Workshop Discussion

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Levels of Theoretical Discourse

(Salthouse, 1991)

LEVEL	CONTENT
World Views	Implicit Assumptions
Frameworks	Concepts and Principles
Theories	Relations Among Concepts
Models	Mechanisms accounting for relations among variables
Descriptive Generalizations	Integrative Summaries or Taxonomic Classifications of Empirical Phenomena
Observations	Empirical Phenomena

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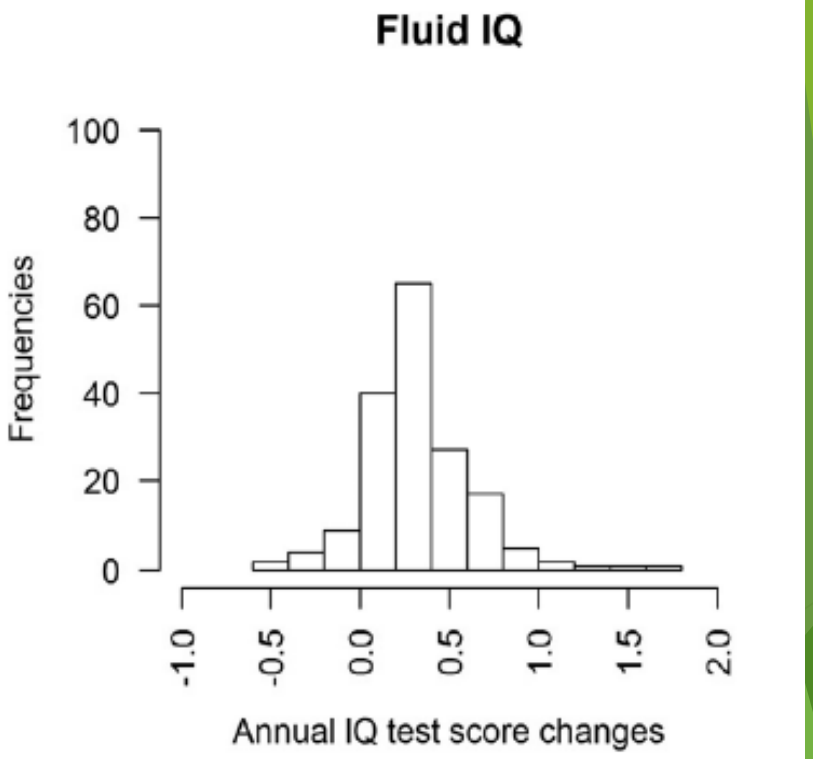
“Flynn Effects” on Adult Cognition

- Increases in mean scores on tests of Inductive Reasoning (like Raven’s Progressive Matrices) over last 100 years
- Successive generations get better and better



From Pietschig & Voracek, 2015

Schaie's estimated cohort effects

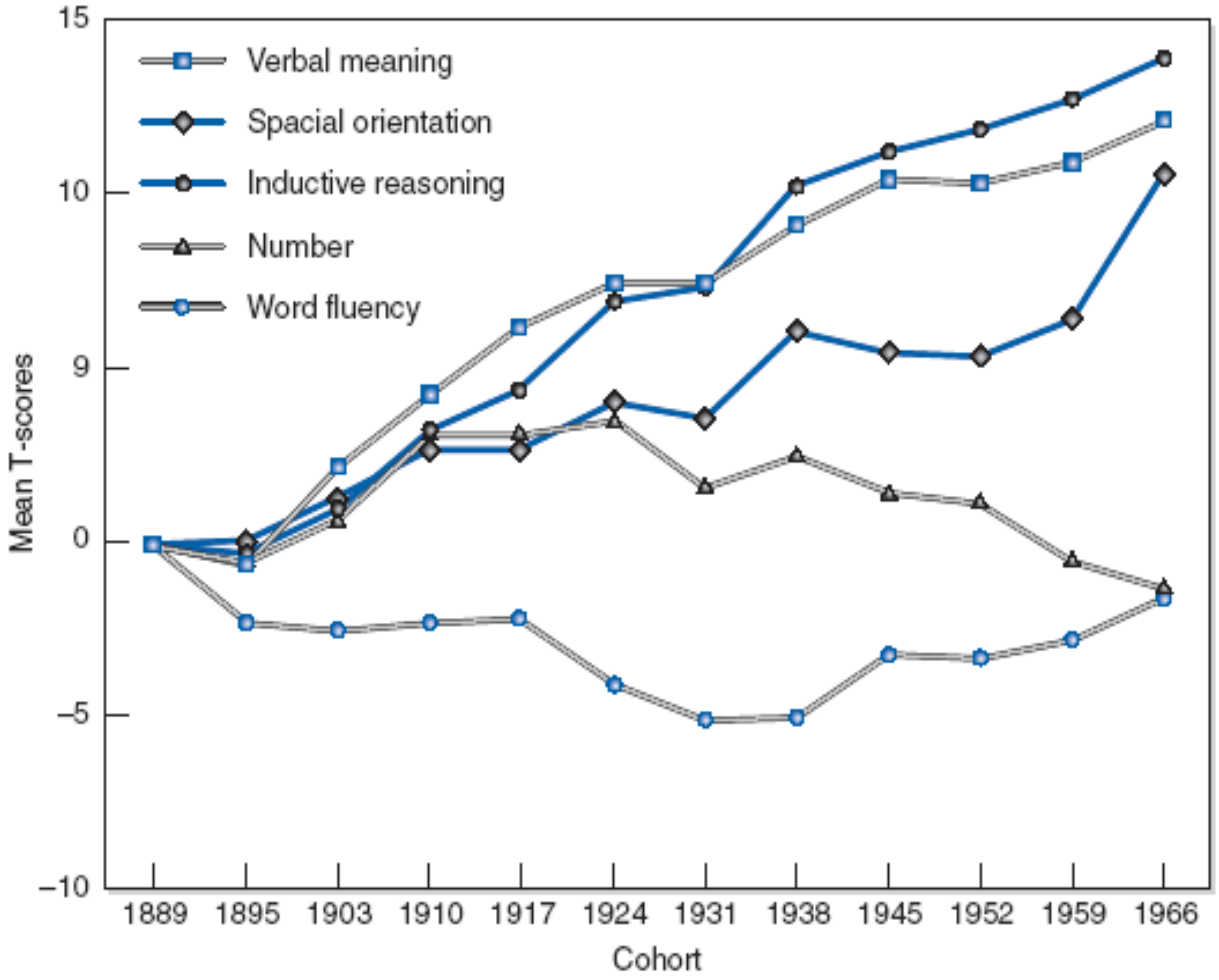
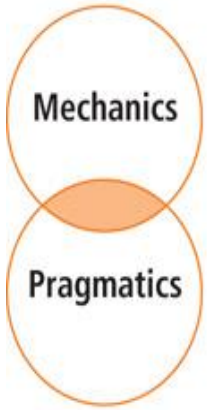


FIGURE 7.8
Cohort Gradients from 1889 to 1996 on PMA Scales

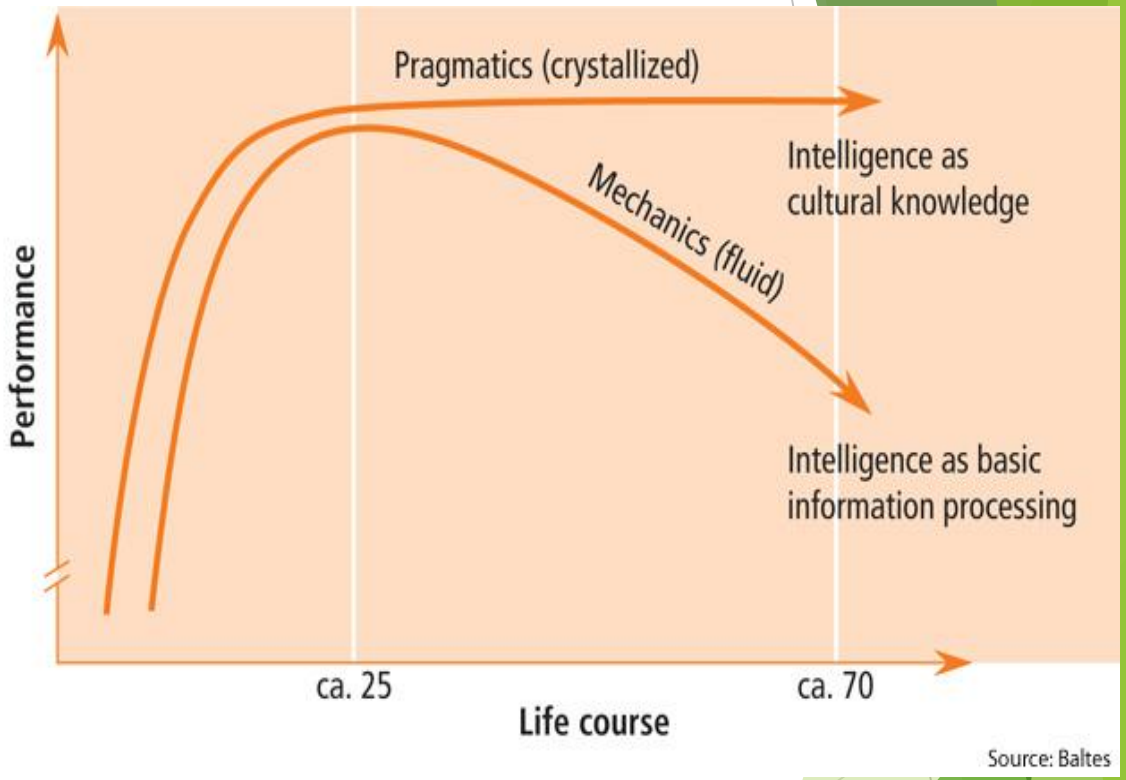
Source: Schaie, 1994.

Defining Intelligence



Basic information processing
Content-poor
Universal, biological
Genetically predisposed

Content-rich
Culture-dependent
Experience-based



“Flynn Effects” on Adult Cognition

- Increases in mean scores on tests of Inductive Reasoning (like Raven’s Progressive Matrices) over last 100 years
- Successive generations get better and better
- Why?
- Horn: Gf is biologically based. NOT POSSIBLE!
- New view: (Fox) Culturally determined application of knowledge (how to apply rules of mapping & inference in induction tests) governs improvements in children’s performance (Sesame Street effects)
- Carries over into generational differences in adult test performance

