UNIVERSITÄT DES SAARLANDES

Age Differences in the Transfer of Task-Switching Training: The Impact of Working Memory and Inhibition Control Demands

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Adaptive Minds

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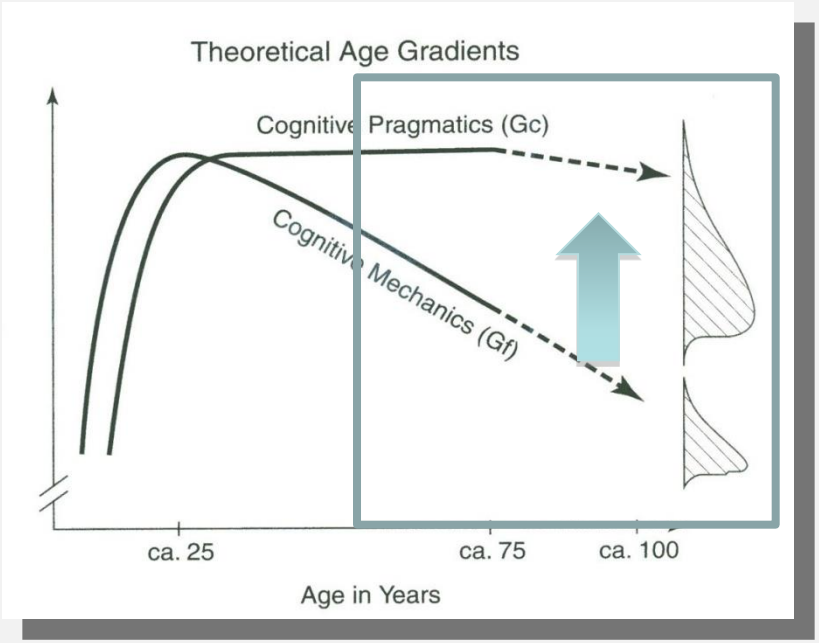
Research Questions

- What are the *potentials/limits* of cognitive enhancement in older age induced by practice in task switching?
- Do we find age differences in training success (i.e. *transfer* to untrained cognitive tasks)?



- How important is the *type of training*? Are higher demands on working memory and inhibitory control critical for the training success in younger and older adults?

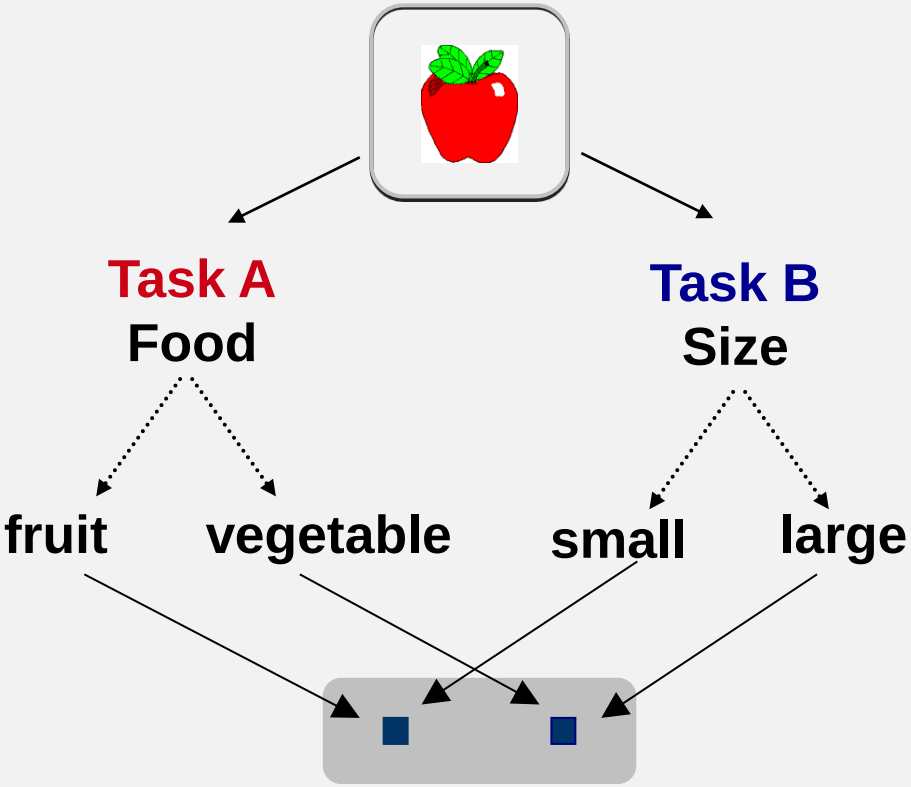
Task Switching & Aging

- Task switching as a key component of cognitive control *(for a review see Kiesel et al., 2010)*
- Larger age differences in task switching at the global than at the local level *(for reviews see Kray & Ferdinand, 2014; Wasylyshyn et al., 2011; see also Karayanidis et al., 2011)*
  - *general switch costs (mixed tasks/single tasks) > specific switch costs (switch/repetition trials)*
- Older adults' impairments in maintaining/biasing of relevant task-set representations *(Braver & Barch, 2002; Miller & Cohen, 2001*
  - *overlapping task-set representations (e.g., Mayr, 2001)*
  - *prefrontal networks*

Practice & Transfer of Training in Task Switching

- Enhancement of task switching (reduction of task-switching costs with practice) in younger and older adults *(e.g., Cepeda et al., 2001; Kray & Lindenberger, 2000)*
- Near transfer to untrained, but structurally similar switching tasks
  - *compensation model* *(e.g., Karbach & Kray, 2009)*
- Mixed results for far transfer effects to other cognitive task domains
  - *improvements in WM, inhibitory control, fluid intelligence* *(Karbach & Kray, 2009; Kray et al., 2012; but see Pereg et al., 2013; Zinke et al., 2012)*

However ...Why This Broad Transfer?



tasks & stimuli in the Karbach & Kray 2009 study

- ambiguity at stimulus and response level
  - *high demands on interference control*
- no task cues but predictable sequences of **AABBAABB**
  - *high demands on keeping track the task sequence*

