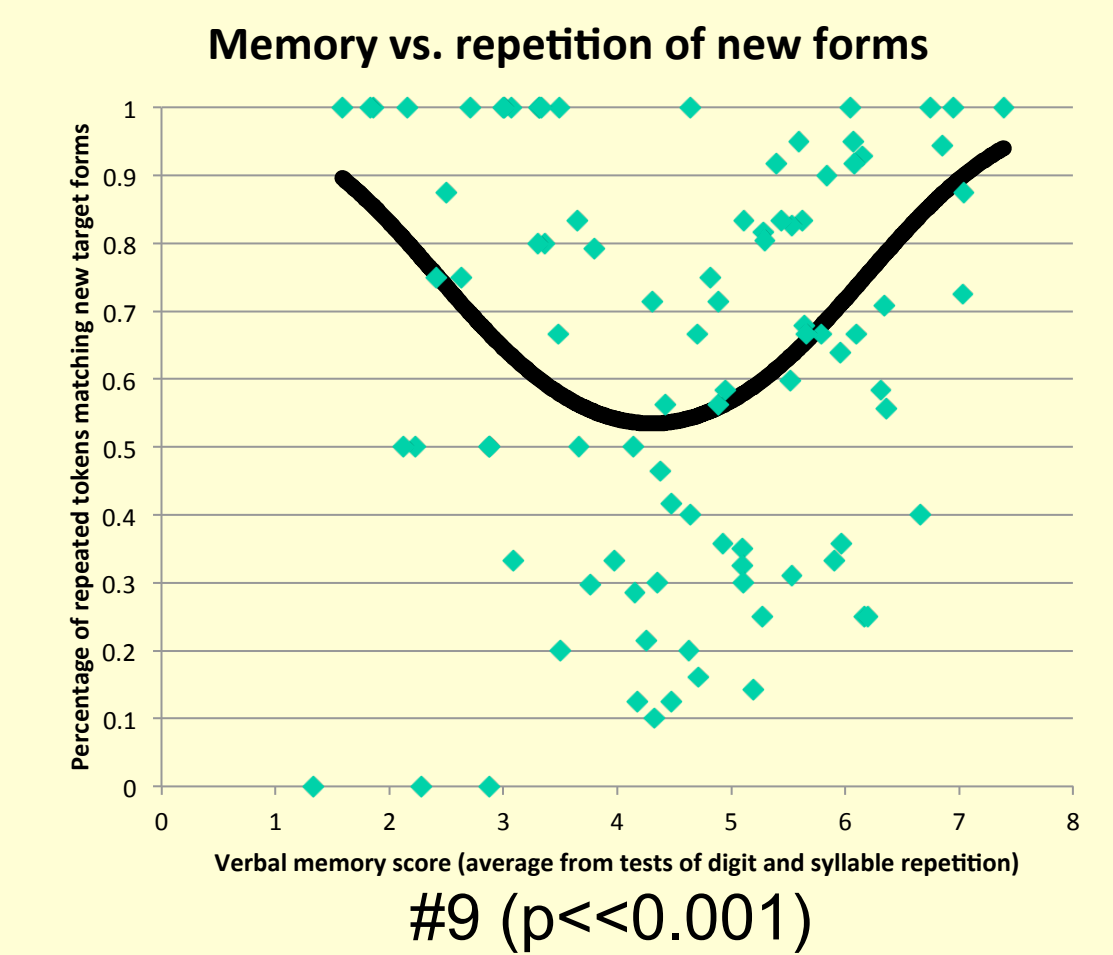
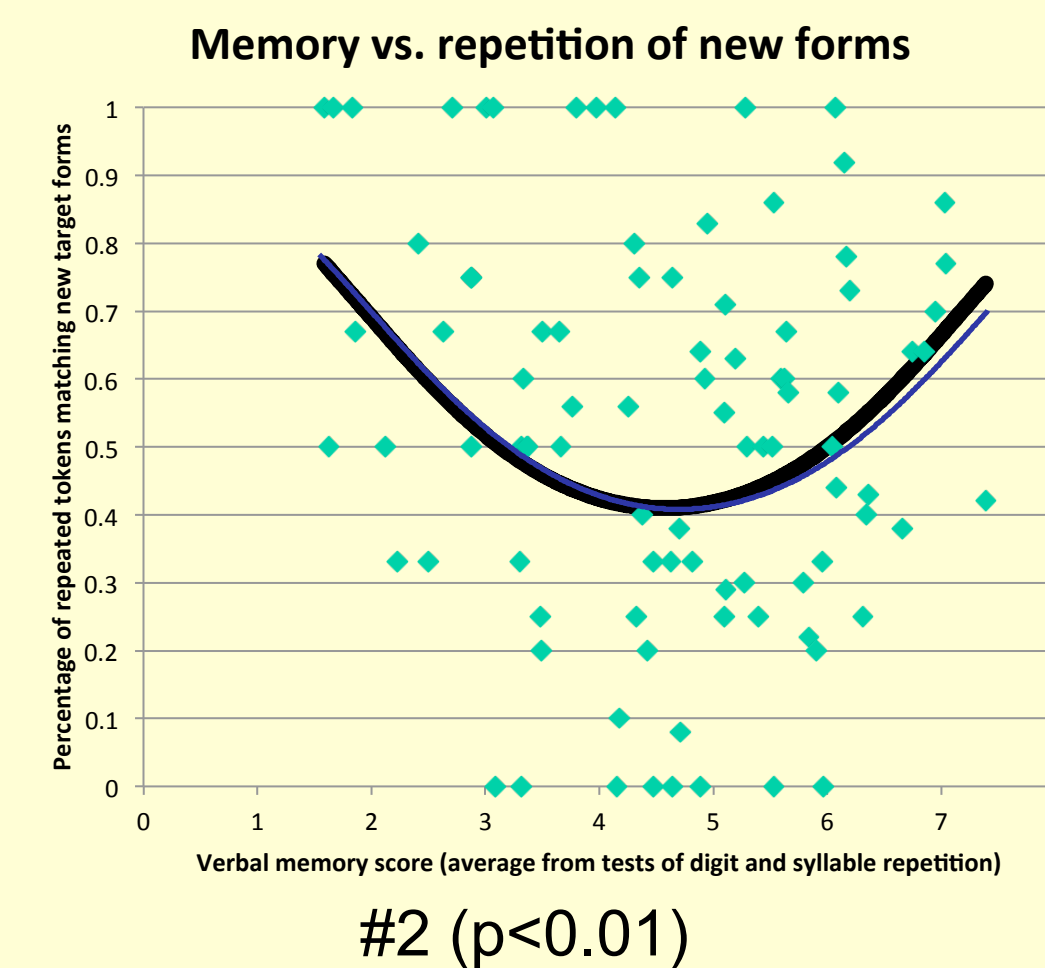


