A possible target for executive function intervention in older adults
Assessing mutual entailment of temporal relations

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# Aging

* Normal aging

  * decline in working memory and episodic memory performance (Hedden and Gabrieli 2004; Salthouse 2011; Schaie 1996)

* Considerable *inter-individual differences* in these trends, with only a small proportion of individuals declining on all measures concurrently.

Neural Complexity

* Brain is a complex system

  * interconnected

  * variation in spatial and temporal scales

* Complexity of neural activity

  * may provide important index of brain function
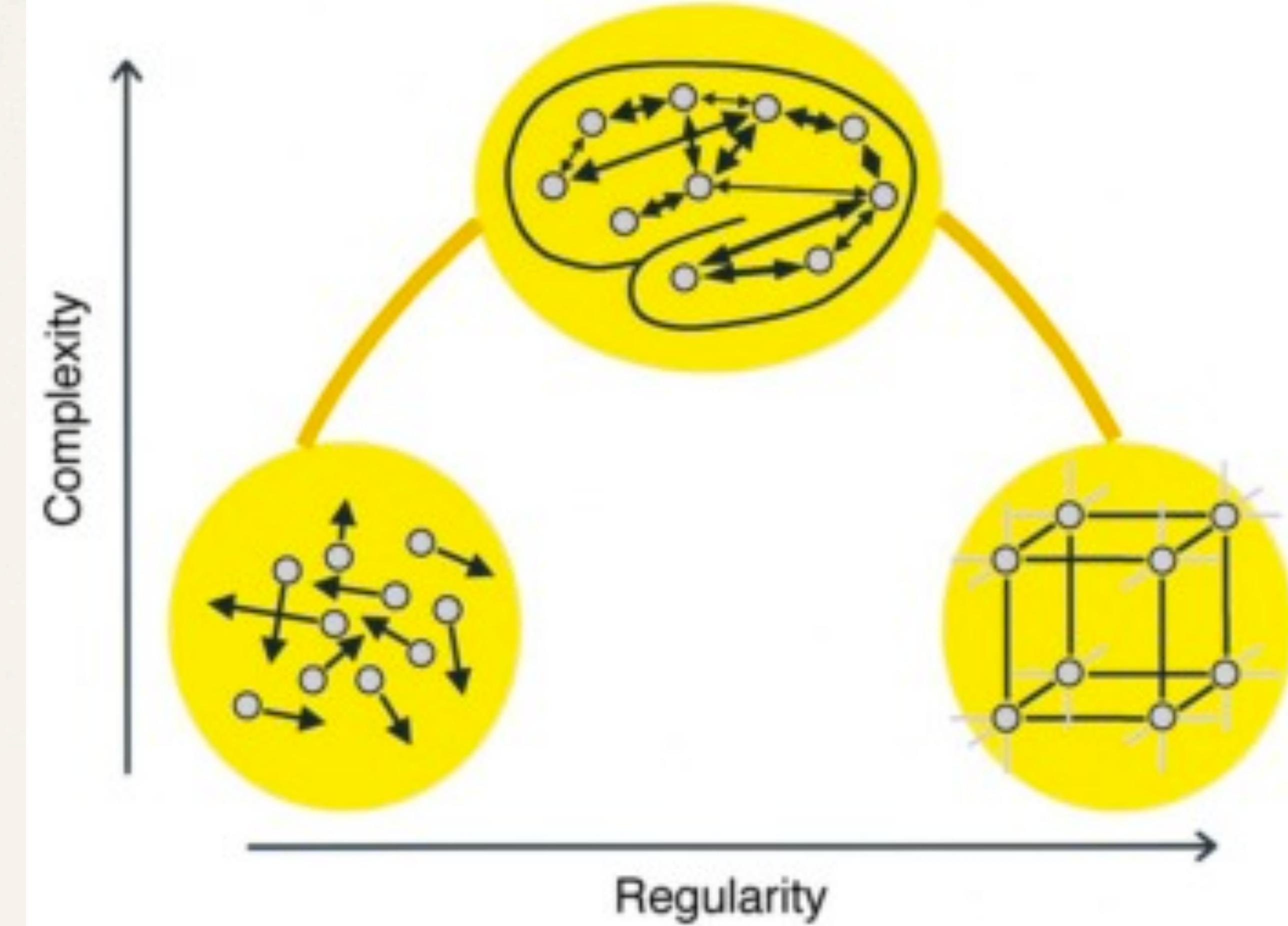
Complexity and coherency: integrating information in the brain

Giulio Tononi, Gerald M. Edelman and Olaf Sporns

Aging

* Neural noise hypothesis

* Age-related *increase* in neurological noise results in slower and less accurate performance in older adults (Crossman and Szafran 1956; Welford 1981).

* Age *reduces* complexity

* Age-related biological changes are expressed in decreased neurological and behavioral complexity (Goldberger 1996; and others)

Aging Brain

* O'Hora et al (2013) investigated the permutation entropy of eeg during encoding tasks