Main Goals

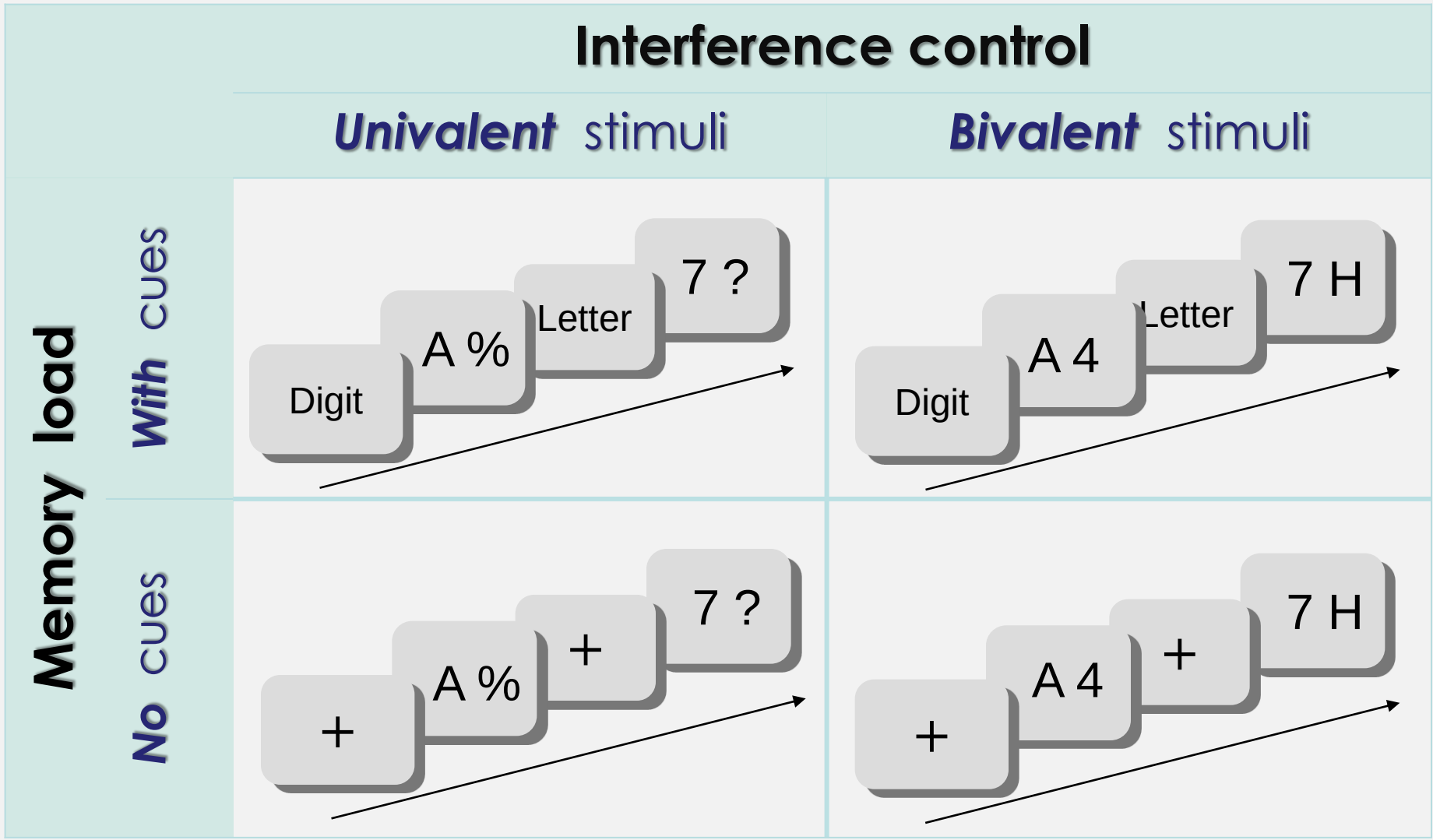
To determine ...

(1) the relative contribution of different cognitive control components by varying demands on
   - interference control (stimulus ambiguity)
   - working memory (task cueing)
   - switching

(2) the transfer scope

(3) long-term maintenance of training effects (after 6 months)

Training Conditions



Study Design

Pretest
(1 session)

Task switching
(A or B) (A and B)

- **Inhibition**
  - Color Stroop
  - Num Stroop
- **Verbal WM**
  - Reading span
  - Counting span
- **Updating**
  - n-back
  - AX-CPT)
- **Reasoning**
  - Raven
  - Bomat

Training
(4 sessions)

Training groups:

(1) Single tasks (C or D)

(2) Task switching (C + D):
with cues – univalent

(3) Task switching (C + D):
no cues – univalent

(4) Task switching (C + D):
with cues – bivalent

(5) Task switching (C + D):
no cues - bivalent

Posttest 1
(1 session)

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(A or B) (A and B)

