

Effects of Working Memory Training in Young and Older Adults

Claudia von Bastian

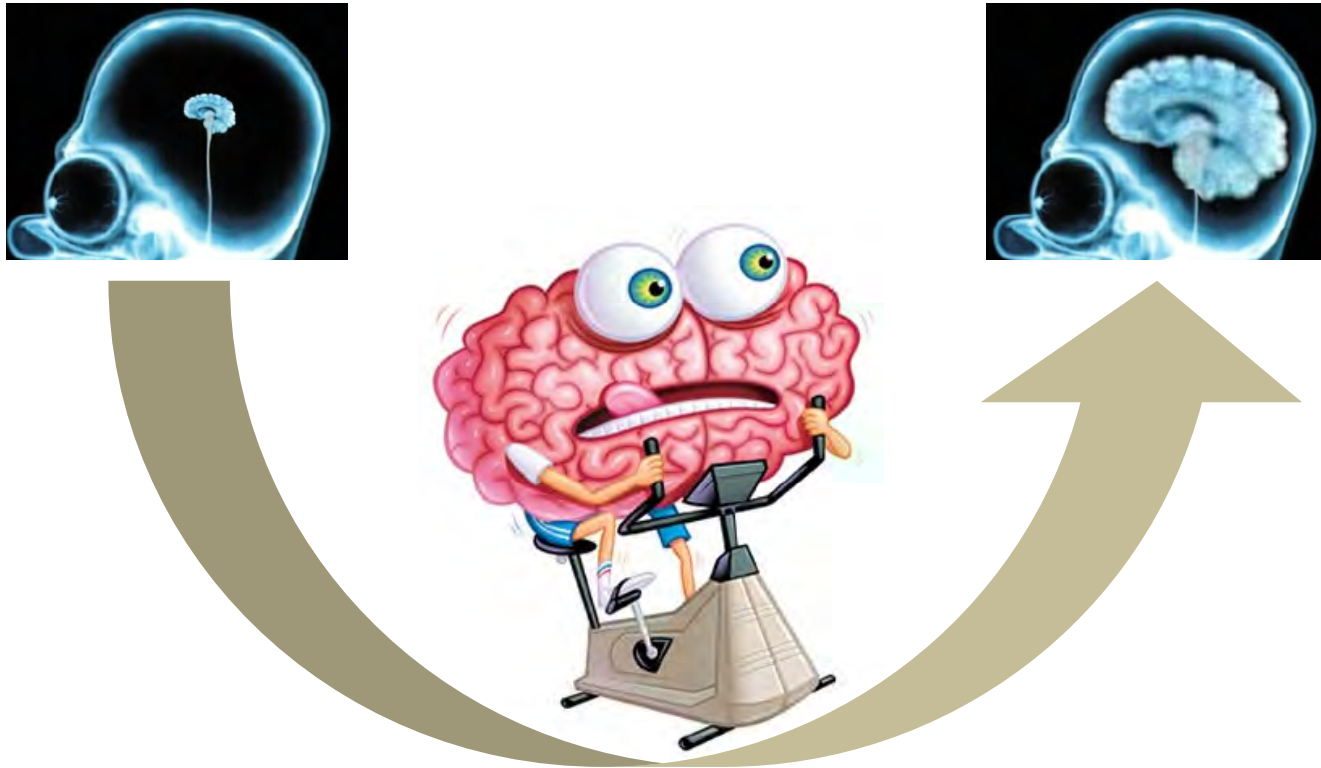


University of
Zurich^{UZH}

Dynamics of Healthy Aging

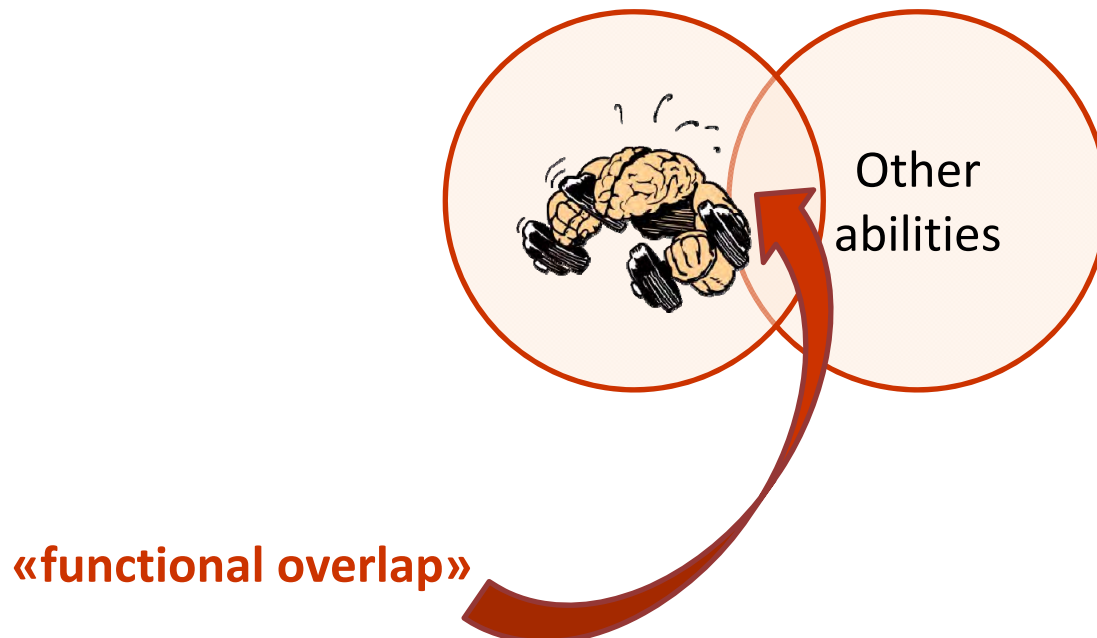


Cognitive Training



Training and Transfer Effects