  * older adults showed less sensitivity to learn and ignore tasks

  * atypical profiles
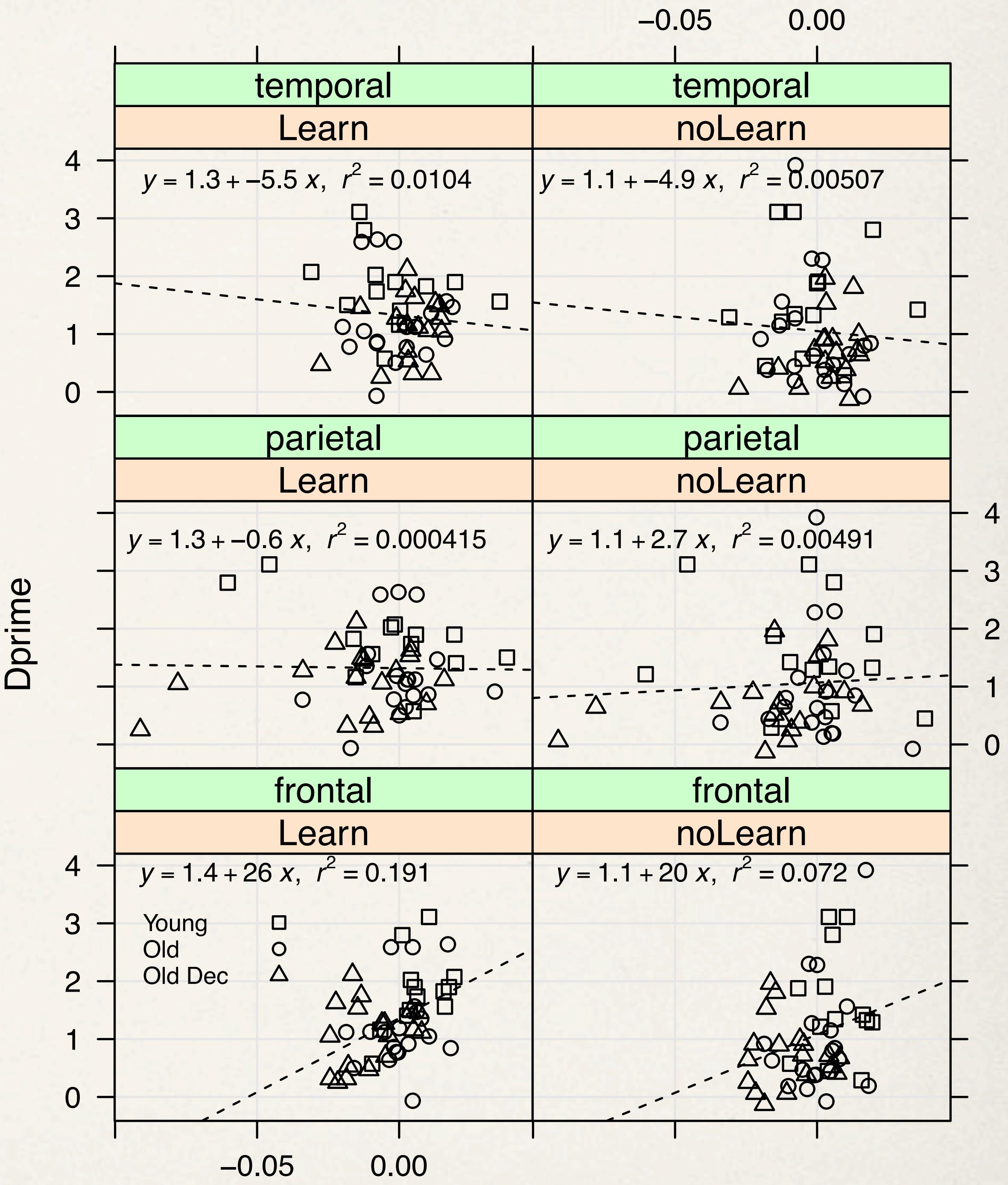
Mutual Entailment

❖ Mutual entailment is a feature of relational framing

❖ Important for relational flexibility, executive function

This is a **liathróid**

trained

Can you see a **liathroid**?

derived
mutually entailed

Temporal Relations

* Mutual entailment of temporal relations

  * always experienced in *before* direction

  * A *after* B is always mutually entailed

A   Time   B

"A *before* B"
"B *after* A"

Temporal Relations

* Acquisition of temporal relational framing correlates with verbal ability (O'Hora *et al* 05 and O'Hora *et al, 08)*

  * and general intelligence (& Barnes-Holmes,

* Reversing temporal relations take time (Hyland *et al,* 12, Hyland *et al,* 13)

A   Time   B

"A *before* B"
"B *after* A"

Method

* Participants

  * Older: 23 (10 males and 13 females)
  * 56 - 81 years ($M = 61$, $SD = 6.68$).
  * Younger: 23 (6 males and 17 females)
  * 18 - 23 years ($M = 19$, $SD = 1.23$)