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Prediction

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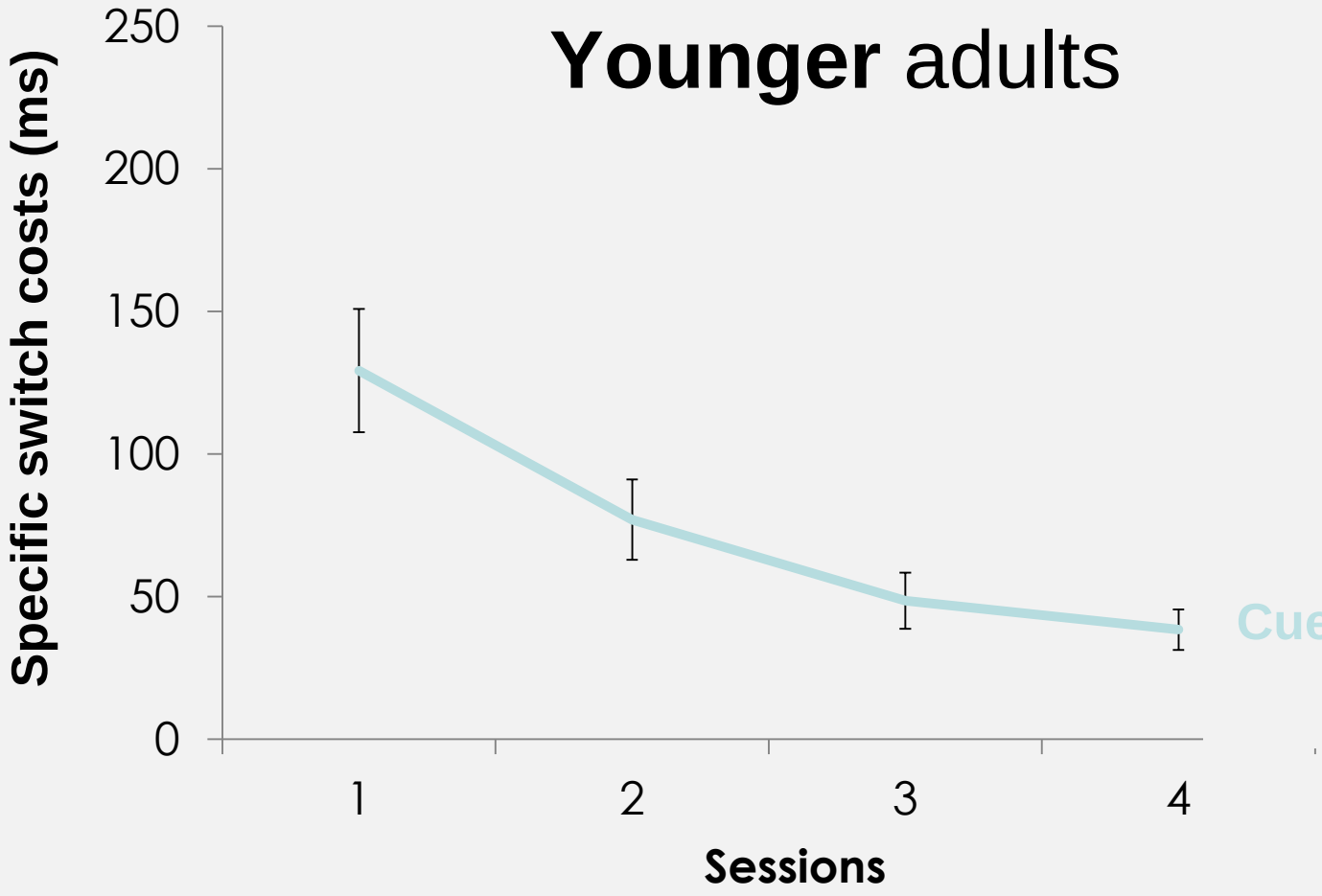
Results: Training Data



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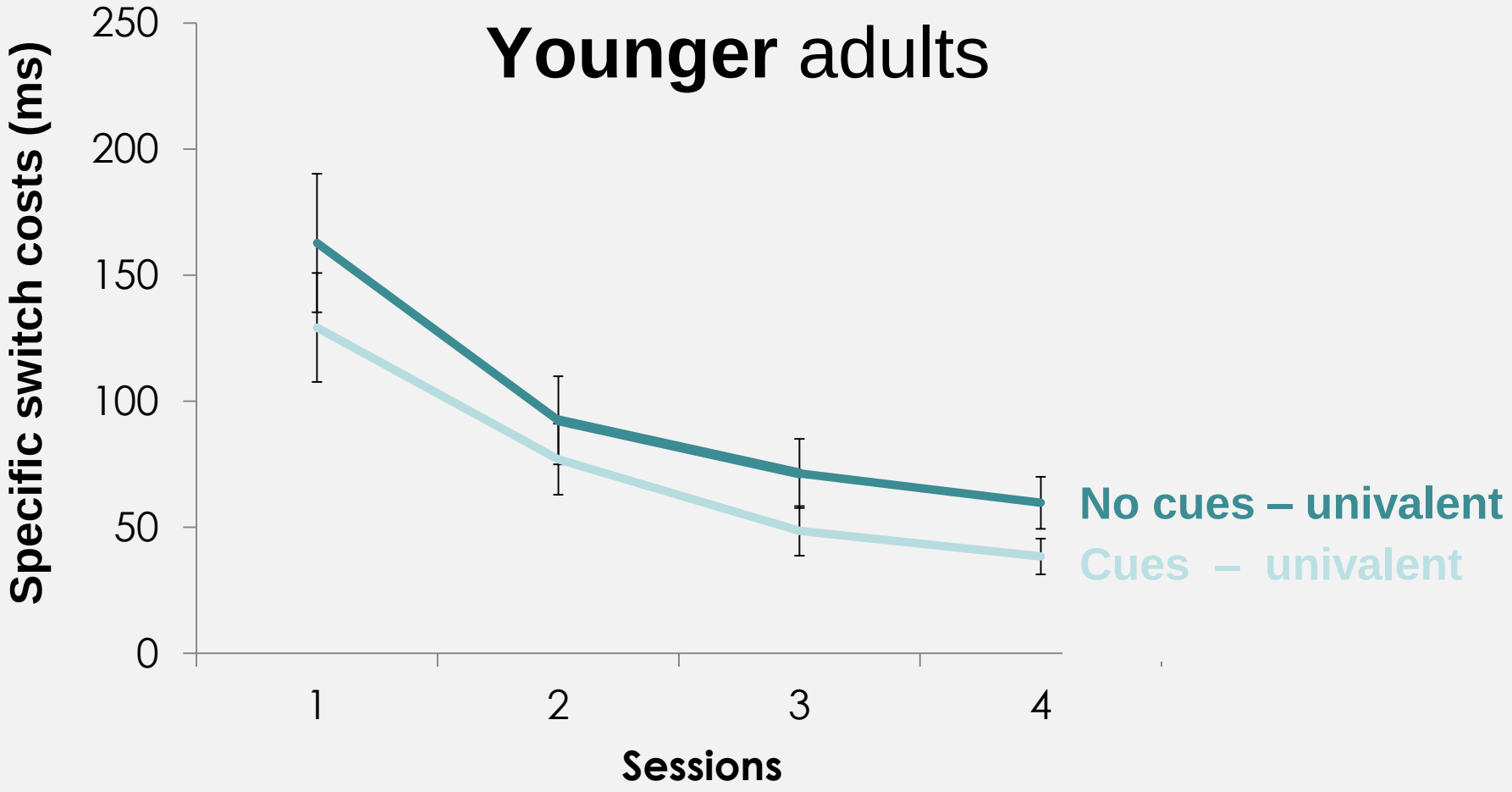