Crossword Puzzle Vocabulary – Cross-Sectional Knowledge Curves

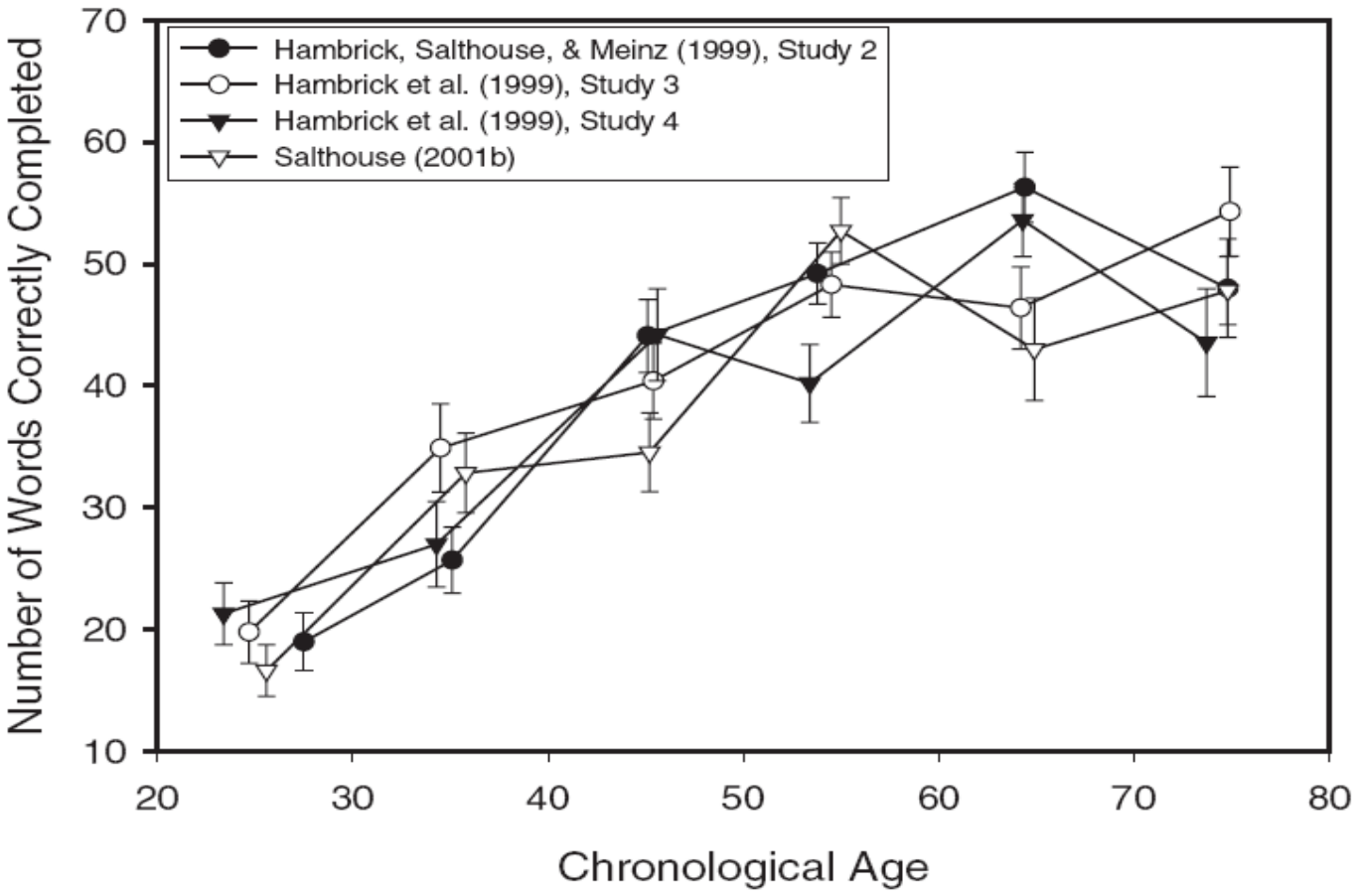
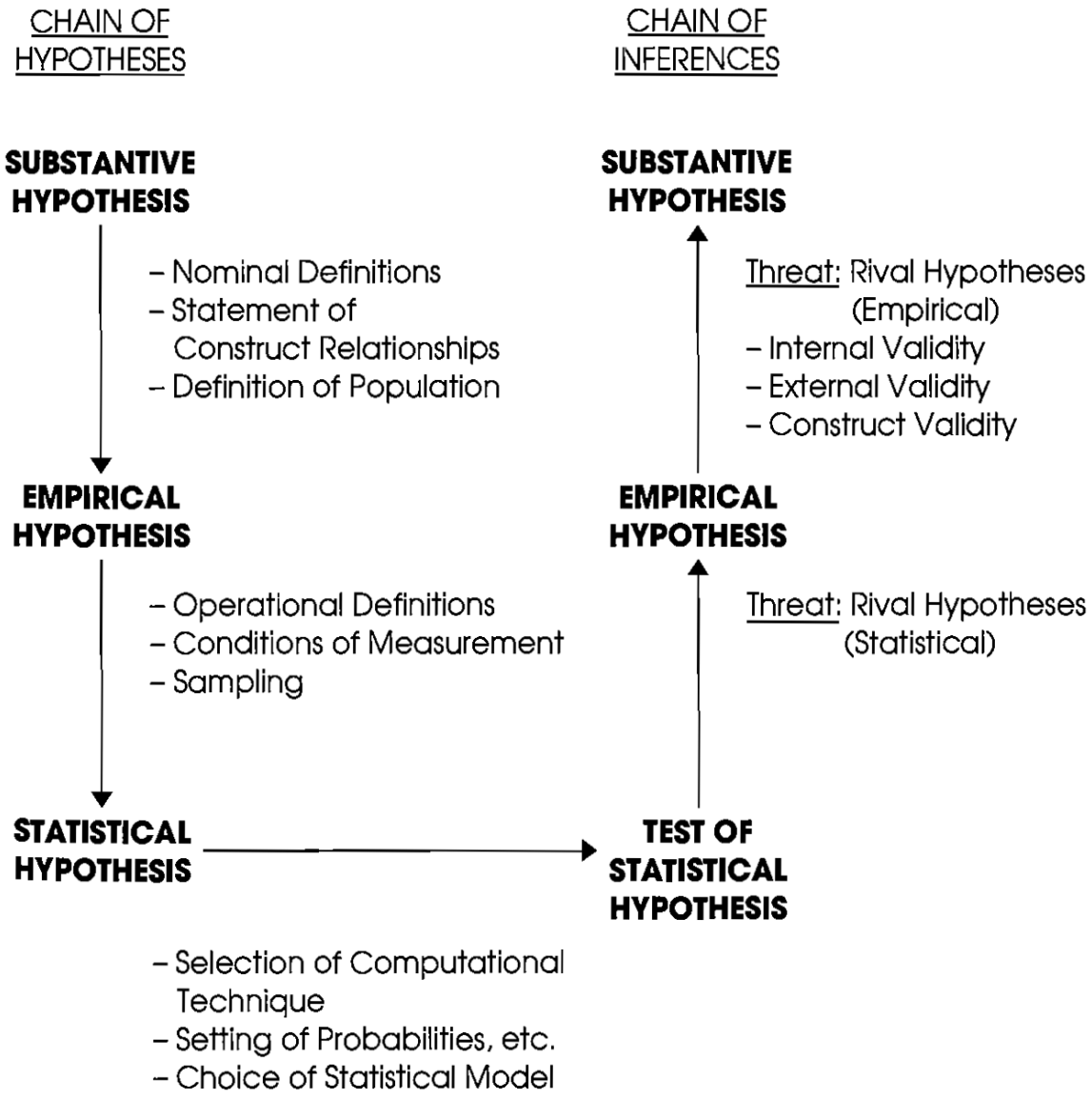


Fig. 2. Means (and standard errors) for the number of words in a *New York Times* crossword puzzle correctly answered in 15 min as a function of age. Between 195 and 218 adults participated in each study. The crossword puzzles required either 76 or 78 words for their solutions.

Hertzog & Dixon (1996)

- Chain of hypotheses, inferences
- Basic idea: research design as an approximation to reality
- Limited scope of observations (empirical measurements) to test hypotheses about relations between variables
- Quasi-experimental design principles (Schaie, 1977; Shadish, Cook, & Campbell, 2002) must be applied to research designs involving (age & other person characteristics) as a variable

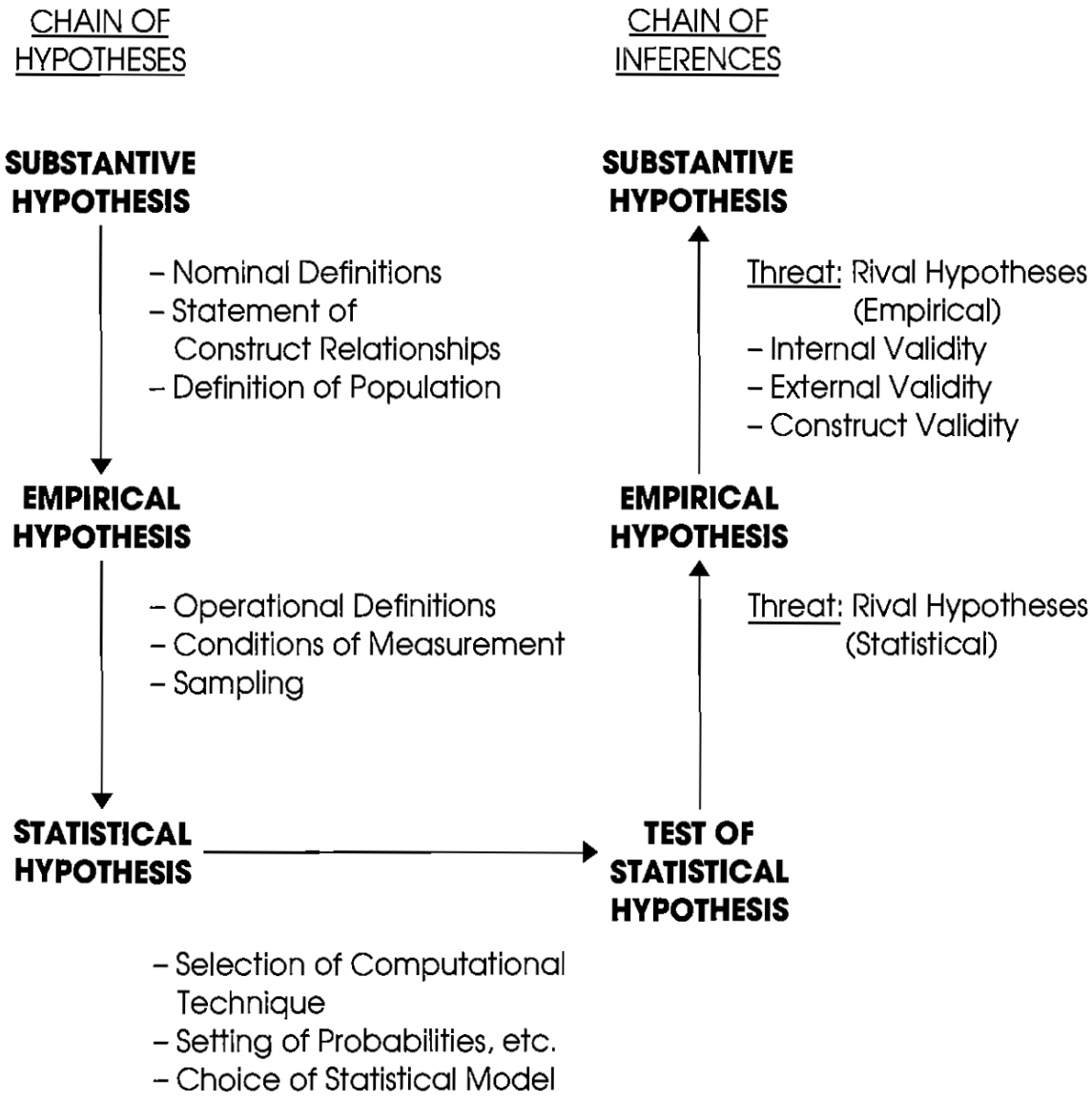
Hypotheses and Inferences



Wohlwill (1991)

- "Partial isomorphism" of method & theory in developmental psychology
- Theory is critical but is often underspecified
  - Paradigms of science (T. Kuhn)
  - Auxiliary assumptions are postulates not tested
  - Modus tollens & the auxiliary belt
- Method is critical and often not carefully thought through w/ respect to the only thing that truly matters:
- WHAT IS YOUR RESEARCH QUESTION?
- IS YOUR DESIGN "FAITHFUL" TO (in alignment with) YOUR QUESTION?

Hypotheses and Inferences



Why “Partial Isomorphism”??

- New methods often lead to discoveries that are (meta)theory-laden but are regularities to be explained
  - ‘default network’ in resting state
  - What are the candidate explanations?
- Inconsistencies of data w/ theory usually lead us to question the data, not the theory

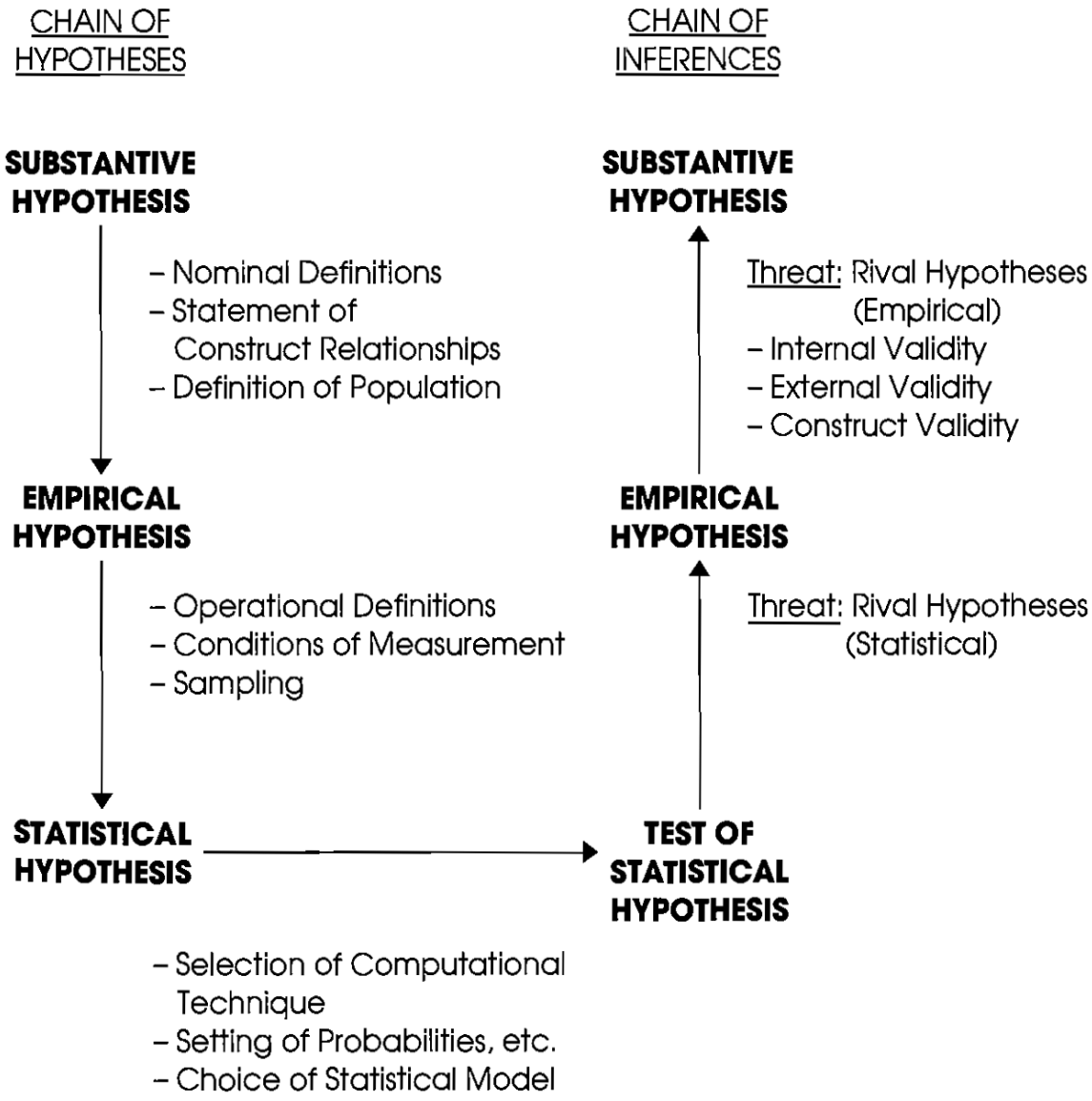
Why "Partial Isomorphism"??