  * 12 older and 2 younger adults did not pass the training phase
  * Mostly due to failure on *after* relations
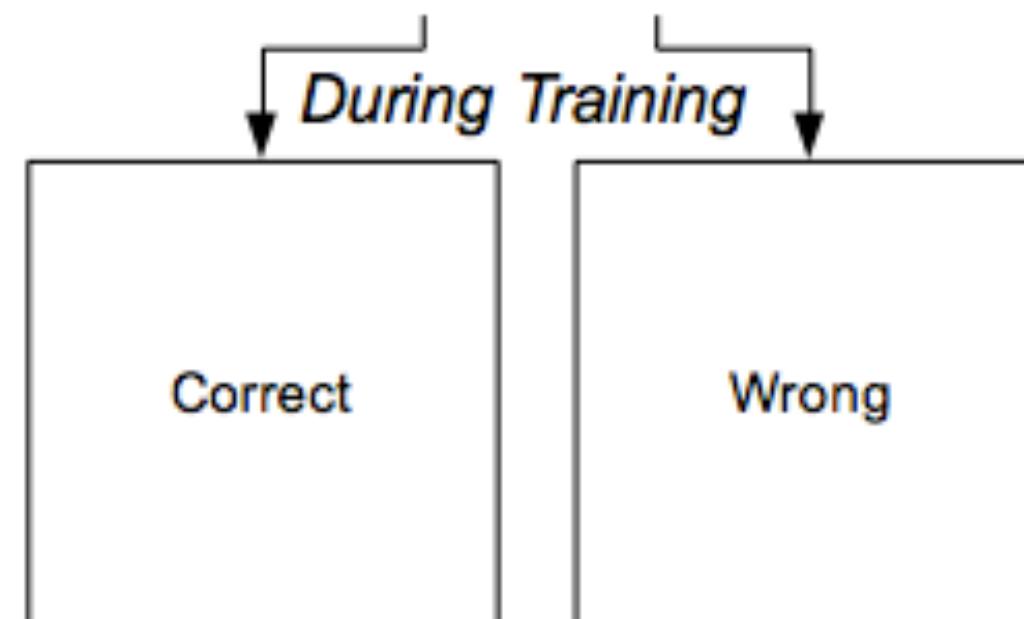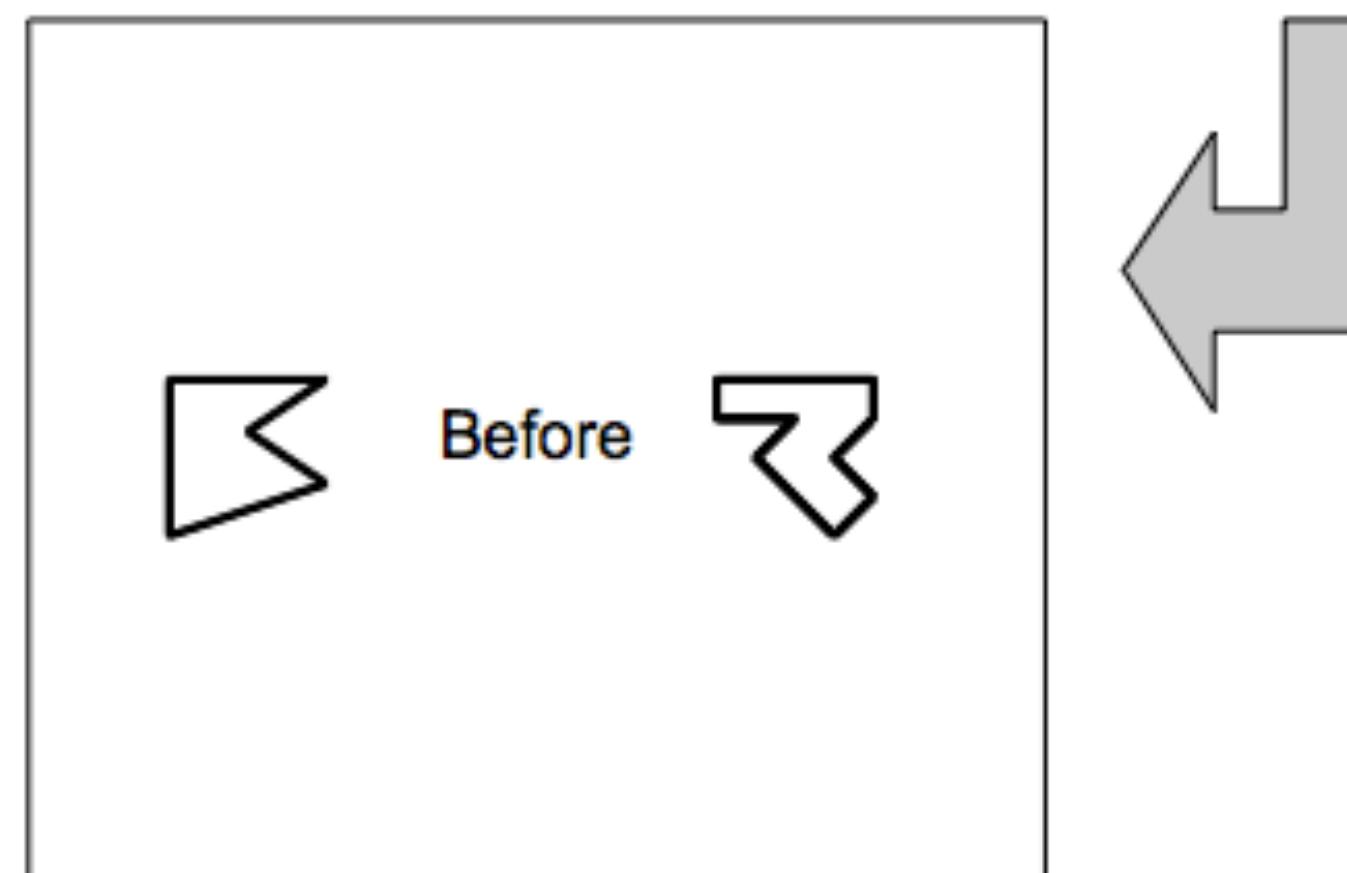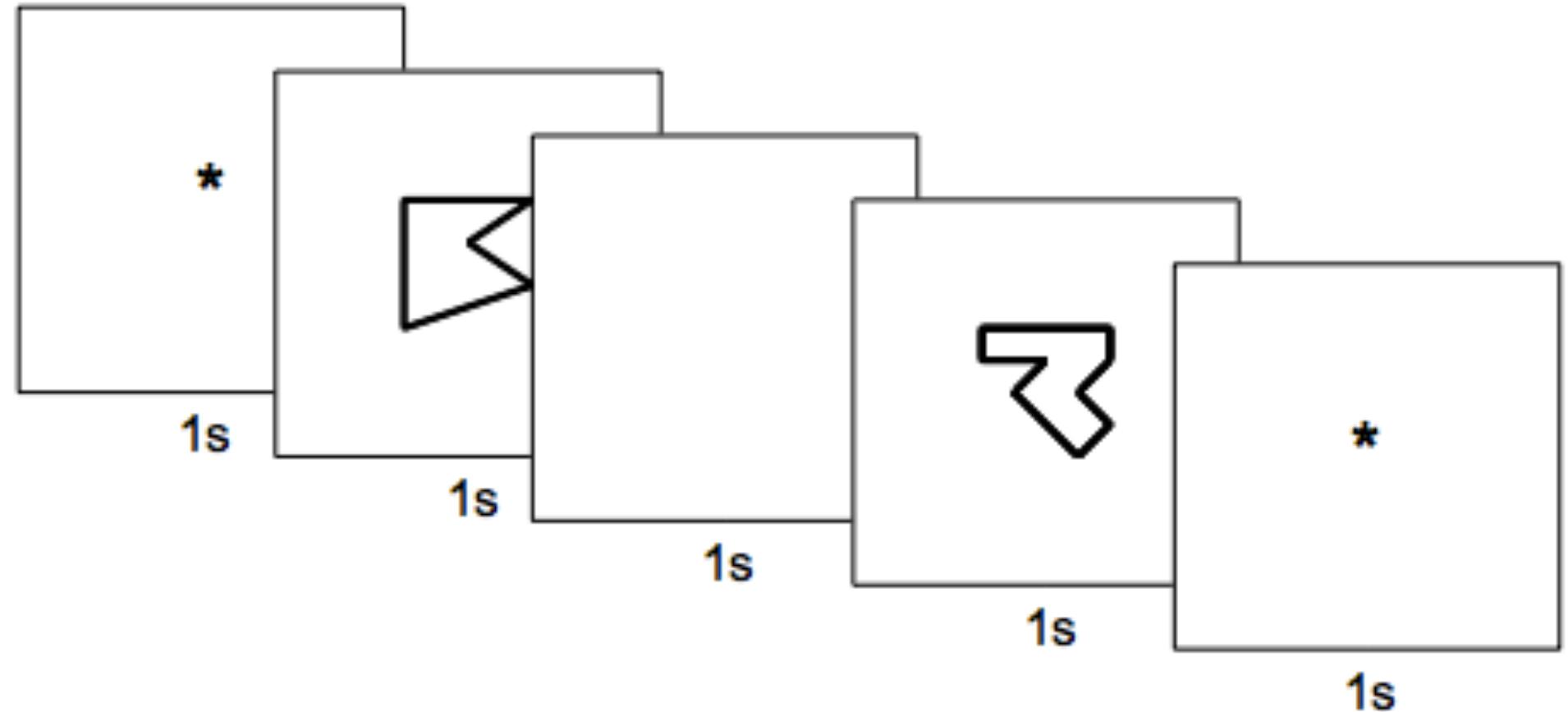
Method