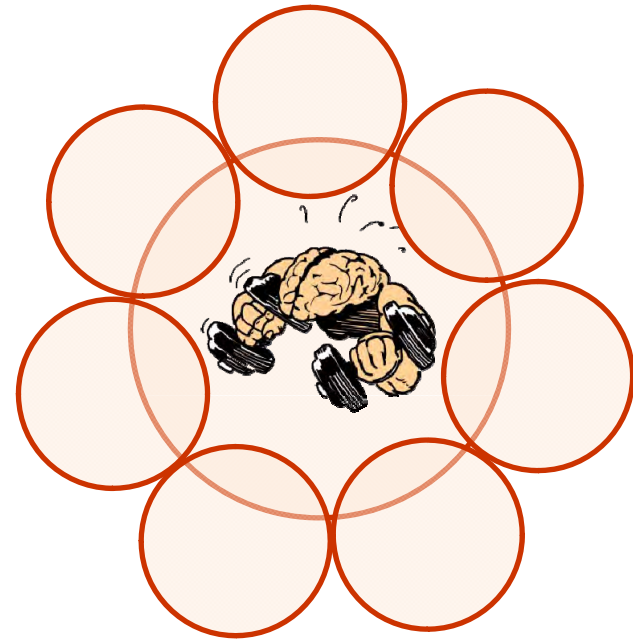
Transfer is the generalisation of improvements in a practiced tasks to other non-practiced tasks. Transfer is expected, if practiced and non-practiced tasks share underlying processes (**functional overlap**).