- Inconsistencies of data w/ theory usually lead us to question the data, not the theory
  - Confirmation bias
  - IT SHOULD BE THE OTHER WAY AROUND!!!!!!
- How can I DECONSTRUCT this argument? How can I falsify my own pet hypothesis?
- What else could explain these outcomes? How can I rule out these rival explanations?
- Think abductively!!!!

Method-Theory discrepancies

- Wohlwill's claim was {for example} that people often TEST THE WRONG HYPOTHESES
- What is the question?
- What is (are) the hypothesis(es)?
- How should these be translated into empirically testable ideas?
- How can these be evaluated statistically?

Hypotheses and Inferences



Developmental Design Validity

- Validity of our research design depends on how well it approximates the substantive reality we are trying to evaluate

- Problem with aging research: need for empirical ‘short-cuts’ because we can’t evaluate life-span change quickly

Developmental designs ….

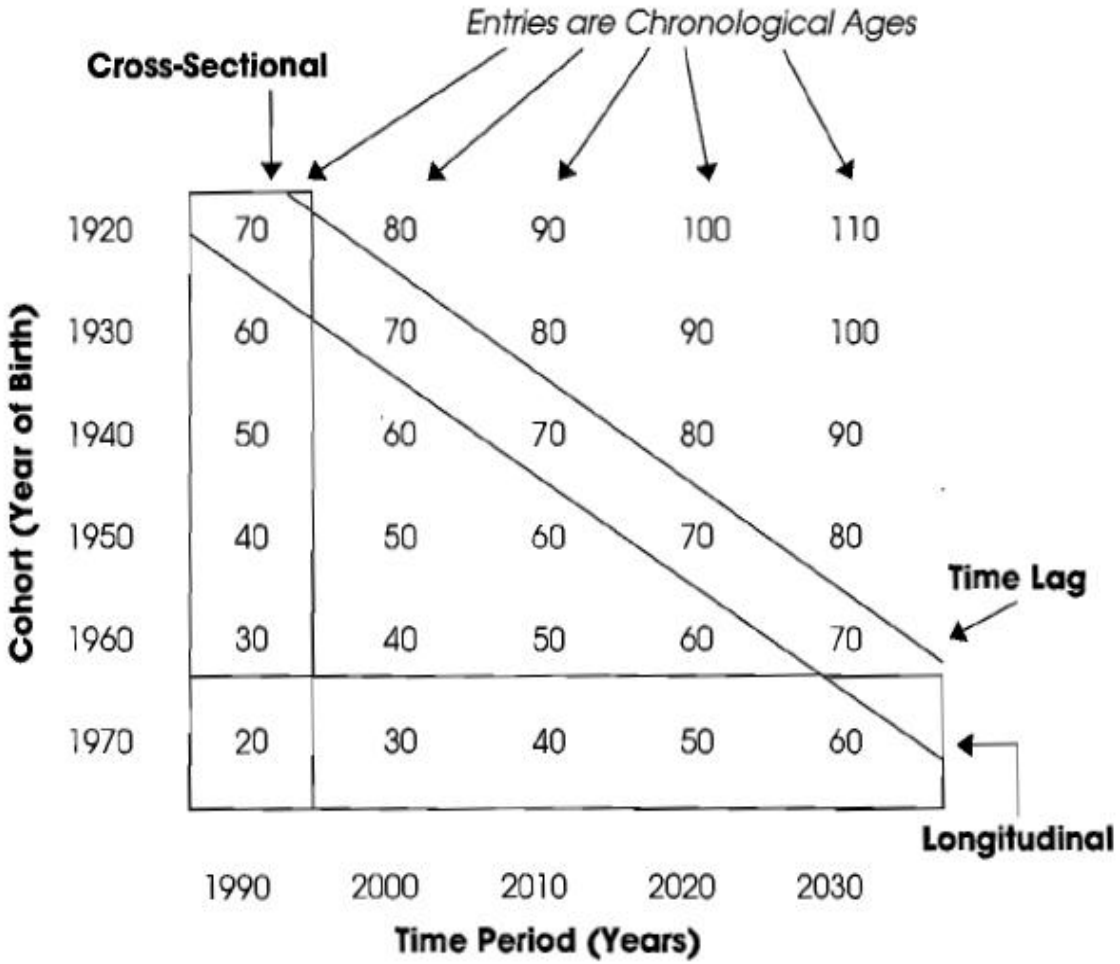


FIGURE 3.2 Illustration of basic age, cohort, and period design with traditional cross-sectional, longitudinal, and time-lag designs. Each of the designs confounds the independent variable of age with another source of variance (e.g., the cross-sectional design confounds age and cohort effects).

Cognitive Science Perspective

- Mind as computer….
- Cognition is the outcome of mental programs operating on information to achieve goal-directed outcomes
- Programs = Data Structure + Algorithms
- Cognition → processes operating on knowledge / updating knowledge /
- Questions about:
  - Structure
  - Mechanisms
  - Function
  - Practical goal-related behavior/achievements

Experimental Manipulation

- In cognitive research, typical to manipulate independent variables to help measure cognitive processes

- w/ cross-sectional studies, one then looks for age differences, or age X process interactions to help understand age effects
  - People tend to assume cohort effects unimportant – not necessarily true

Example: mental rotation task

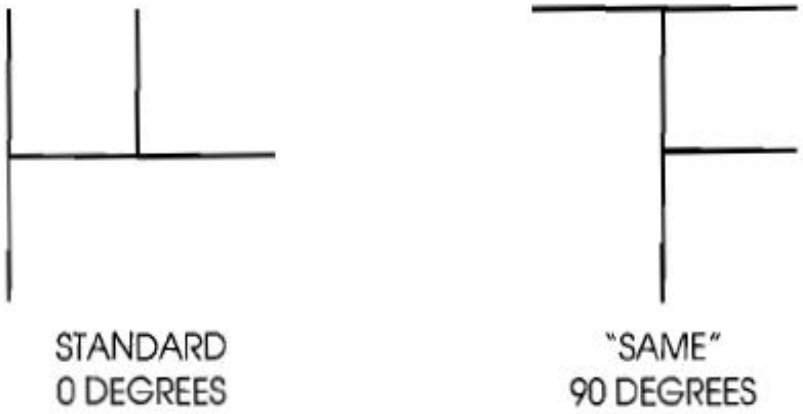


FIGURE 3.5 Example of stimuli from a mental rotation experiment. Each row corresponds to a pair of figures that are involved in a single experimental trial. In the top row, the two figures are identical, except that the comparison (right-hand) figure has been rotated 90 degrees clockwise from the standard (left-hand) figure's orientation. In the bottom row, the two figures cannot be rotated to congruence in the two-dimensional plane; the comparison figure is a mirror image of the standard figure.

Age X Angle interaction: slowing in mental rotation rate

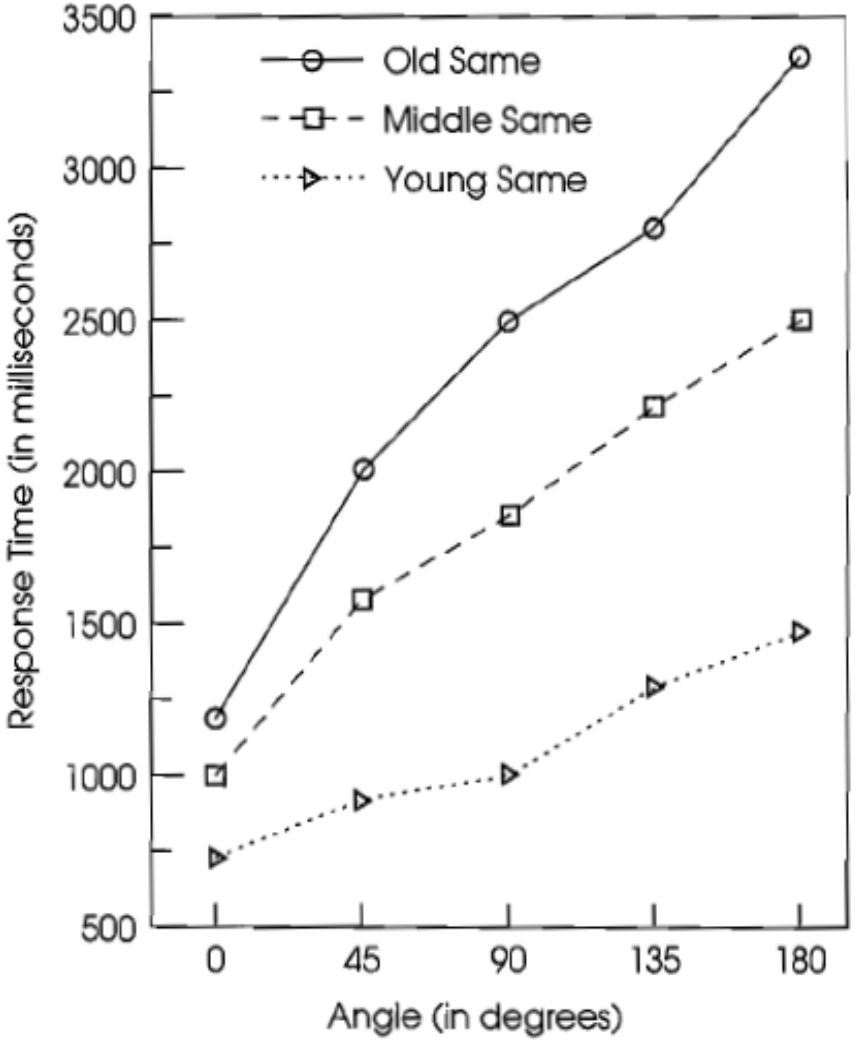


FIGURE 3.6 Results from an unpublished mental rotation study by Hertzog and Yuasa (1988). Response times for correct mental rotation discriminations (same trials only, as in the top row of Figure 3.5) are plotted as a function of (1) angle of orientation of the comparison figure, relative to the standard figure and (2) age group (young, middle-aged, old). Age is associated with increases in the intercept and slope of the linear function regressing mental rotation response times on angle of orientation. (*Source:* Reprinted from Hertzog (1994) with permission from Lawrence Erlbaum Associates.)

Construct Validity of Causes (& Effects)

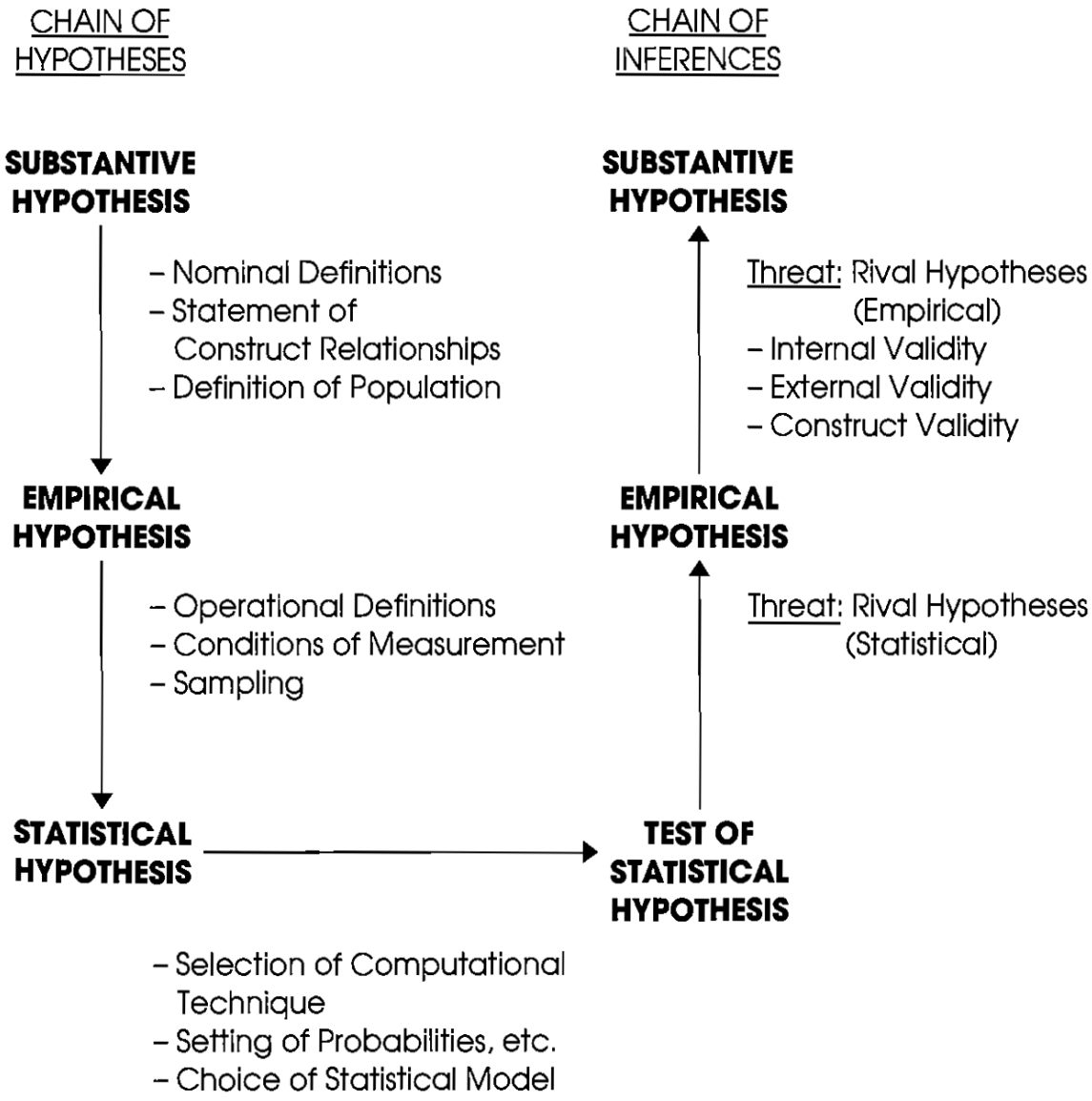
- Independent of the age question (or in relation to it) we can wonder whether the regularity of the pattern truly reflects the underlying cognitive mechanism that was targeted
- Construct validity issue: what if the MR slope is NOT a pure measure of mental rotation 'in the mind's eye?'
- NO, IT IS NOT!!
  - Speed-accuracy tradeoffs differ for old vs. young (Hertzog, Vernon, & Rypma, 1993)
  - Serial mental rotation task shows that slope is strongly influenced by post-rotation decision & comparison processes that increase as a function of angle of disparity
    - (e.g., Hertzog & Rypma, 1991)