* Go- No Go task

  * See relation

  * See statement

  * Correct? - press spacebar (Go) for Yes, wait (No Go) for No
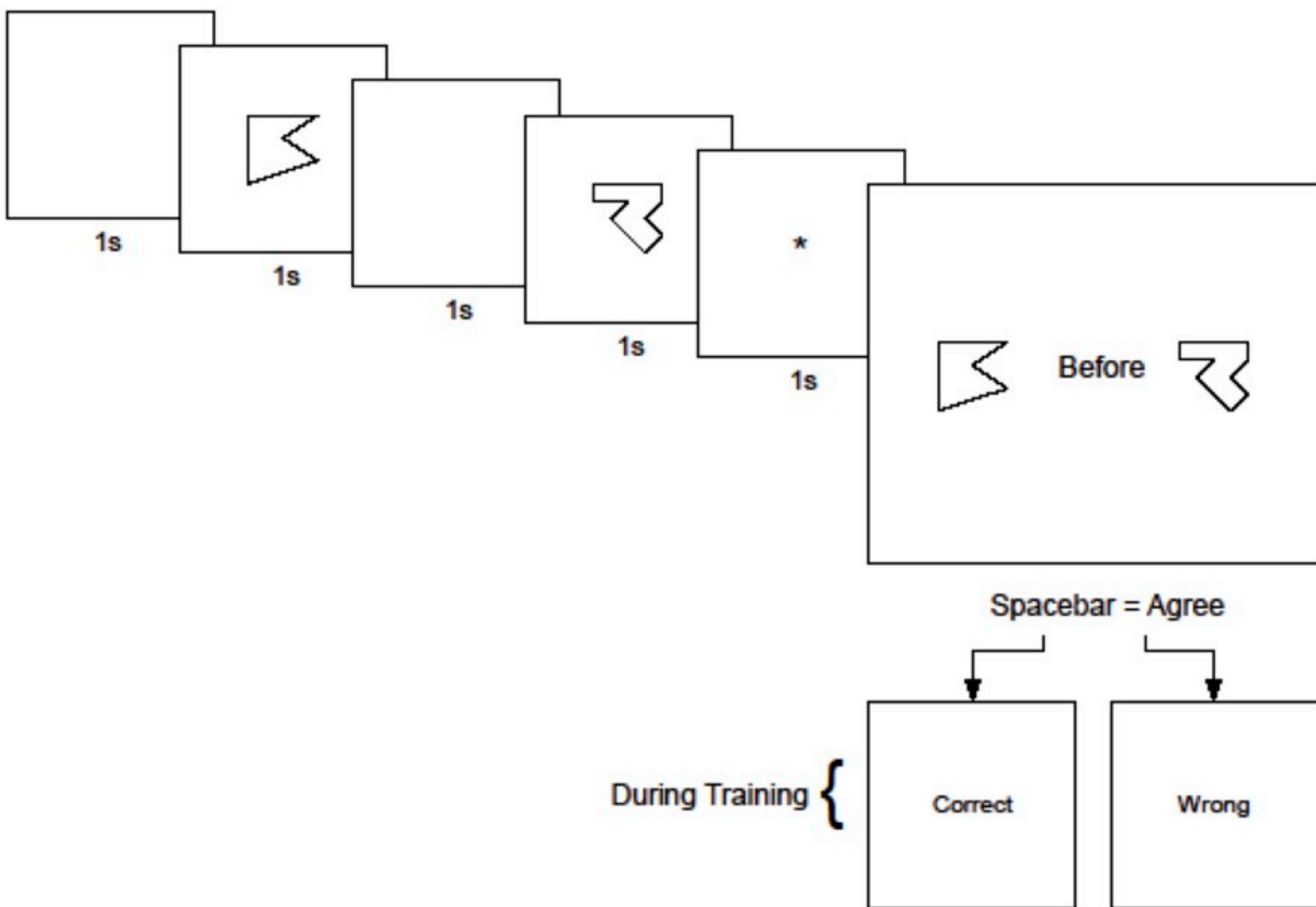
# Method

- Procedure

 - Training: Blocks of 16 trials (mastery: 15/16)