Training and Transfer Effects

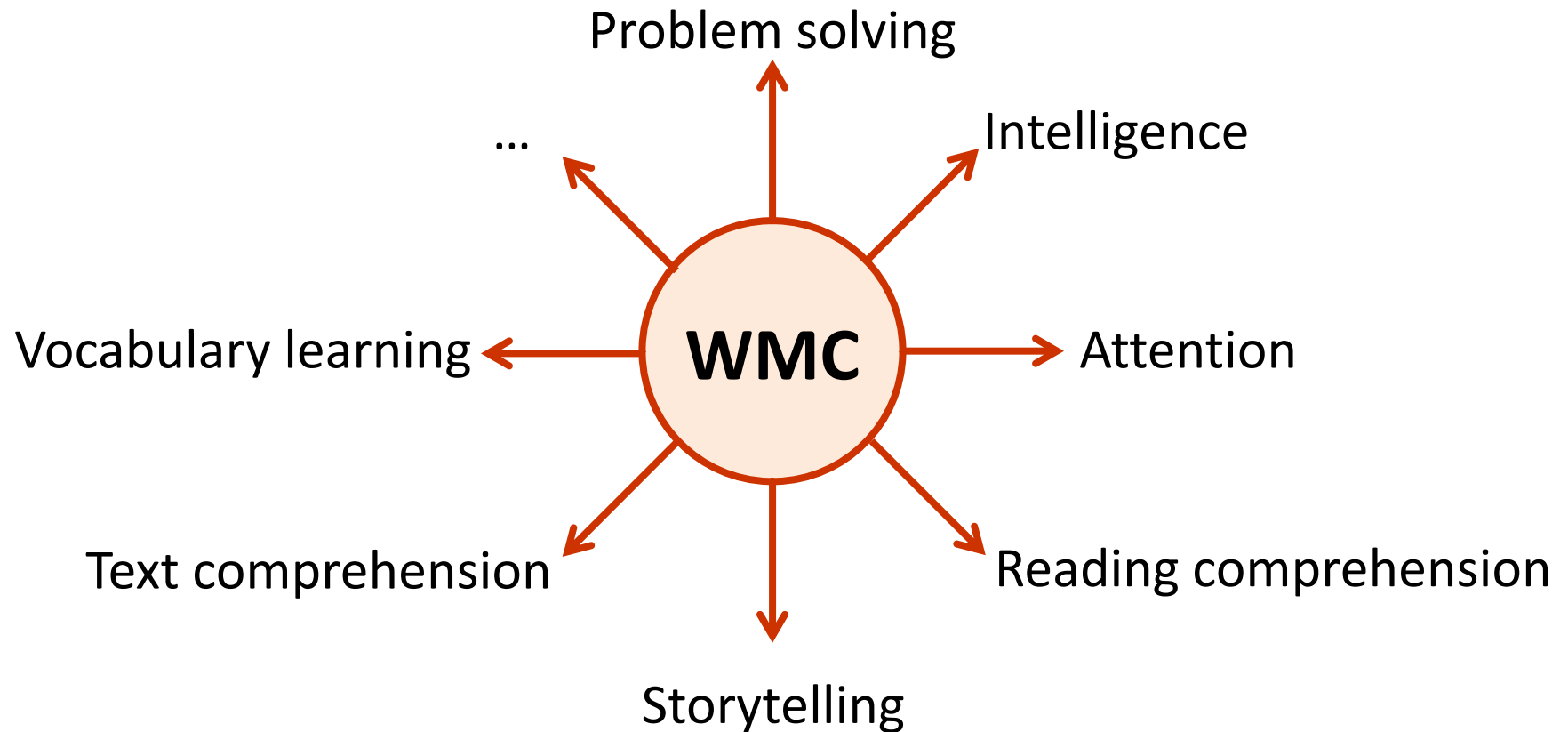
A basic cognitive ability which correlates positively with multiple other abilities would be an ideal candidate to induce broad transfer.