Developmental Designs as "Passive Observational Studies"

- Shadish, Cook, & Campbell (2002)

- Other threats to the validity of developmental designs because individuals cannot be randomly assigned to age, cohort, or period membership

Hypotheses and Inferences



Developmental Design Validity Issues

Internal validity

- (other than cohort/time)
- selection/sampling
- experimental mortality
- practice effects/reactive effects

External Validity

- (populations/settings/times)

Construct Validity

- Measurement equivalence
- Example: speeded tests of intelligence

Statistical Conclusion Validity

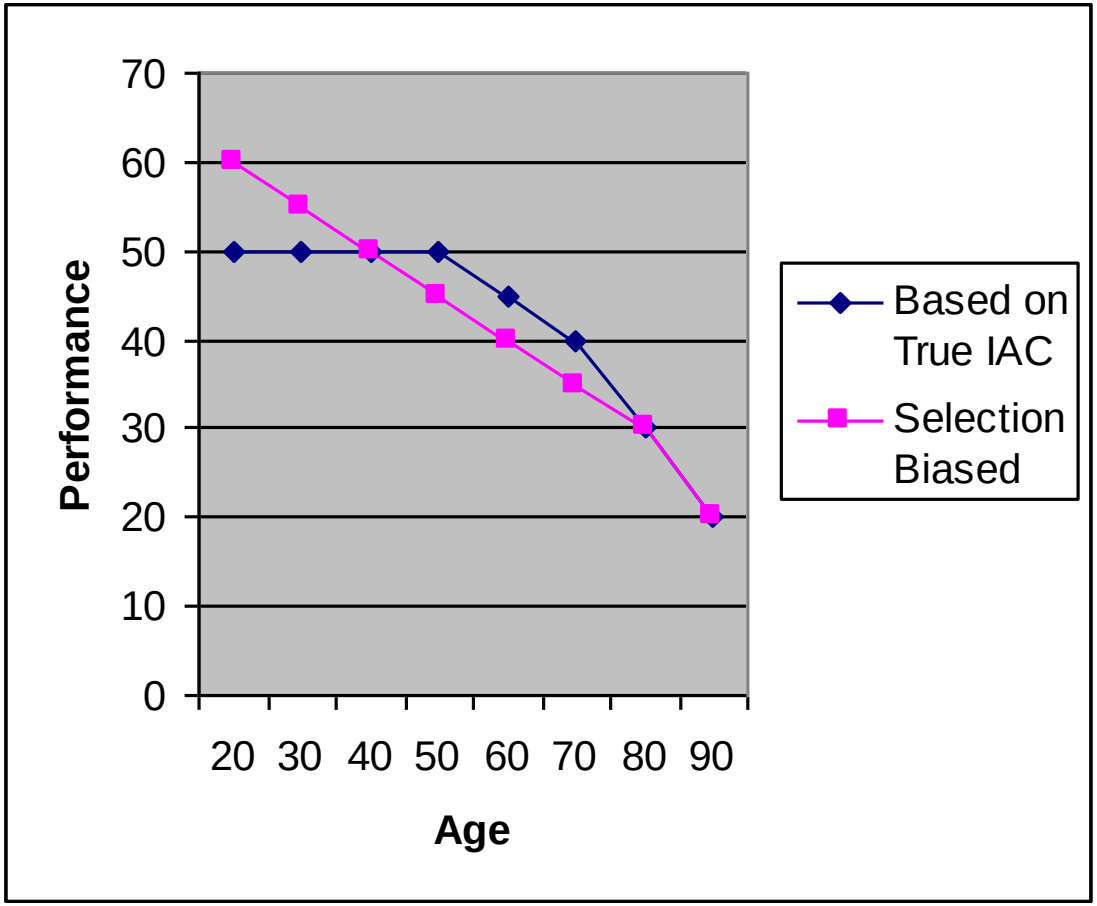
- Testing wrong hypothesis
- Inflated Type I error rate
- Low statistical power

Major Issues for Developmental Designs

Cross-sectional – selection, selection X age

Longitudinal – practice effects, experimental mortality, selection X time interactions

Selection-biased XS Gradient



Positive selection in 20 yr olds (university students) & negative selection in middle-aged (best differentially prefer working, leisure) creates spurious linear decrement in mid-life

Developmental Validity Issues

- Measurement equivalence:
  - Does a measure have equivalent measurement properties at different points in time (or for people of different ages)?
- Heterotypic continuity
  - Is a construct qualitatively the same, but has different manifestations at different ages?
- Competence-Performance Distinction
  - Difference between what one [can, could] do and what one does

Processing Speed and Development

- Construct of central relevance (to be studied)?
  - Kail, Salthouse
  - OR
- Performance confound to be controlled?
  - Should (?) [OR How Should] presentation times be adjusted to equate people of different ages (or abilities) for rates of information processing speed?
- Older adults require about 2 x the presentation time to achieve the same cognitive outcome (e.g., time needed to form mental image to mediate a new association)
- If you hold presentation times constant for old and young, what is the resulting effect?

Adjusting for Processing Speed

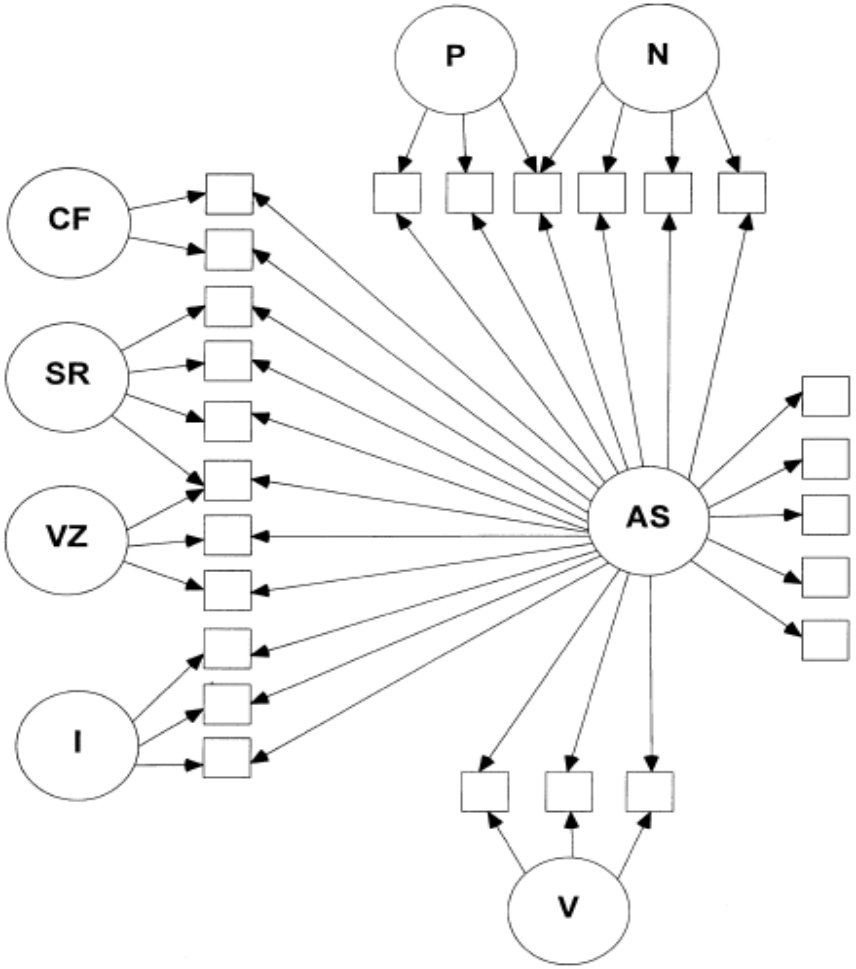


Fig. 1. Factor model depicting the specification of an answer sheet factor in which all primary ability variables load on both the answer sheet factor and an (residual) ability factor.

Models for Change

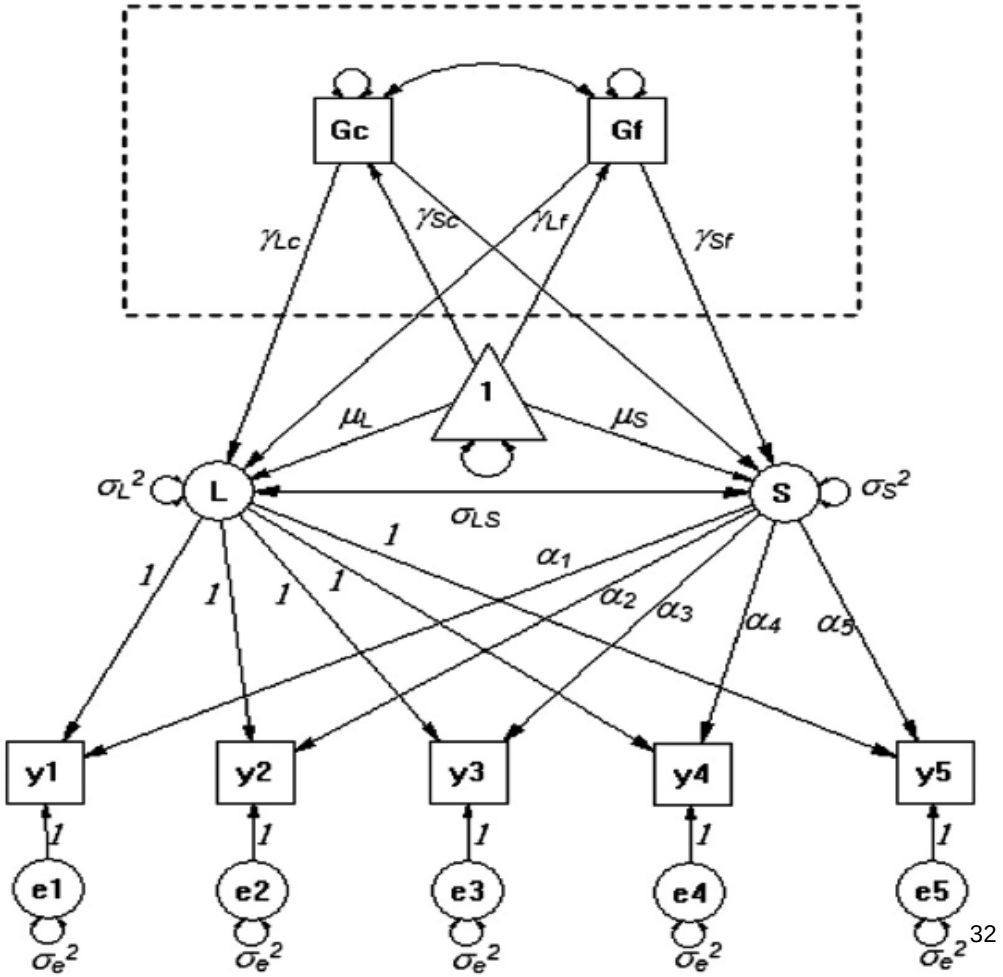
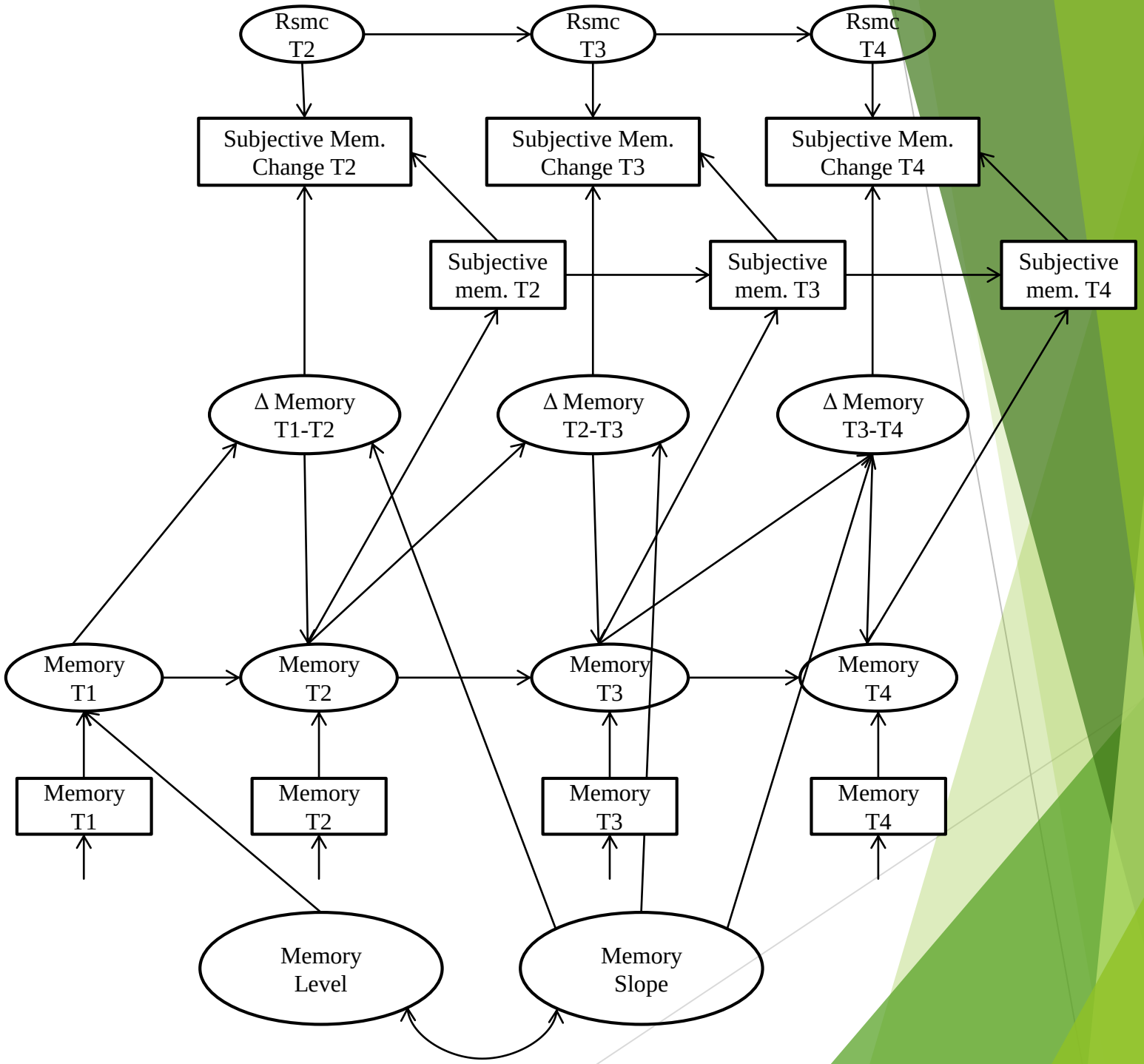