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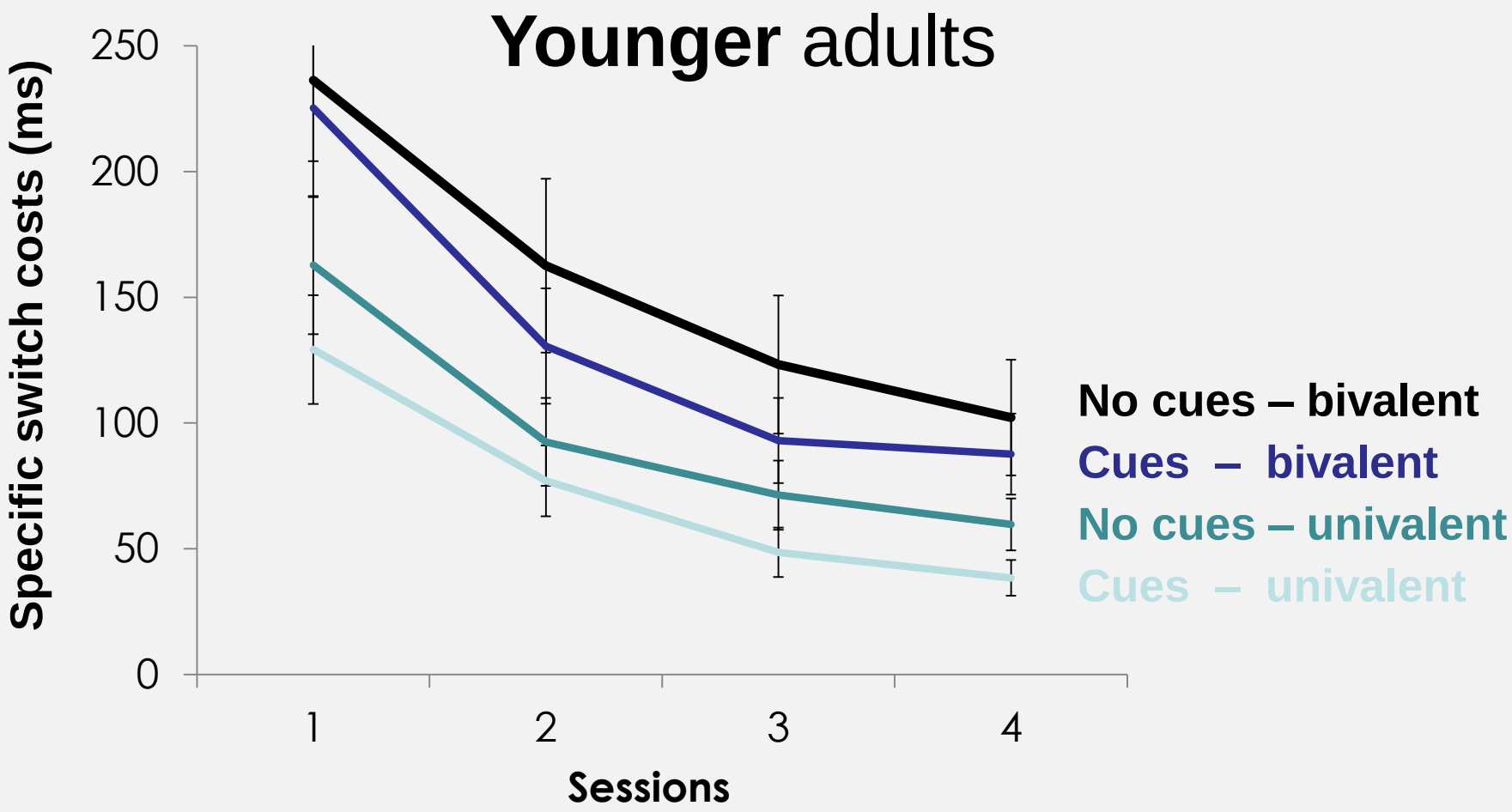