Memory was the best predictor of other results, used below, indirectly representing age.

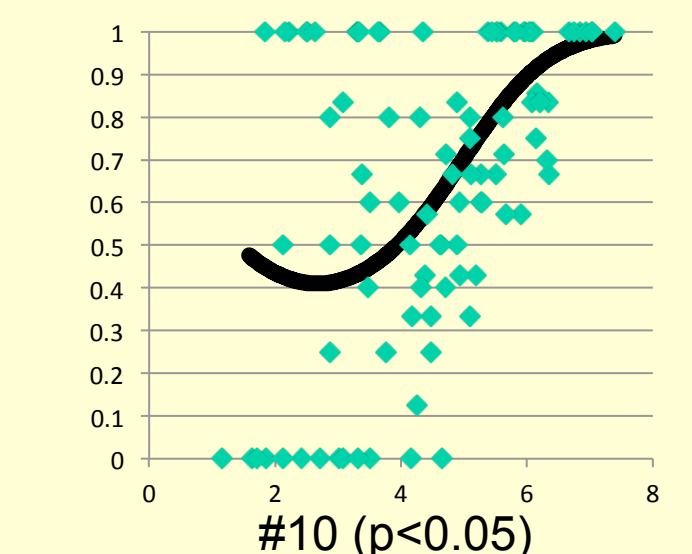
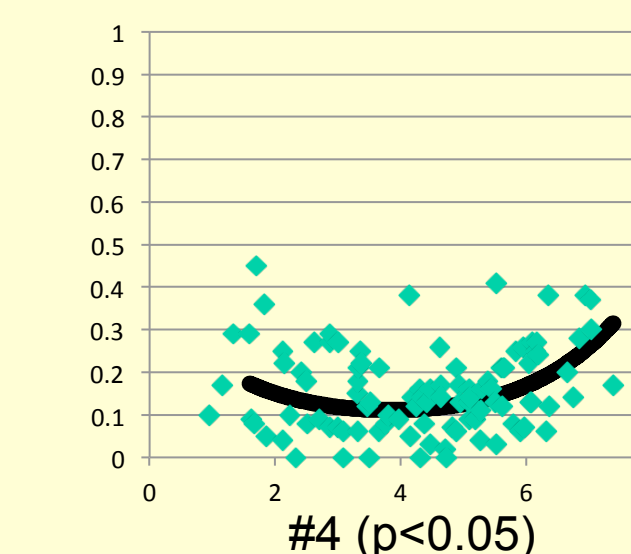


The primary measure was based on the number of instances for each manipulation that the form was copied from the artificial dialect compared to the total number of tokens repeated for that manipulation. Several results showed a non-linear correlation with memory scores:

Statistical method: mixed logistic regression with quadratic input ax^2+bx+c for memory.



Manipulations #4 and #10 were significant for a non-linear model but less extreme, not indicating a strong advantage for the lower range as in #2 and #9, but also suggesting that the benefit of memory in the higher range develops non-linearly.



Manipulations #1 and #8 were marginally non-linear; Manipulations #6 and #7 had linear correlations only.

Two manipulations were excluded from analysis: #3 did not show any significant correlations (about as difficult for all ages/memory levels, and widely dispersed, inconsistent results); #5 was too difficult for everyone, results at floor.

Results correlated strongly with memory scores (and marginally directly with age in some cases) but there were *no correlations* with Mean Length of Utterance (MLU) or fluency/speech rate measures.

Discussion

- In some of the manipulations, the U-shaped curve showed an advantage for young children, suggesting use of their strong procedural memory systems.
- All manipulations showed an advantage for adults, suggesting declarative memory strategies (rote repetition, metalinguistic analysis, conscious filtering, etc.).
- Those manipulations without U-shaped curves likely required more memorization and use of declarative memory.
- Age effects appear to be at least partially due to changes in memory systems: strong procedural memory in children is not available for adults who rely on declarative memory, which does not lead to high ultimate attainment.
- Performance on linguistic tasks can be explained indirectly by the effect of age on shifting dominance between memory systems. Ullman's DP model is supported by the data.
- The transition point (minimum) on the graph corresponds to approximately 10±2 years, around the proposed time of the end of the critical period.
- This methodology is useful for comparing the ability to learn across individuals.
- It is not the case that all experimental results necessarily show an advantage for higher age: we find an advantage that decreases with increasing age among younger children.
- No correspondences to MLU or speech rate were found; age effects are likely cognitive.

References

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Acknowledgements

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