Fig. 1. Illustration of the path diagram for the basic growth curve model used in the analyses. Extensions of the model consisted of incorporating covariates in the analyses as represented in the dashed square, and using the same model with multiple age groups and multiple variables.

Not always the right model!!!

- See Hertzog & Nesselroade (2003)
- Example:
- Validating perceptions of memory change (subjective memory) from longitudinal changes in memory
- Need within person correlations of perceived change at time t with prior change in memory from time t-1 to t
- Latent growth curve doesn't get at this problem!!!!
- MUST FLEXIBLY SPECIFY MODEL TO CAPTURE PHENOMENON OF INTEREST & REMAIN FAITHFUL TO THE RESEARCH QUESTION


Rsmc T2
Rsmc T3
Rsmc T4
Subjective Mem. Change T2
Subjective Mem. Change T3
Subjective Mem. Change T4
Subjective mem. T2
Subjective mem. T3
Subjective mem. T4
Δ Memory T1-T2
Δ Memory T2-T3
Δ Memory T3-T4
Memory T1
Memory T2
Memory T3
Memory T4
Memory T1
Memory T2
Memory T3
Memory T4
Memory Level
Memory Slope

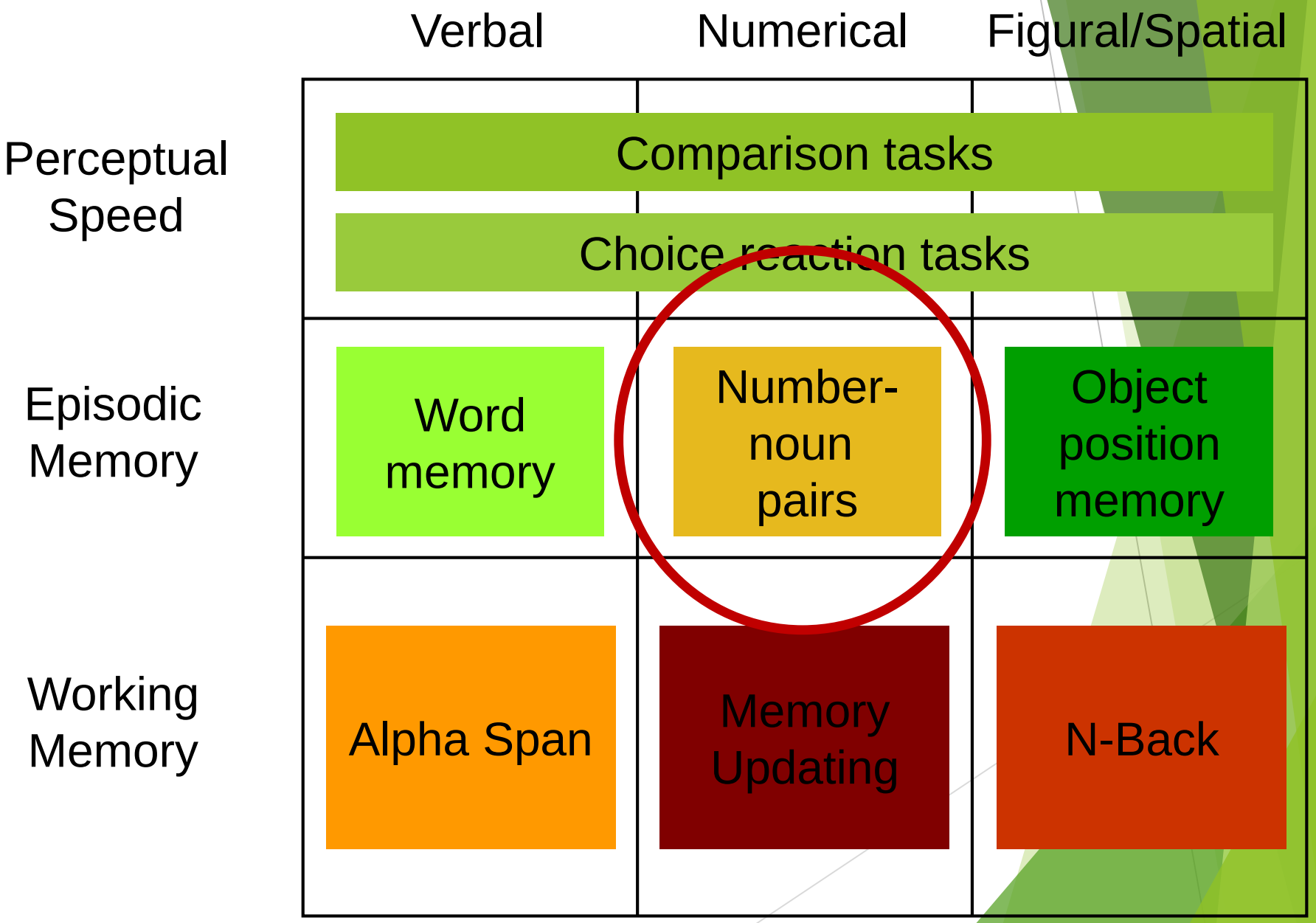
Separating Variability from Change

- Important question is how labile people are
- Nesselroade (1991) – warp & woof of developmental fabric
- Variability may be an indication of secondary aging (e.g. AD) or ‘tertiary’ aging (terminal decline)
- Need intensive intraindividual measurement (frequent testing of the same person over time) to separate them out

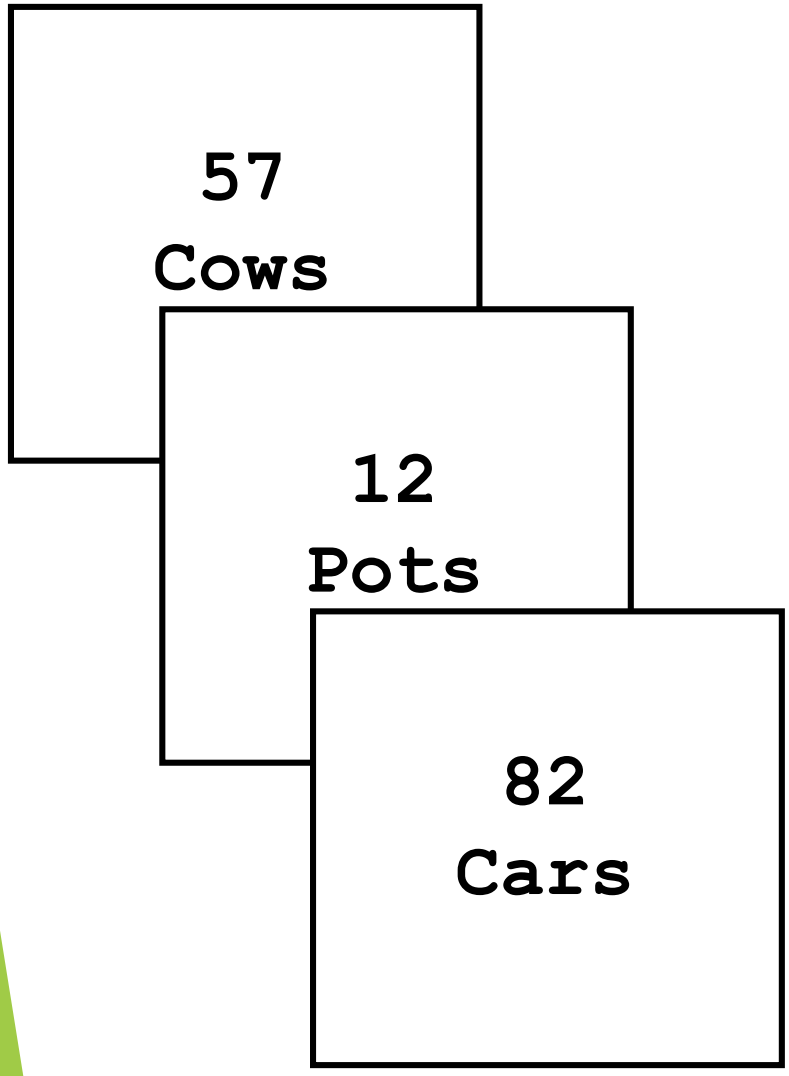
Schmiedek et al COGITO (100 days) Study

- Intensive practice in cognitive task performance (WM, Episodic Memory) over 100 sessions
- N = 100 young adults and 100 older adults

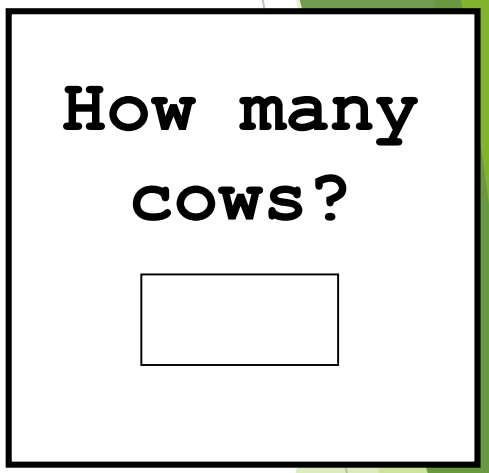
Cognitive tasks



Episodic memory tasks: *Number-noun pairs*



Recall in random order:



…etc.