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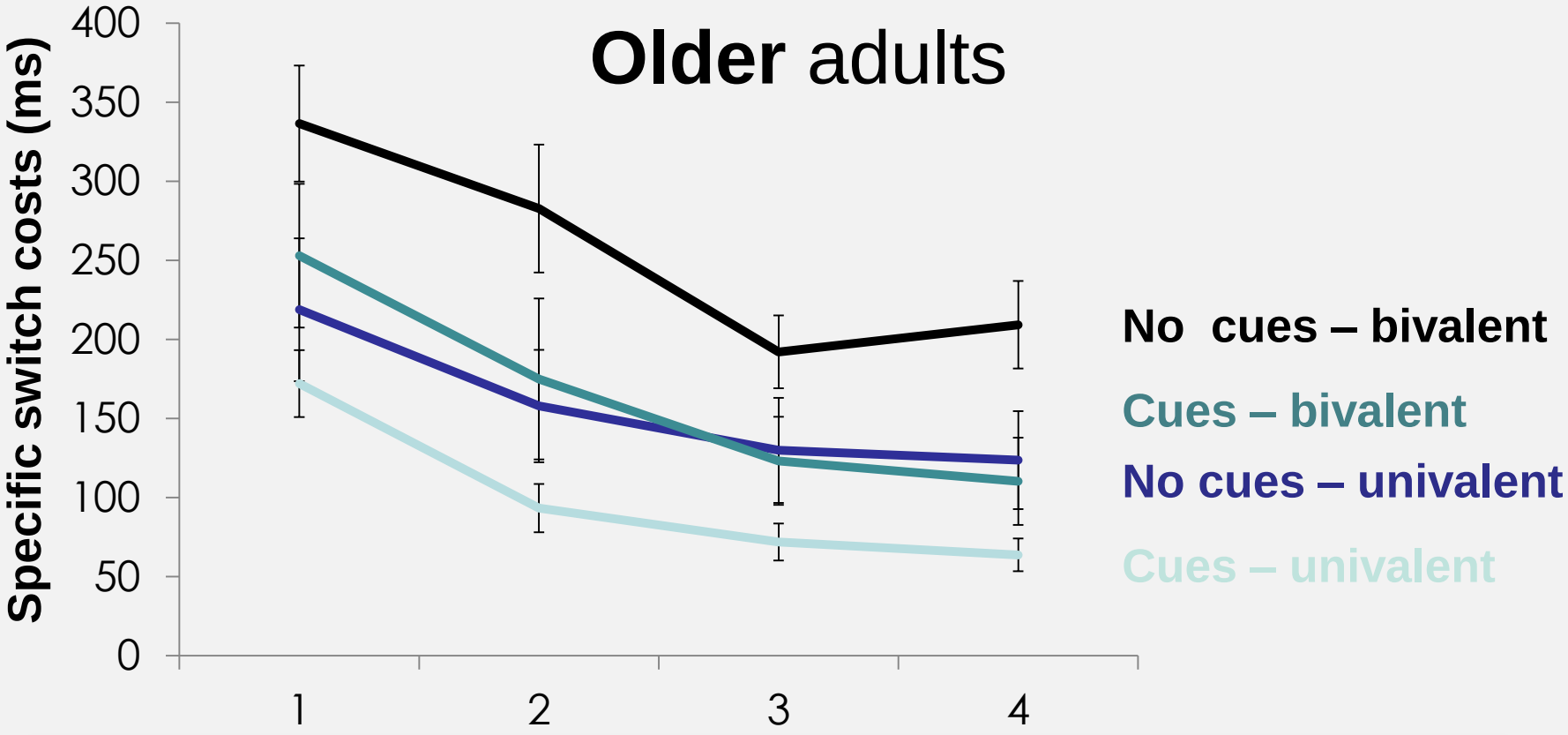