  - Test: 128 trials
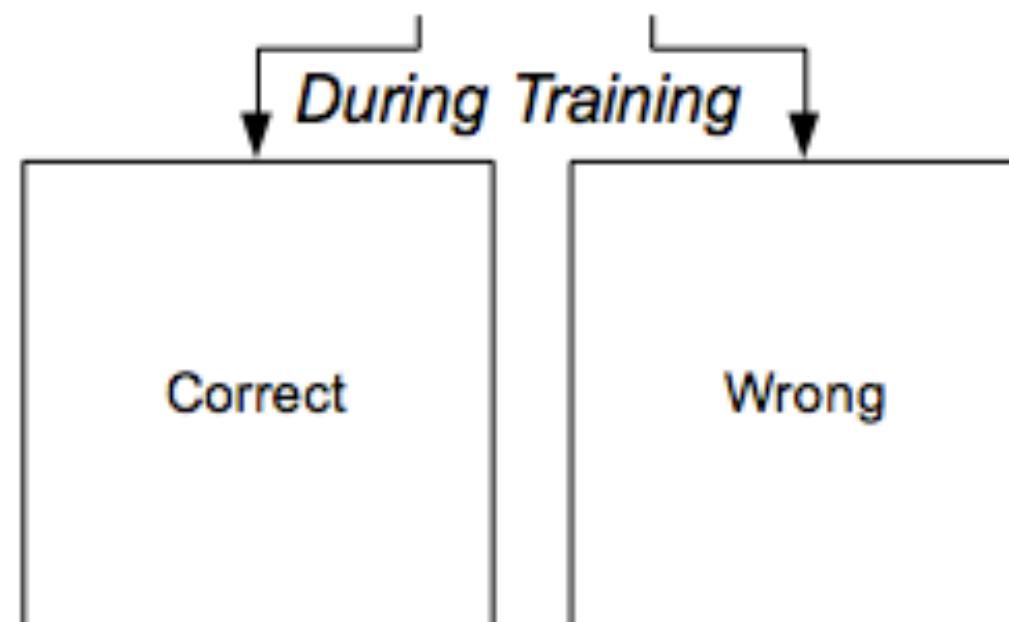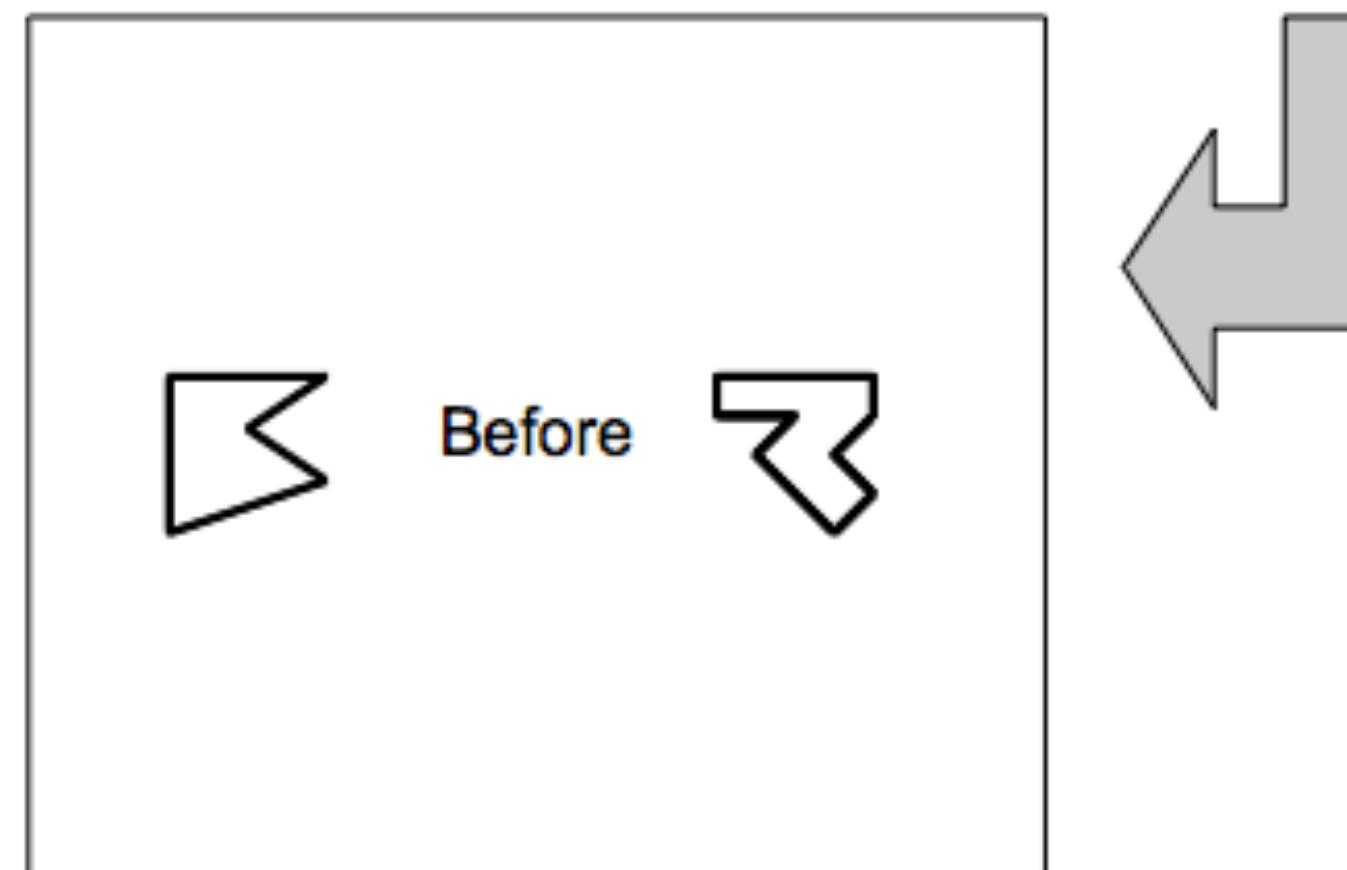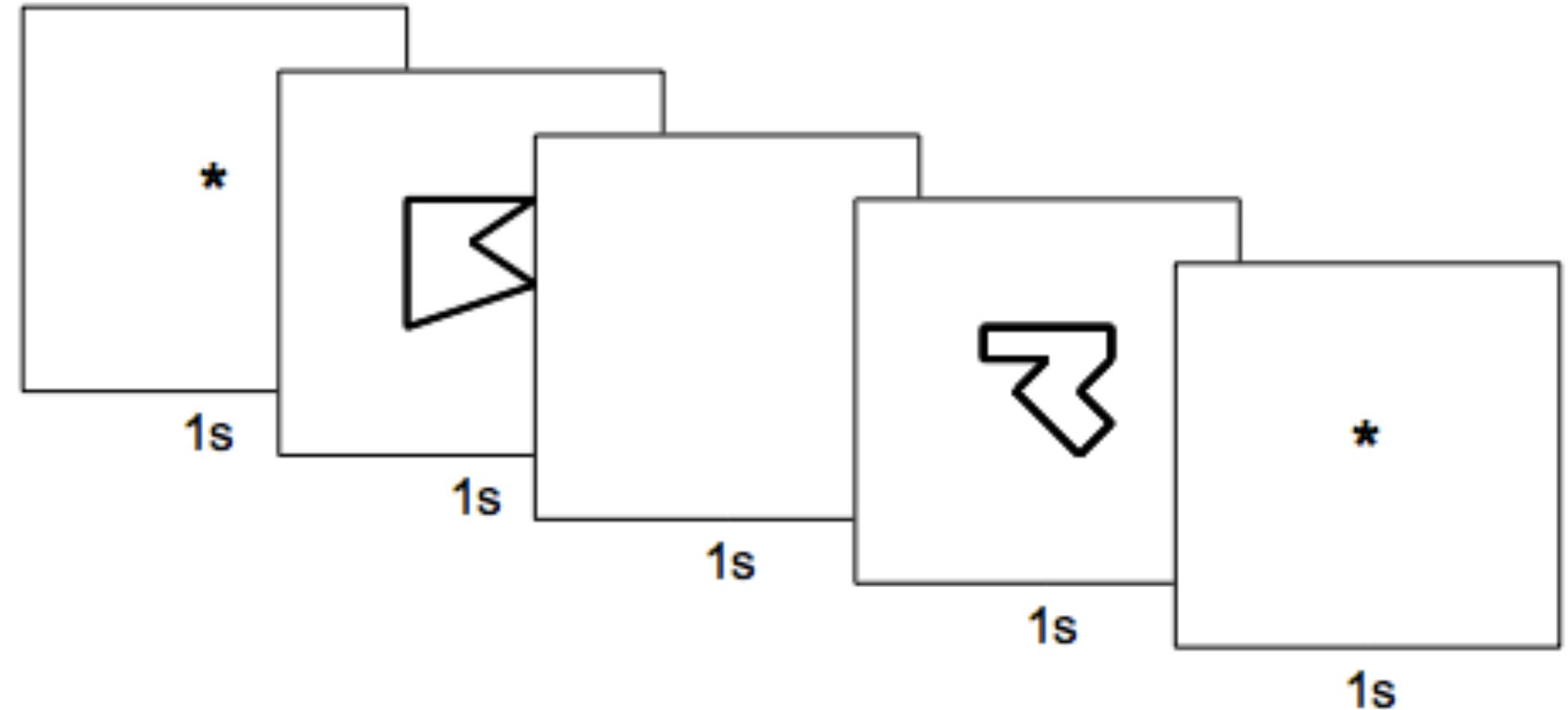
Results

* Acquisition (training)

  * older adults took longer to pass training

  * older adults found after relations more difficult

* Accuracy (testing)