→ **Working memory**



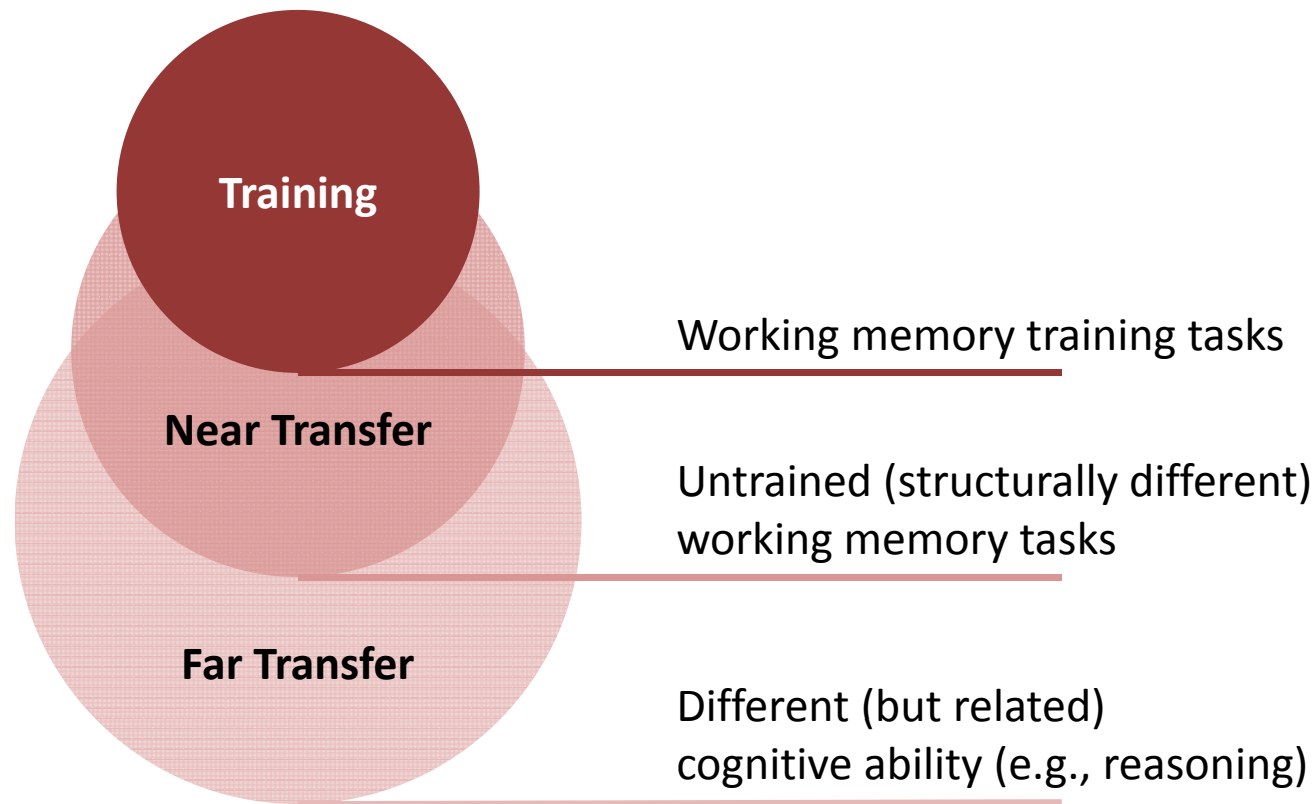
Training and Transfer Effects

Working Memory Capacity (WMC)



Barrett, Tugade, & Engle (2004)

Training and Transfer Effects



Empirical Evidence

Can we get any smarter through training?



“Yes, we can!”

e.g., Borella, Carretti, Riboldi, & De Beni (2010); Jaeggi et al. (2008); Jaeggi et al. (2010); Jausovec & Jausovec (2012); Karbach & Kray (2009); Klingberg et al. (2005); Stepankova et al. (2014); ...



“No, we can’t.”

e.g., Chooi & Thompson (2012); Colom et al. (2010); Harrison et al. (2013), Holmes, Gathercole, & Dunning (2009); Nouchi et al. (2012); Owen et al. (2010); Redick, Shipstead, et al. (2013); ...

Reasons for Inconsistencies

Methodological issues

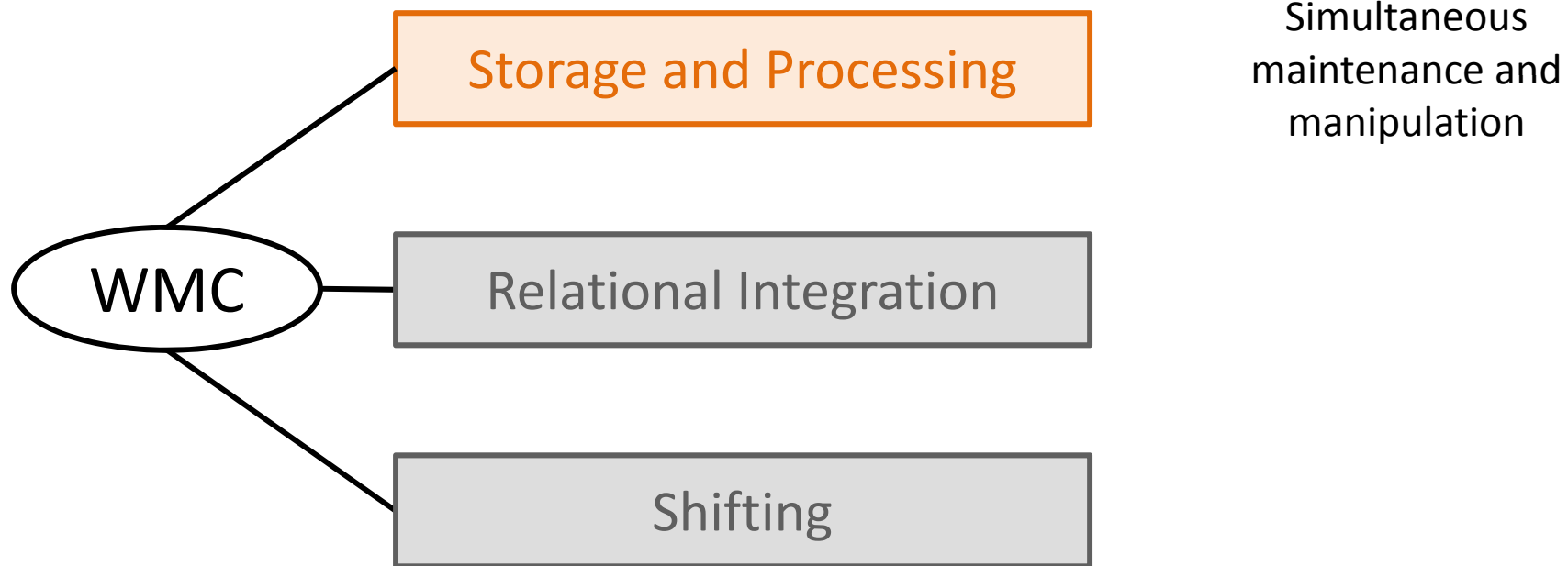
- Lack of theory-driven selection of training tasks
- Single indicators to measure cognitive abilities
- Lack of active control groups