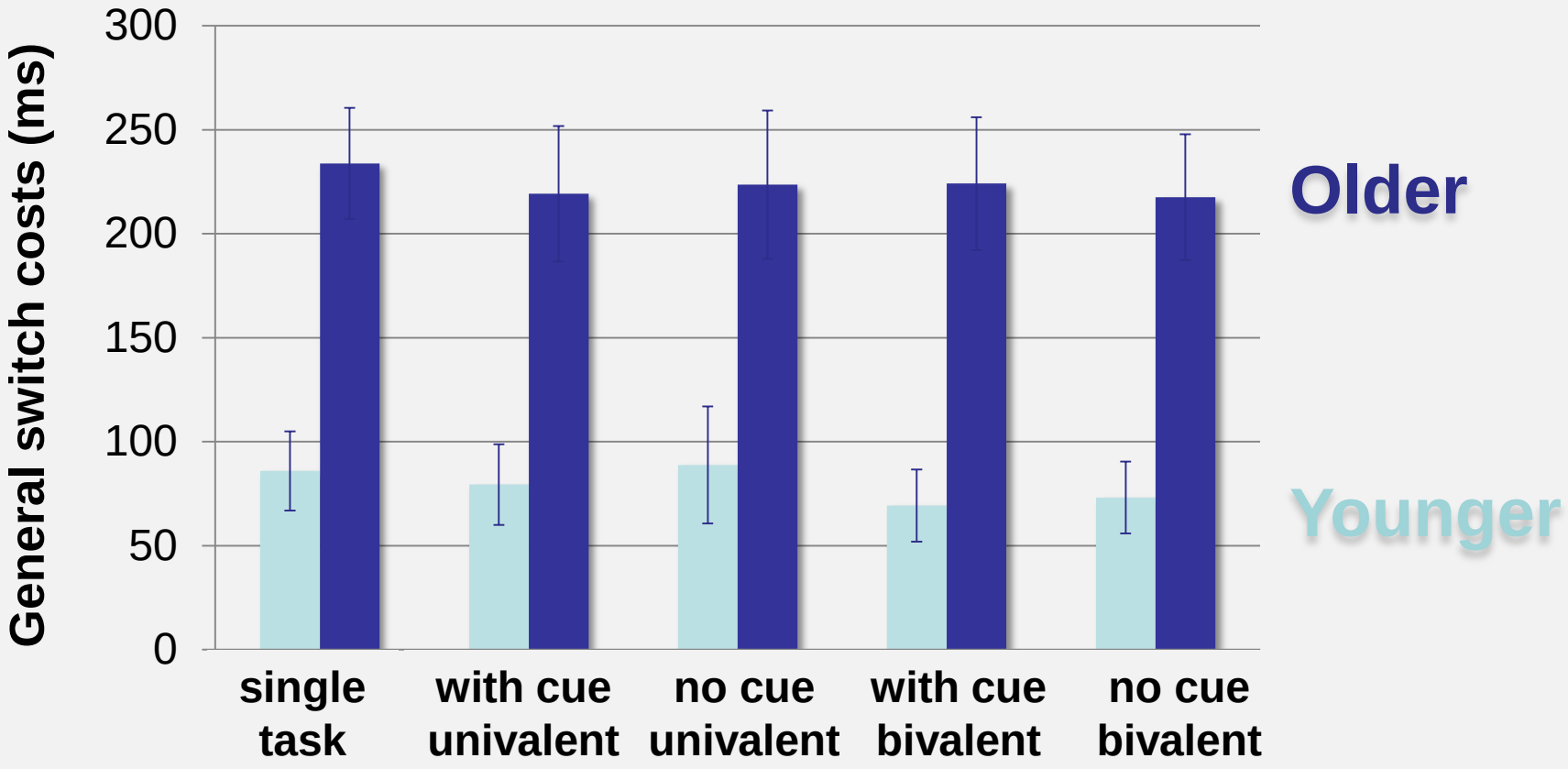
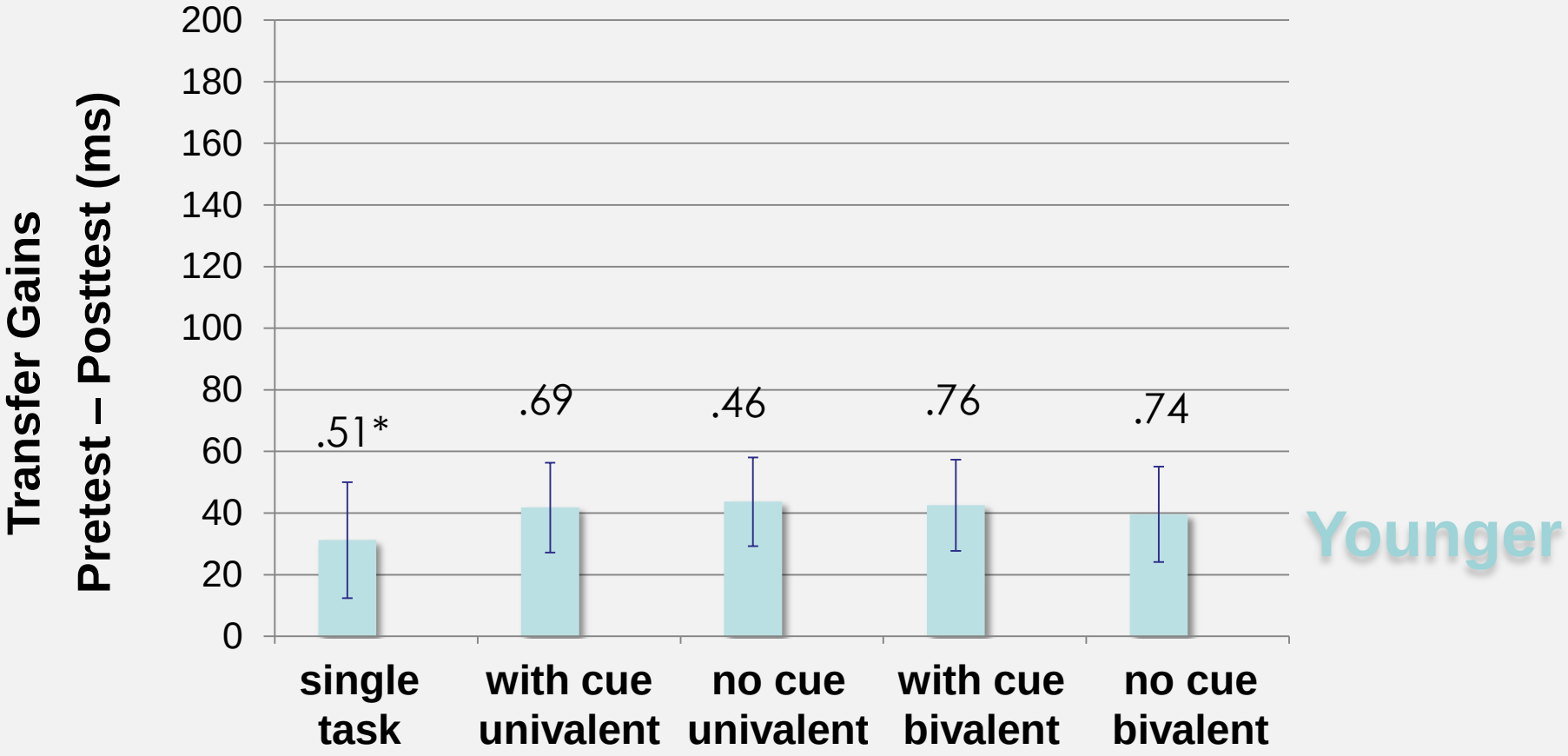