  * significant probe by group interaction

 * older adults found after more difficult during testing
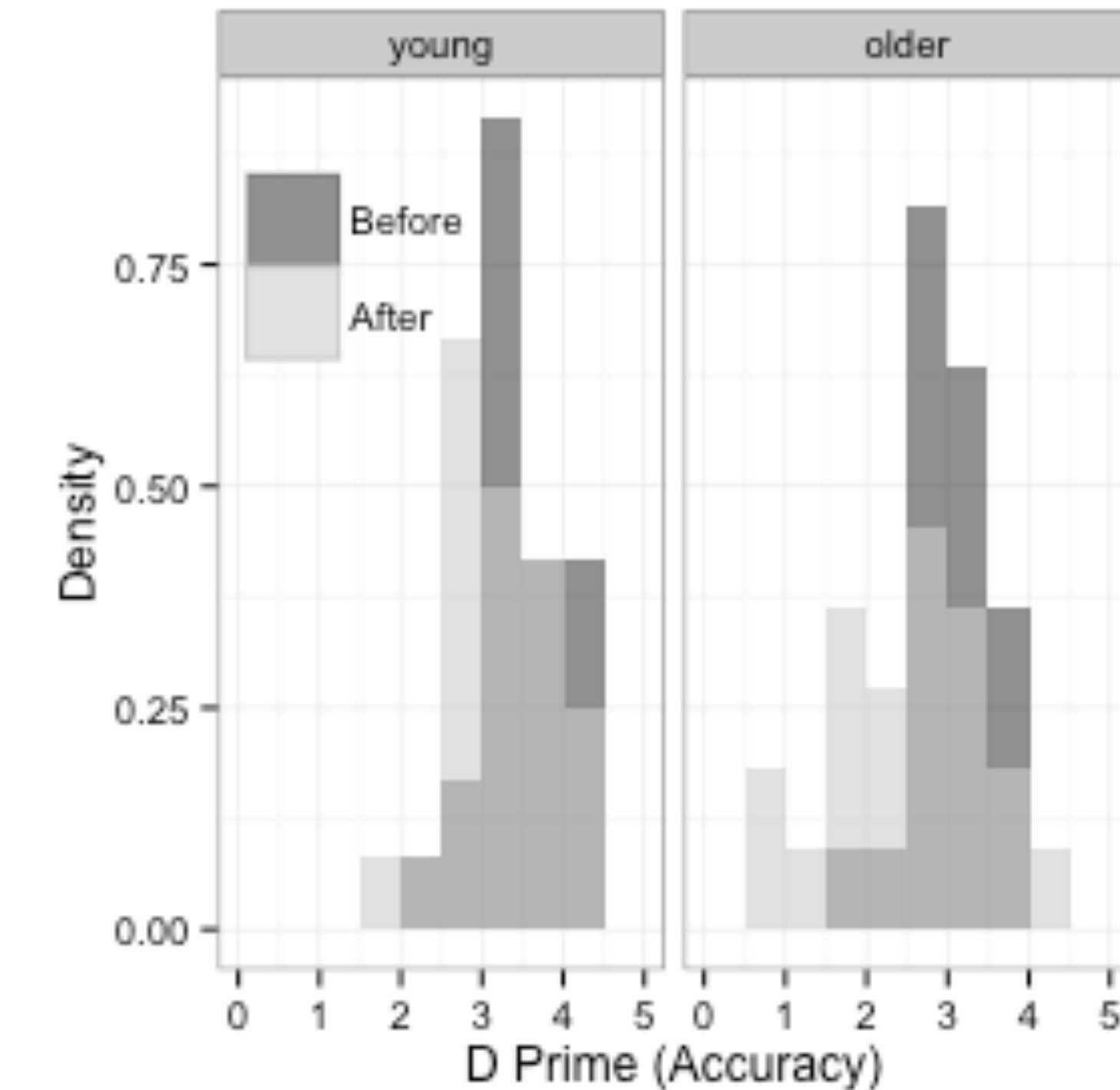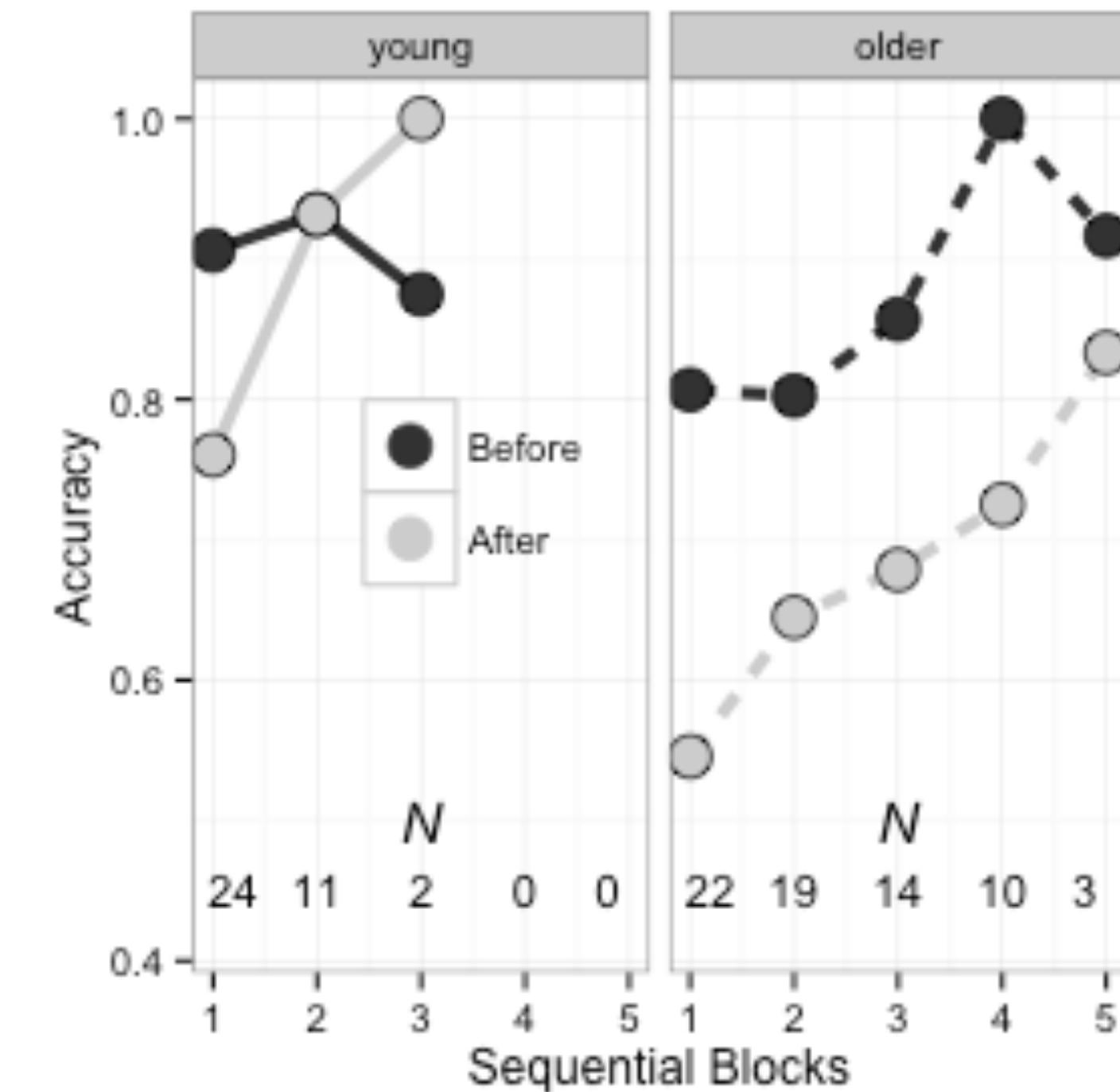
Reaction Times