…12 number-noun pairs total

2 trials per day

Brief strategy questionnaire (after each list)

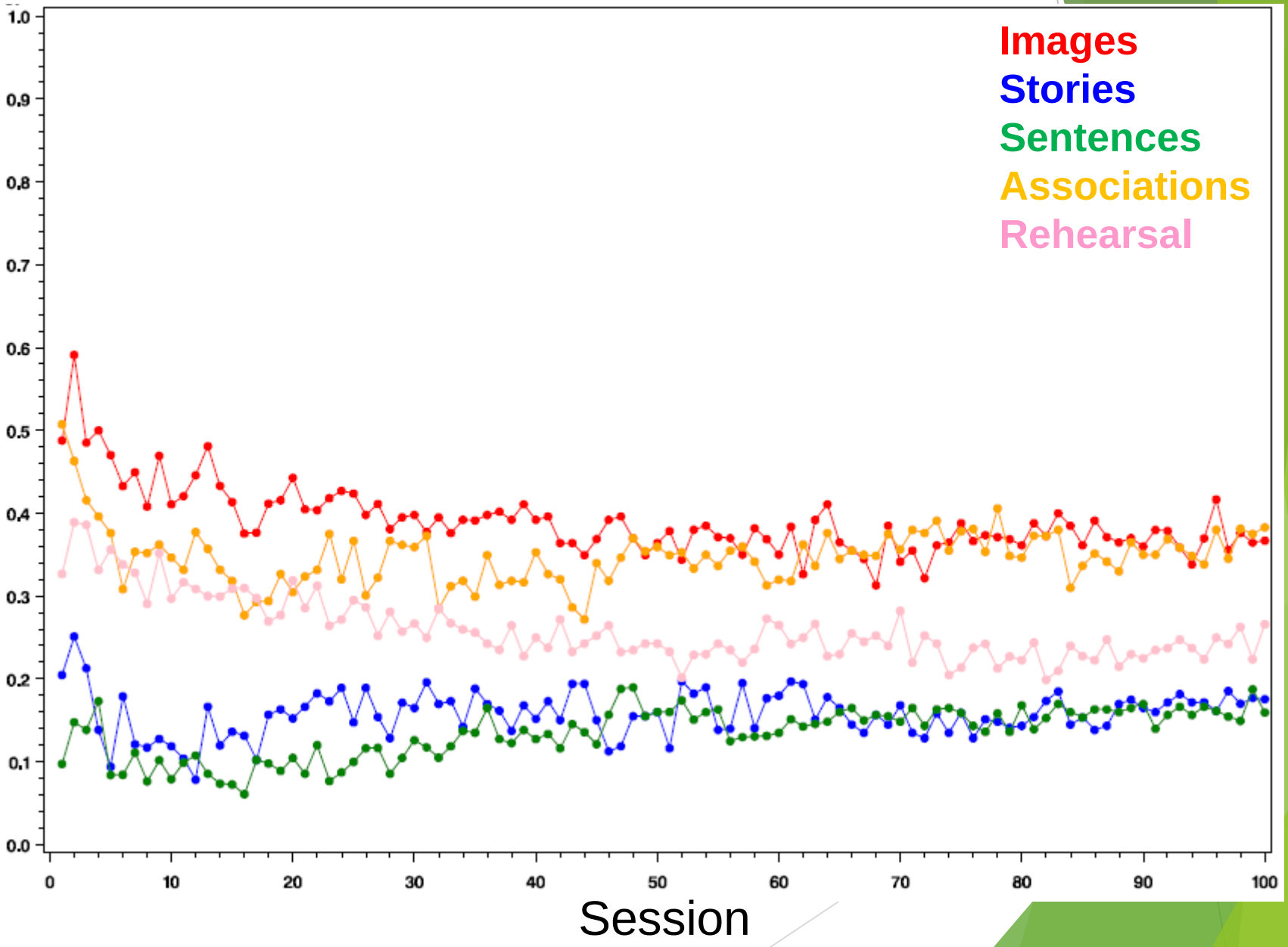
Have you used one or more of these strategies to memorize the numbers?

Have you…

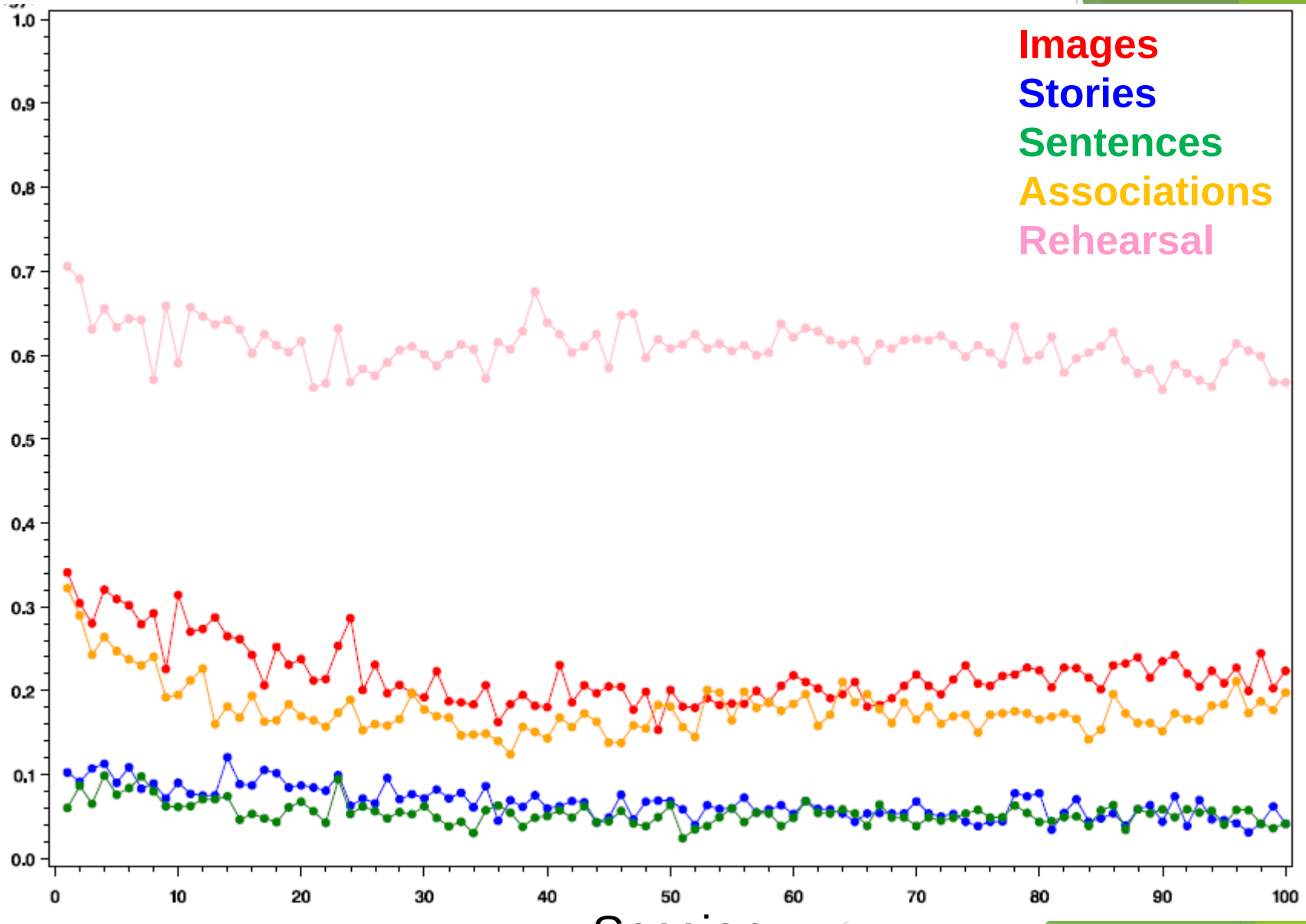
- *formed a **pictorial imagination** of the number-noun pairs?*
- *tried to combine the number-noun pairs into a **story**?*
- *tried to build one or more **sentences** that combine the number-noun pairs?*
- *used a specific **personal association** that came to your mind regarding the number-noun pairs?*
- *tried to remember the number-noun pairs with repeated silent **rehearsal**?*

- *Used another strategy? If so, which one?* _____

Average strategy use: Younger adults



Average strategy use: Older adults



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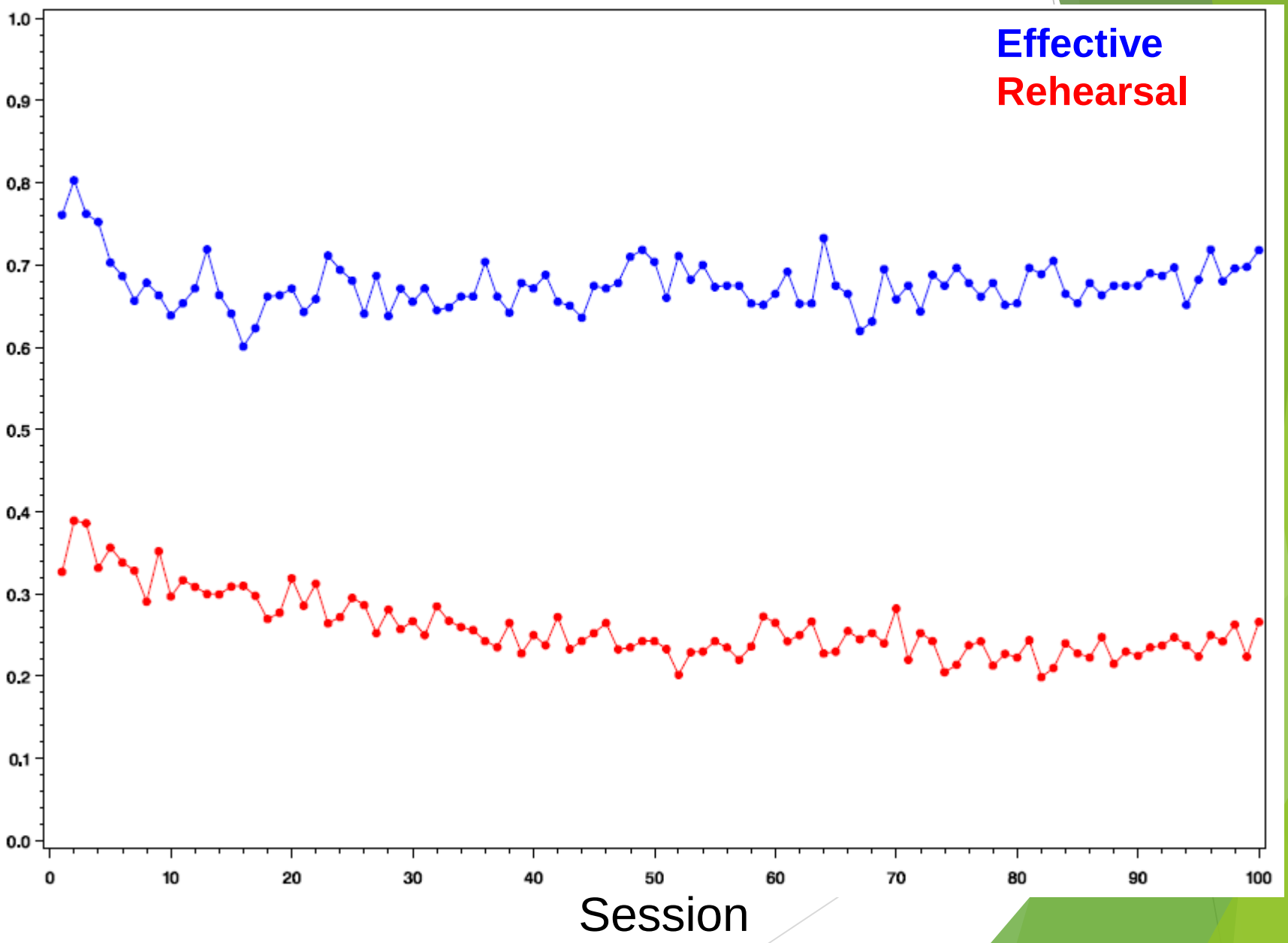