→ *No differences in training-related improvements in task switching across training and age groups*

Baseline Performance

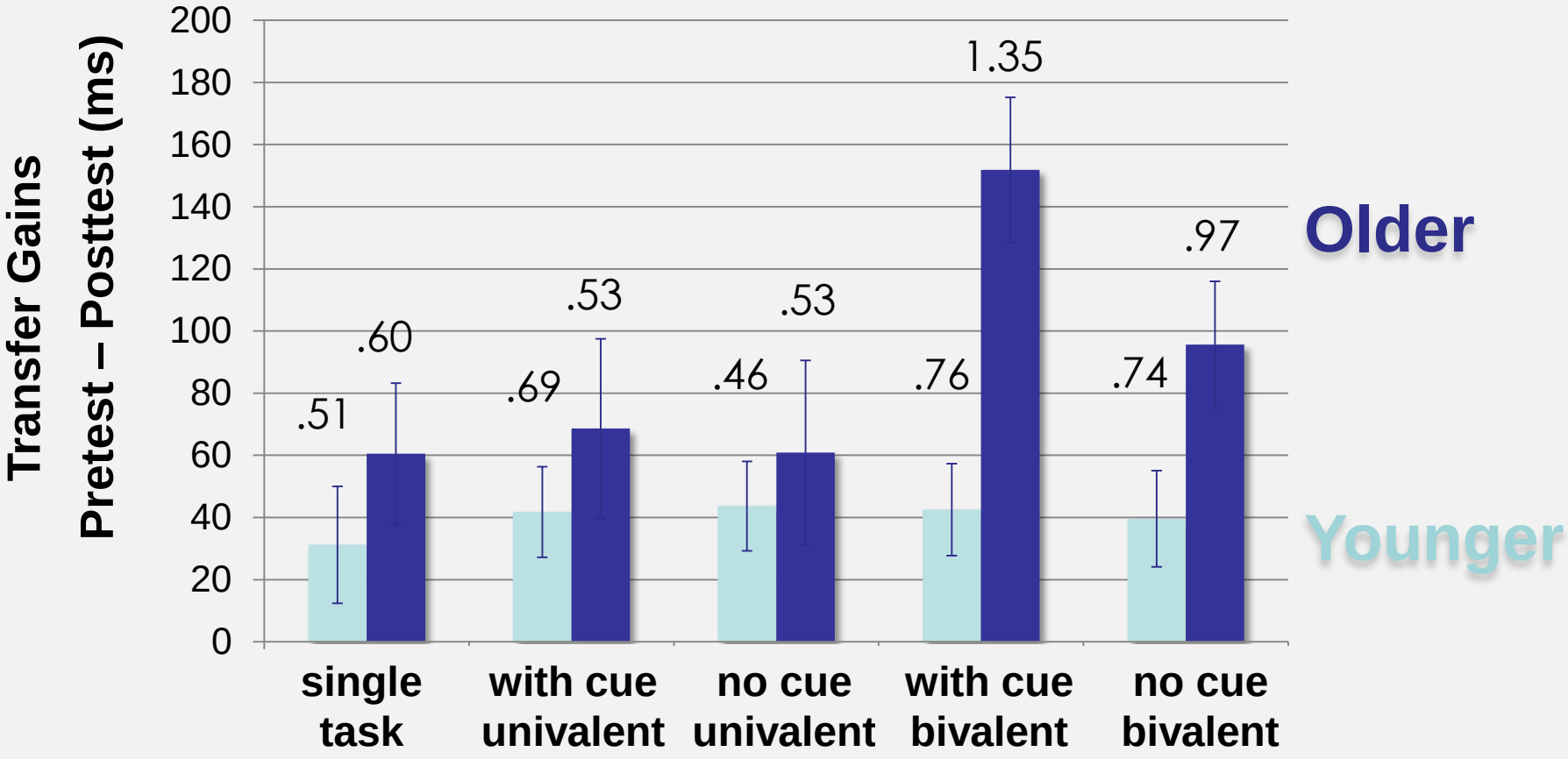


Results: Near Transfer



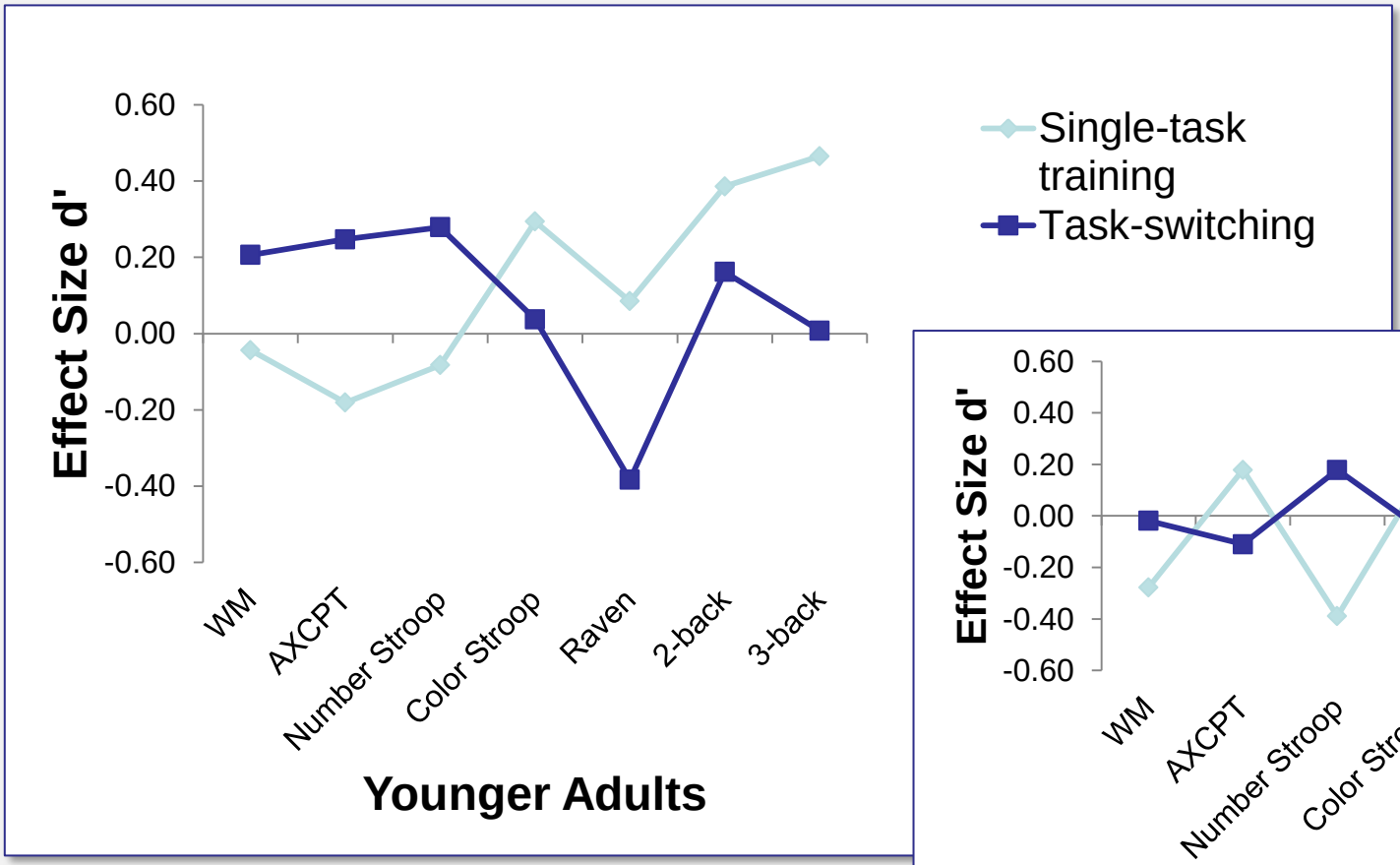
* values correspond to Cohen‘s d‘

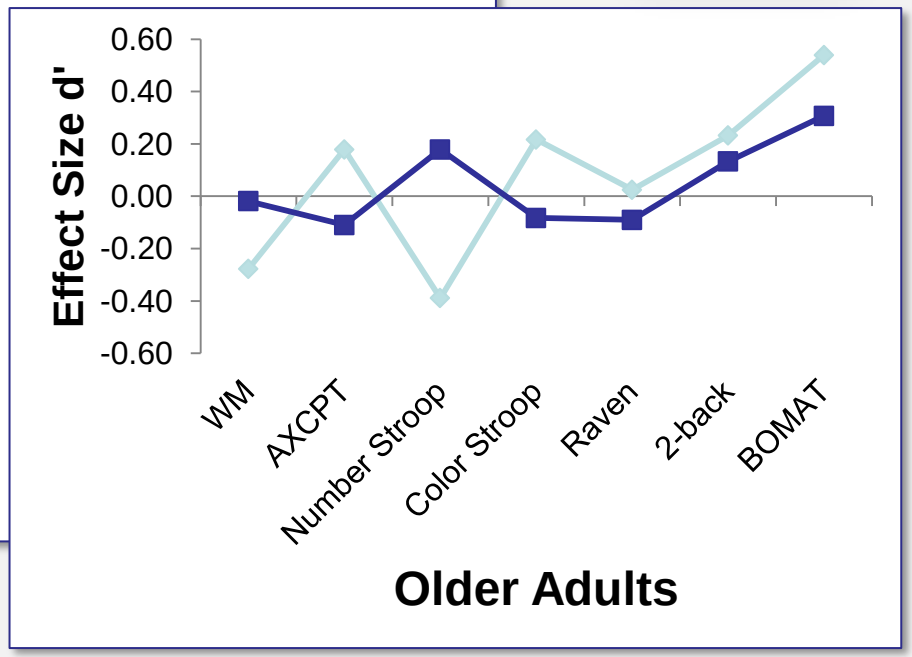
Results: Near Transfer



Older: resolving task interference in a dual-task situation

Results: Far Transfer





Summary

- smaller switch costs when task ambiguity and memory load is reduced (treatment effects of training condition)
- large enhancements of task-switching performance in younger and older adults (*d ‘* = .62 - 1.59)
- larger near transfer effects in older adults than in younger adults
  - *resolving interference in a switching situation*
    - *Multi-tasking training enhanced midline frontal power and frontal-posterior theta coherence* *(see Anguera et al., 2013)*
- no far transfer to other cognitive control tasks

Discussion & Conclusion

- Why no far transfer ?
  - *High performance at pretest ...*
  - *Less reliable measures ...*
  - *Task-specific features: A4 versus* 
- Training enhancing prefrontal control networks in order to promote resolving interference in multitasking situations may be the most promising training intervention in the elderly

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Jenny Sinzig

THANK YOU FOR YOUR ATTENTION !