* Older adults slower

* Not significantly slower on *before* probes

* Older adults slower on *after* trials when Before responding controlled for
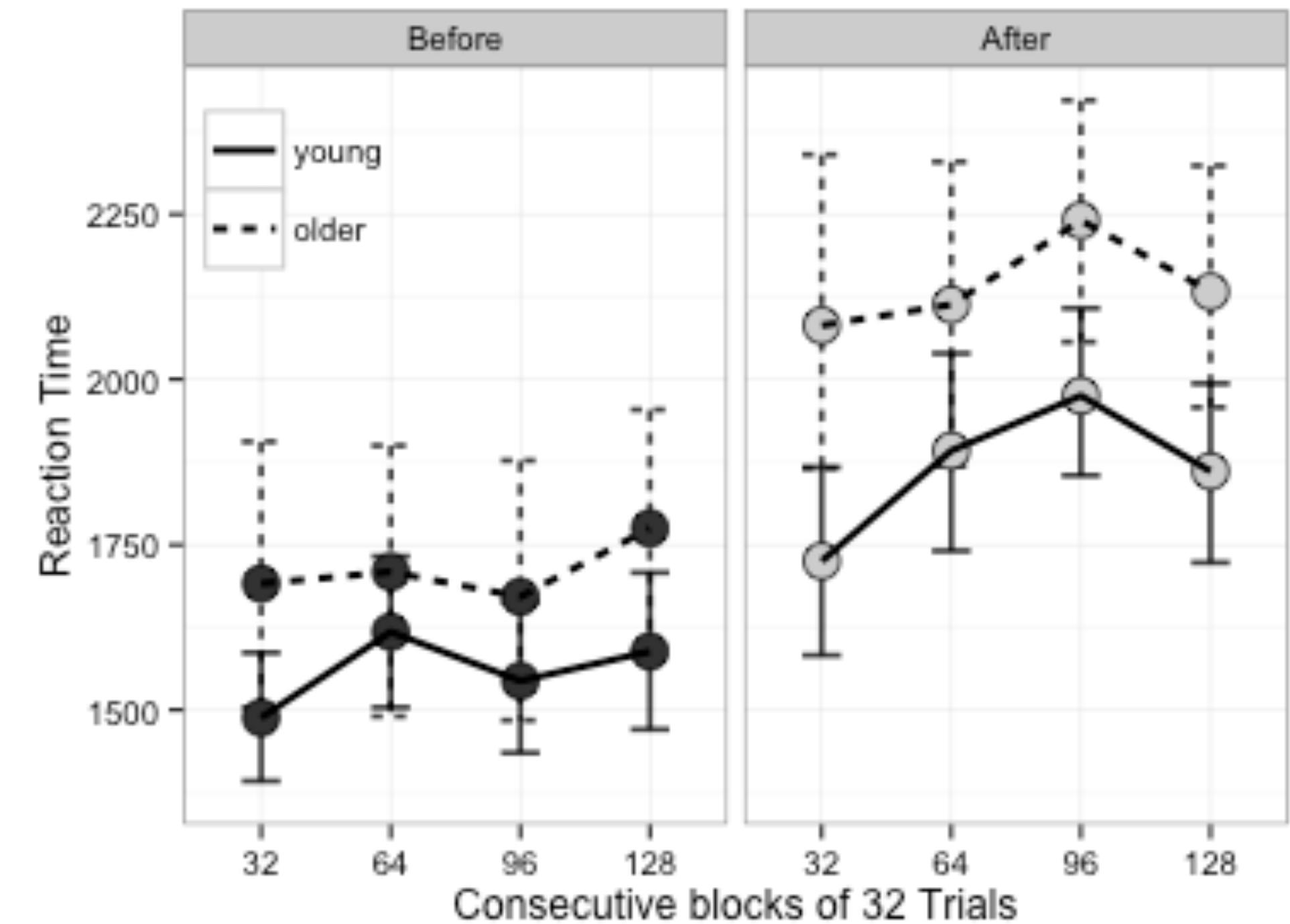
Foils