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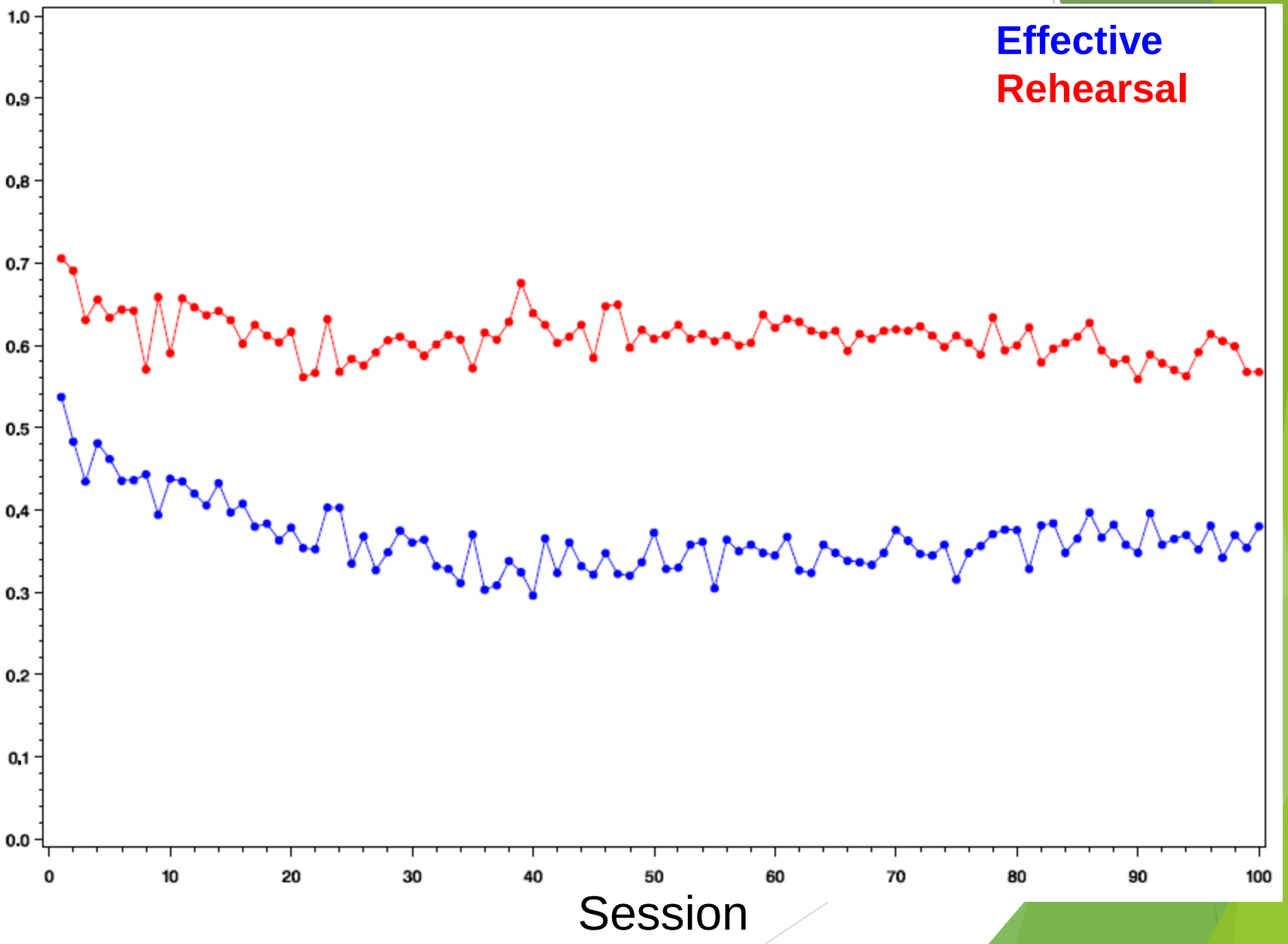
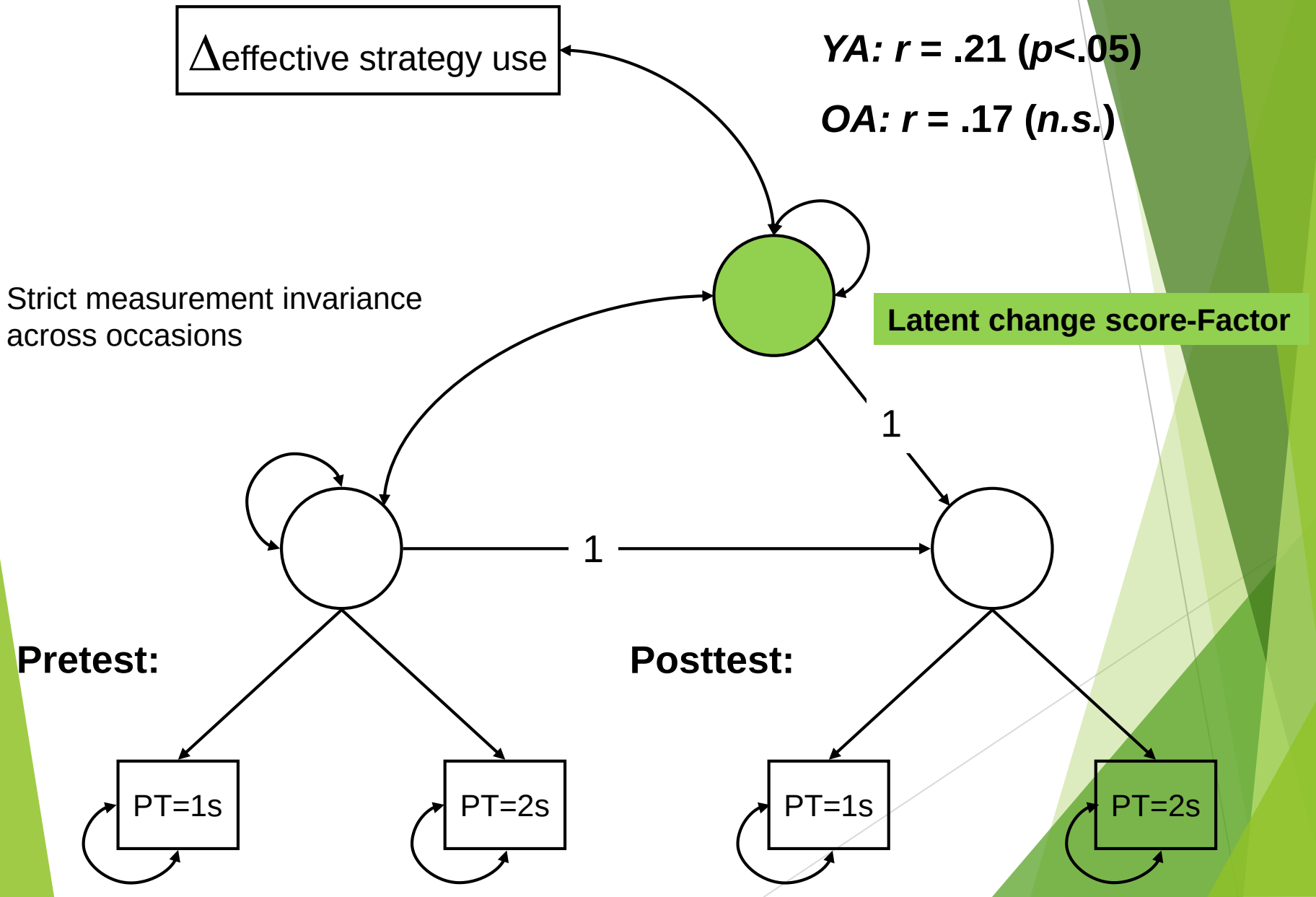


Correlations of changes in strategy use and performance



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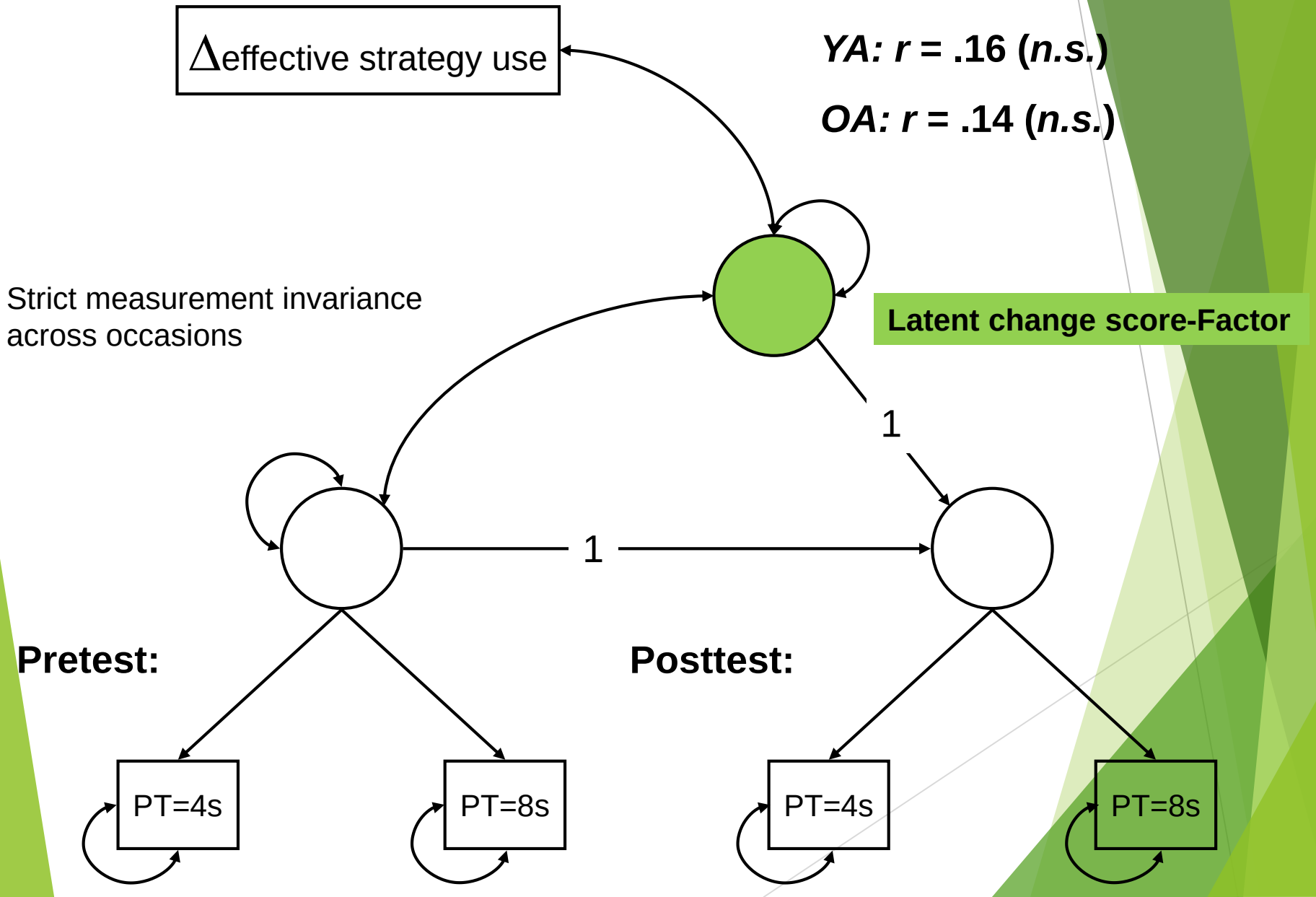


Within-person couplings of strategy use and daily performance

Mixed models with SAS PROC MIXED and logit(accuracy) as DV
Intraindividual means (M_Eff) and residuals (Res_Eff) of effective strategy use

Fixed effects:

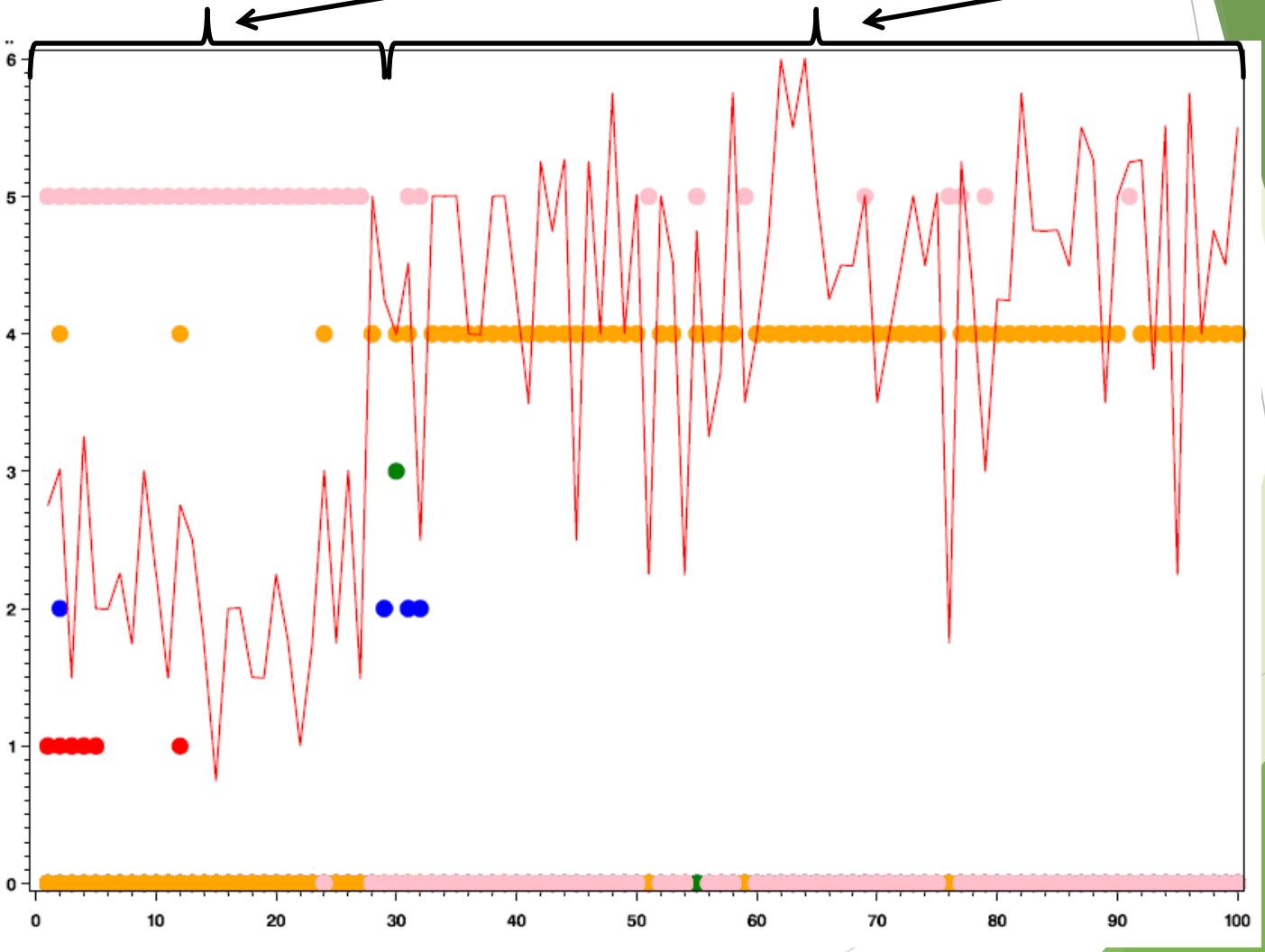
List:	.005 (SE=.0004, *p*<.05)
M_Eff:	2.22 (SE=.53, *p*<.05)
Res_Eff:	**1.21 (SE=.16, *p*<.05)**
Age group:	-.43 (SE=.22, *p*=.05)
M_Eff x Age group:	-.77 (SE=.33, *p*<.05)
Res_Eff x Age group:	**-.50 (SE=.10, *p*<.05)**