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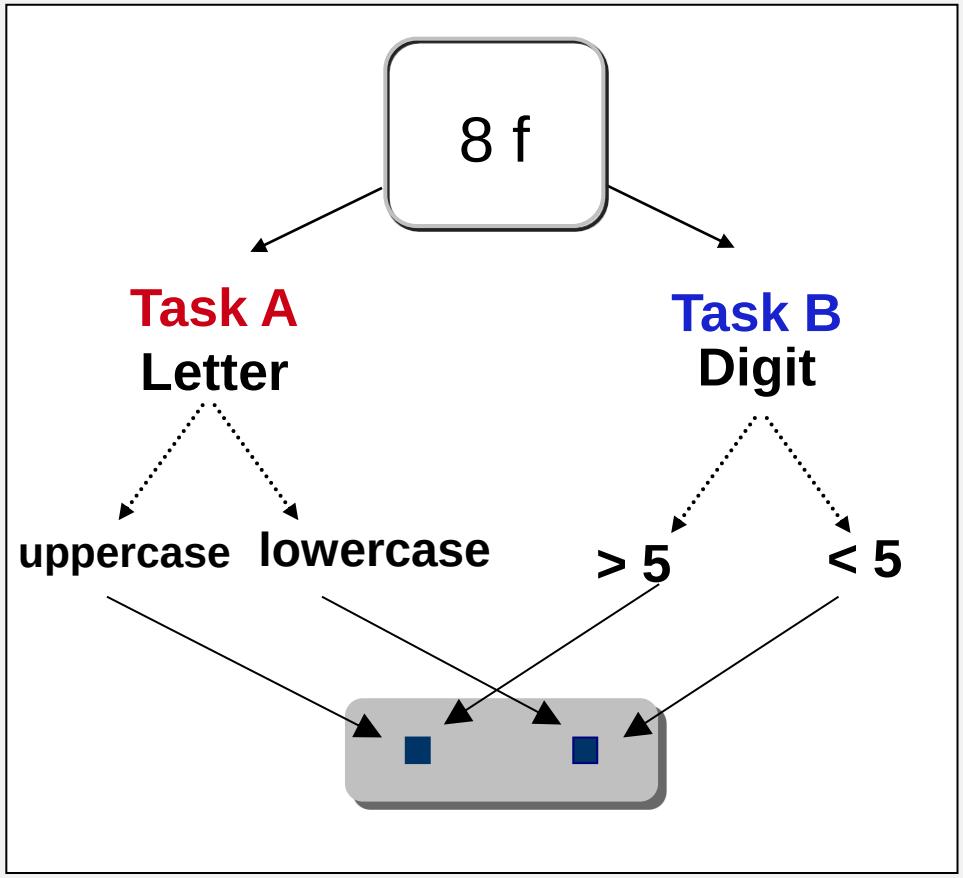
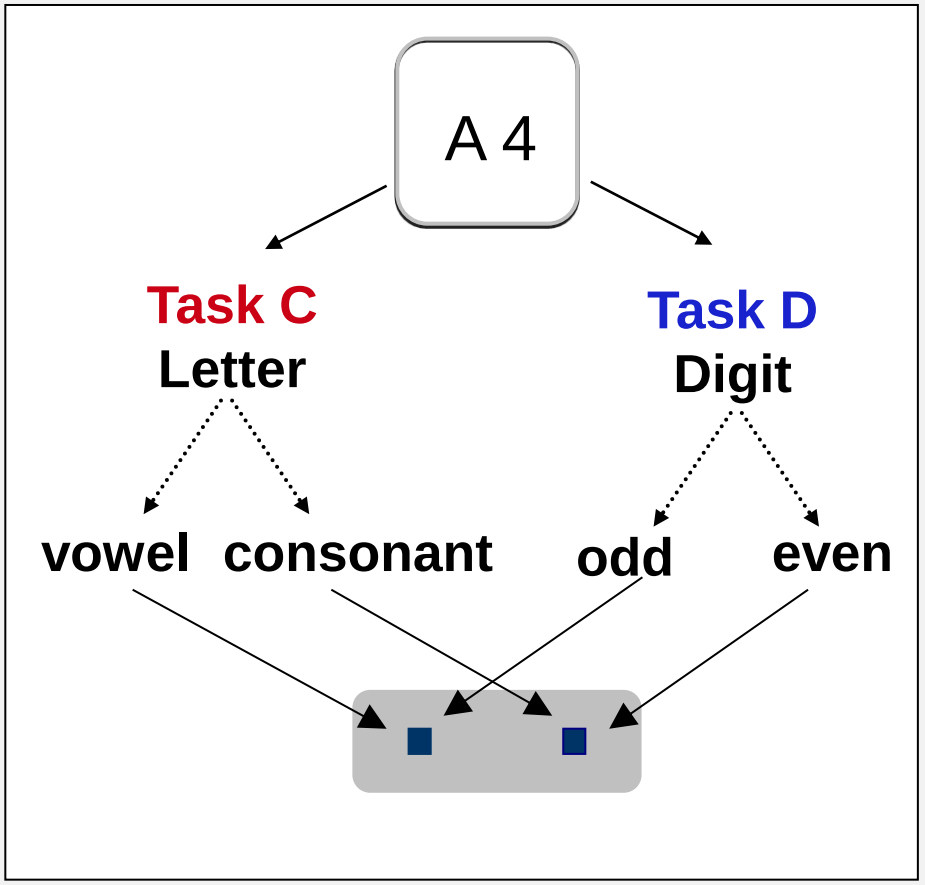
Pre- and Posttest Tasks



Training Tasks



Measurement of Task Switching

Single task blocks: **A A A A A A** … (Animal)
B B B B B B … (Color)

Mixed task blocks: **A A** B B **A A** B B …

General switch costs =

mixed – single tasks

⇨ Maintaining / Selection between tasks

e.g., Kray & Lindenberger, 2000

Measurement of Task Switching

Single task blocks: **A A A A A A** … (Animal)
B B B B B B … (Color)

Mixed task blocks: **A A** B B **A A** B B …

Specific switch costs =

Switch trials (A , A) – repetition trials (AA,)

⇨ switching at a local level

Lifespan Changes in Task Switching