* Stimulus Foils

  * AS foils were easy for both groups

  * older adults found B_1s foils difficult

* Relational foils

  * More difficult that stimulus foils

  * Older adults found foils more difficult
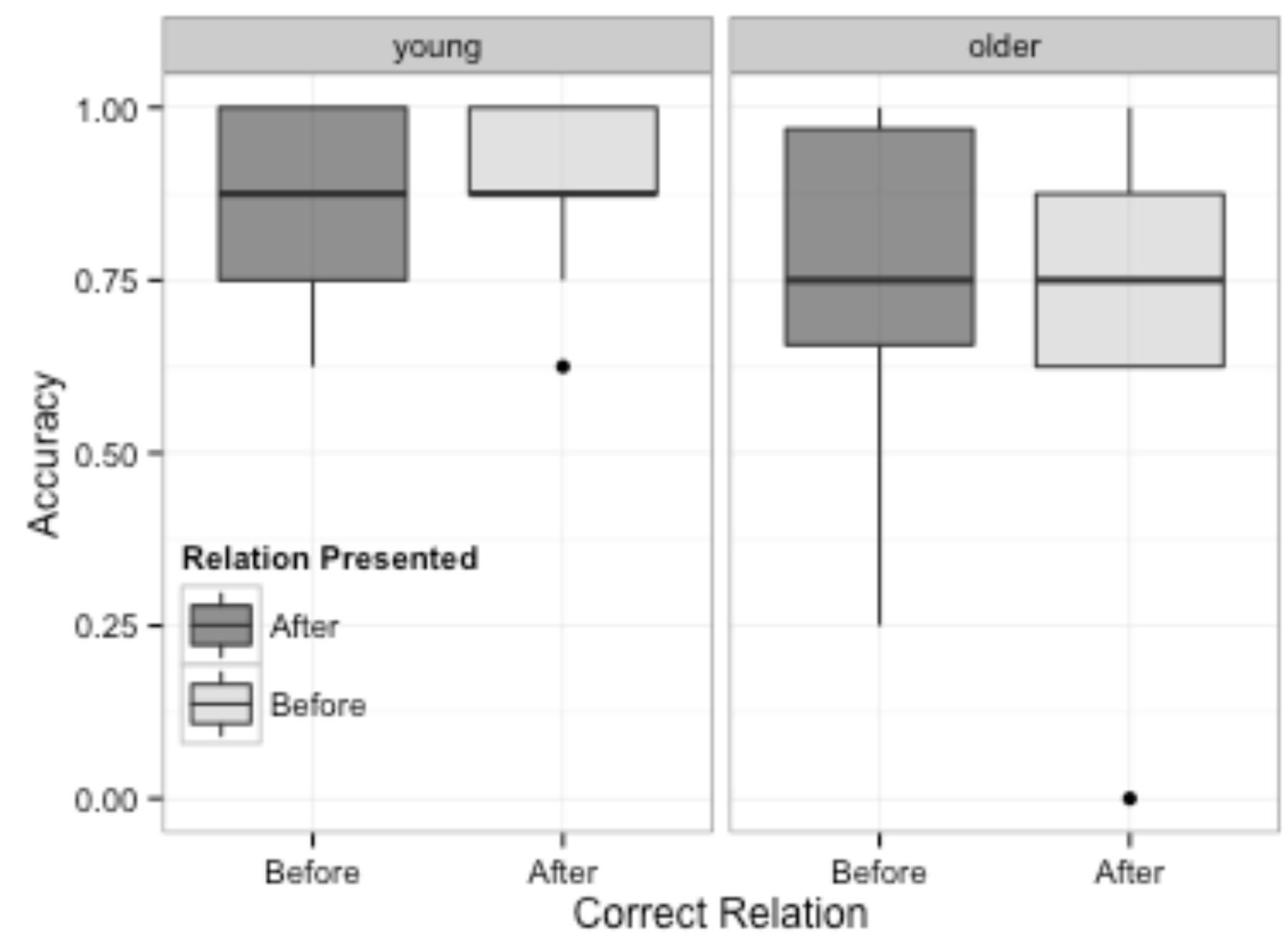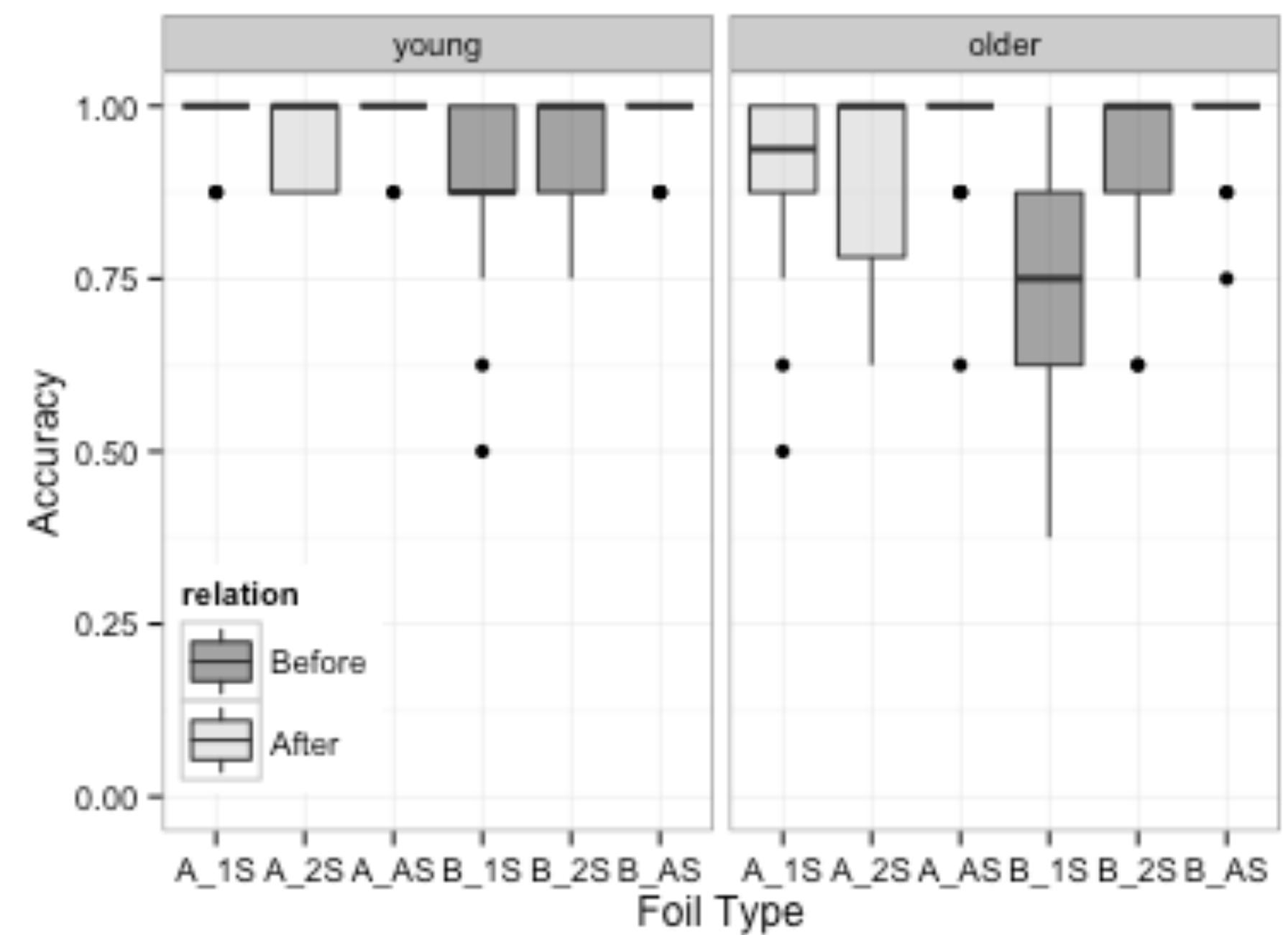
Discussion

* Reversing temporal relations takes time

  * difficult for older adults

  * fits with executive function account

  * *but,* specific behavioral target

Discussion

* Not a simple picture

  * Considerable variability in performance in older adults

  * Some older adults among most accurate

  * Response speed slower

  * Did not control for years of education

  * Differences in *after* not *before*

Discussion

- Developing relational flexibility interventions may facilitate general cognition improvements

- Correlational data so far