Random effects for Intercept, List, Res_Eff
(all *p*<.05, unstructured covariances)

→ Within-person couplings: Lists with effective strategy use are lists with better performance (accounting for longer-term trends and individual differences in level of strategy use),
But less so for OA

Illustrative examples

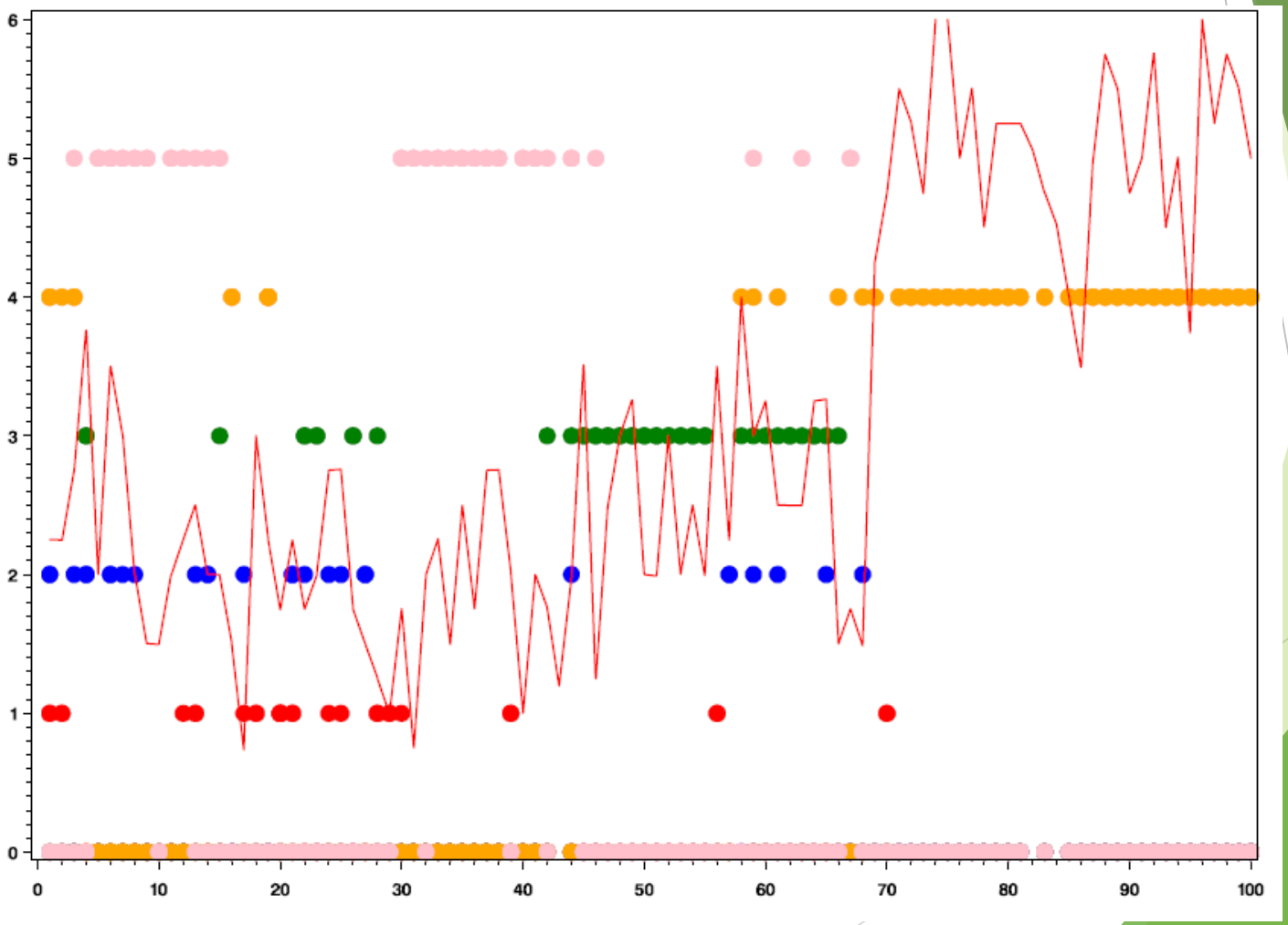
Younger adult who switched from rehearsal to use of personal associations



Fixed effect: 1.21
Individual effect: +.65

Illustrative examples

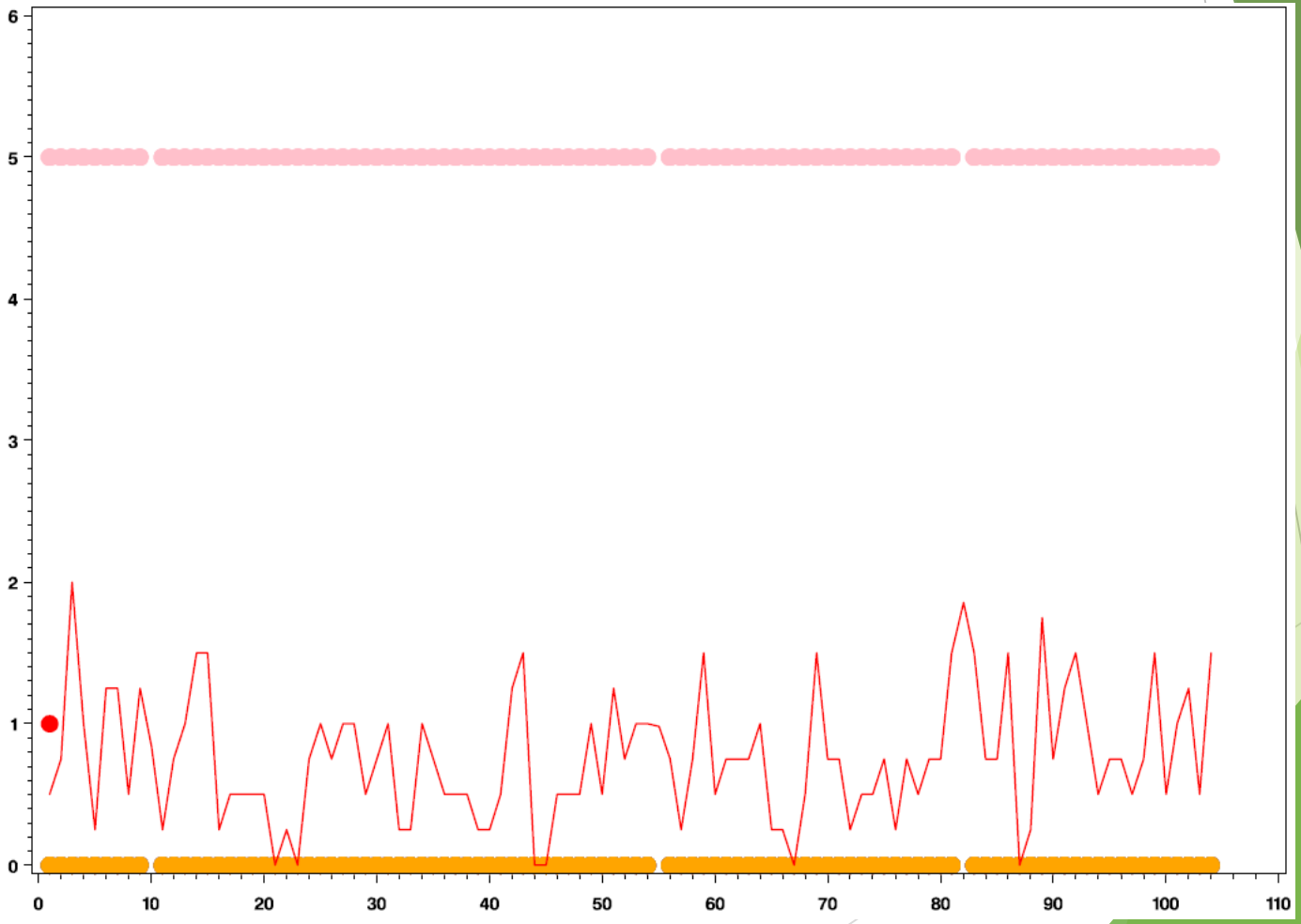
Younger adult who switched between different effective strategies



Fixed effect: 1.21
Individual effect: -.15

Illustrative examples

Older adult who only used rehearsal



Fixed effect: .78
Individual effect: -.01

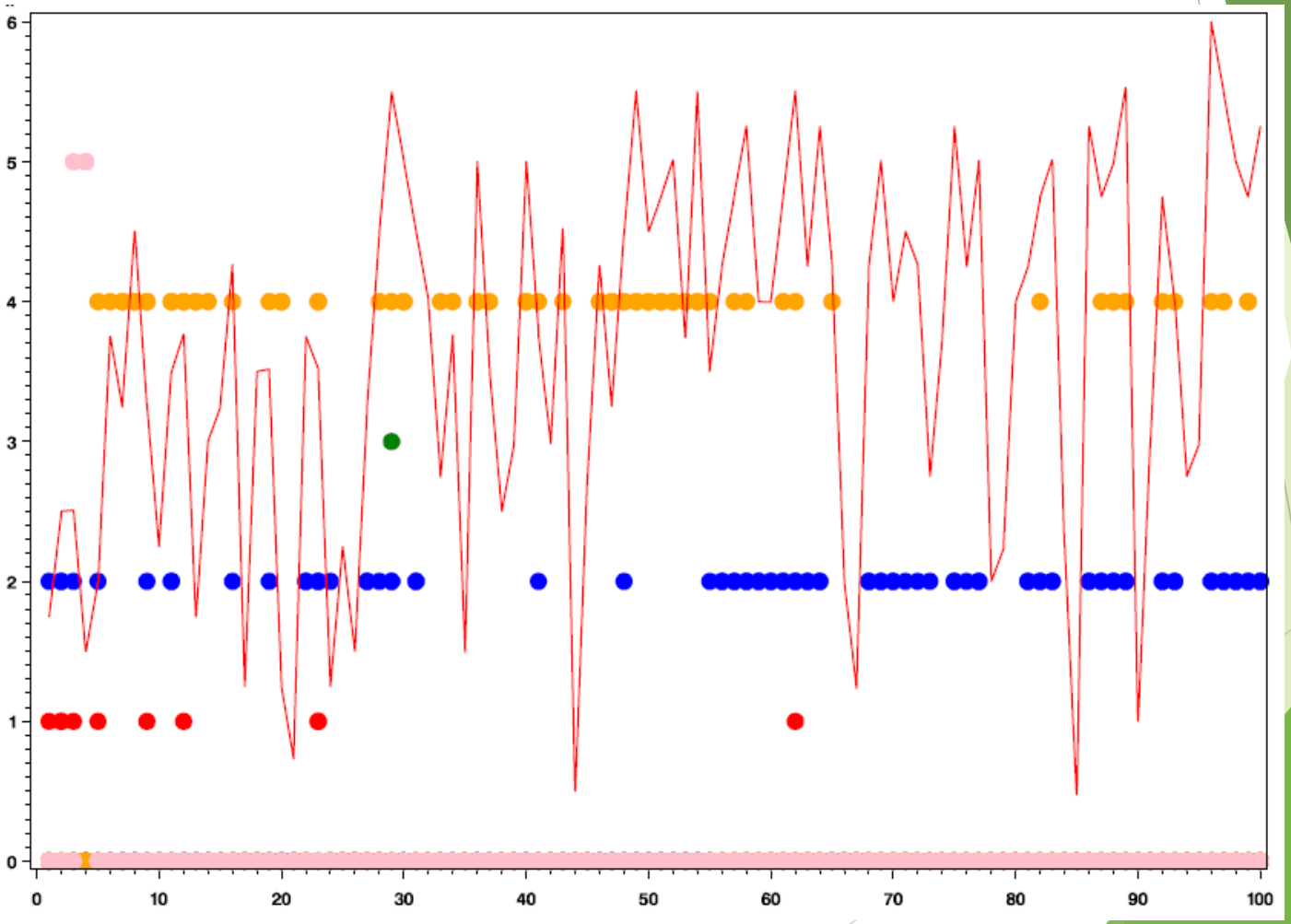
Illustrative examples

Older adult who started using associations

Fixed effect: .78
Individual effect: +.23

Illustrative examples

Younger adult with high individual coupling estimate because of comparatively bad performance on days when no effective strategies are used



Fixed effect: 1.21
Individual effect: +1.01

Experimental Approaches to aging…

Intervention designs, in which age is simulated (e.g., perceptual limits for younger adults) or age effects are tested for plasticity (e.g., training studies)

- Example: exercise intervention to test hypothesis that cerebral blood flow restrictions impact cognition in old age

Quasi-experimental design

- Art of creating ‘comparison’ or ‘control’ groups when true experiments (random assignment) not possible
- Matching or ‘case-control’ studies
  - Find persons just like the ones who have an existing condition in all respects other than having the condition you are studying
- Problem: how do you know they are = ?