Does working WM training enhance fluid cognitive abilities with a methodological sound design?

cf. Shipstead, Redick, & Engle (2012)

Theory-Driven Task Selection

Facet model of working memory capacity



Oberauer et al. (2000; 2003)

Theory-Driven Task Selection

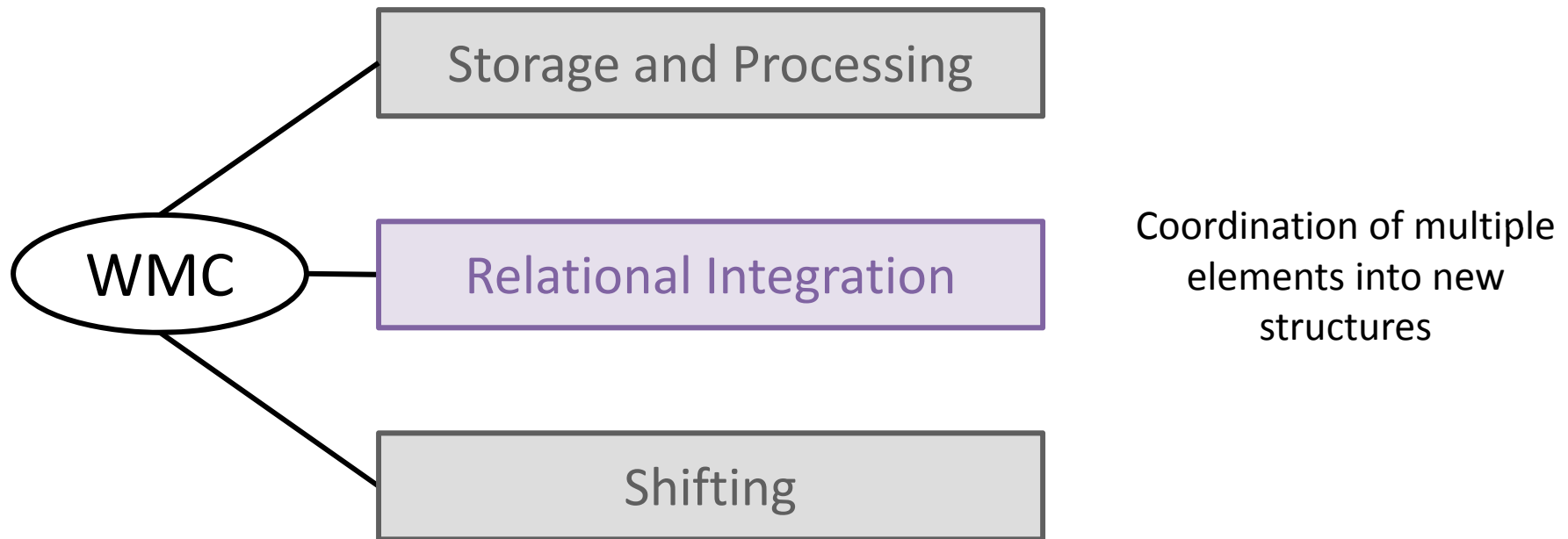
Storage and Processing

Complex Span

Recall numbers:

Theory-Driven Task Selection

Facet model of working memory capacity



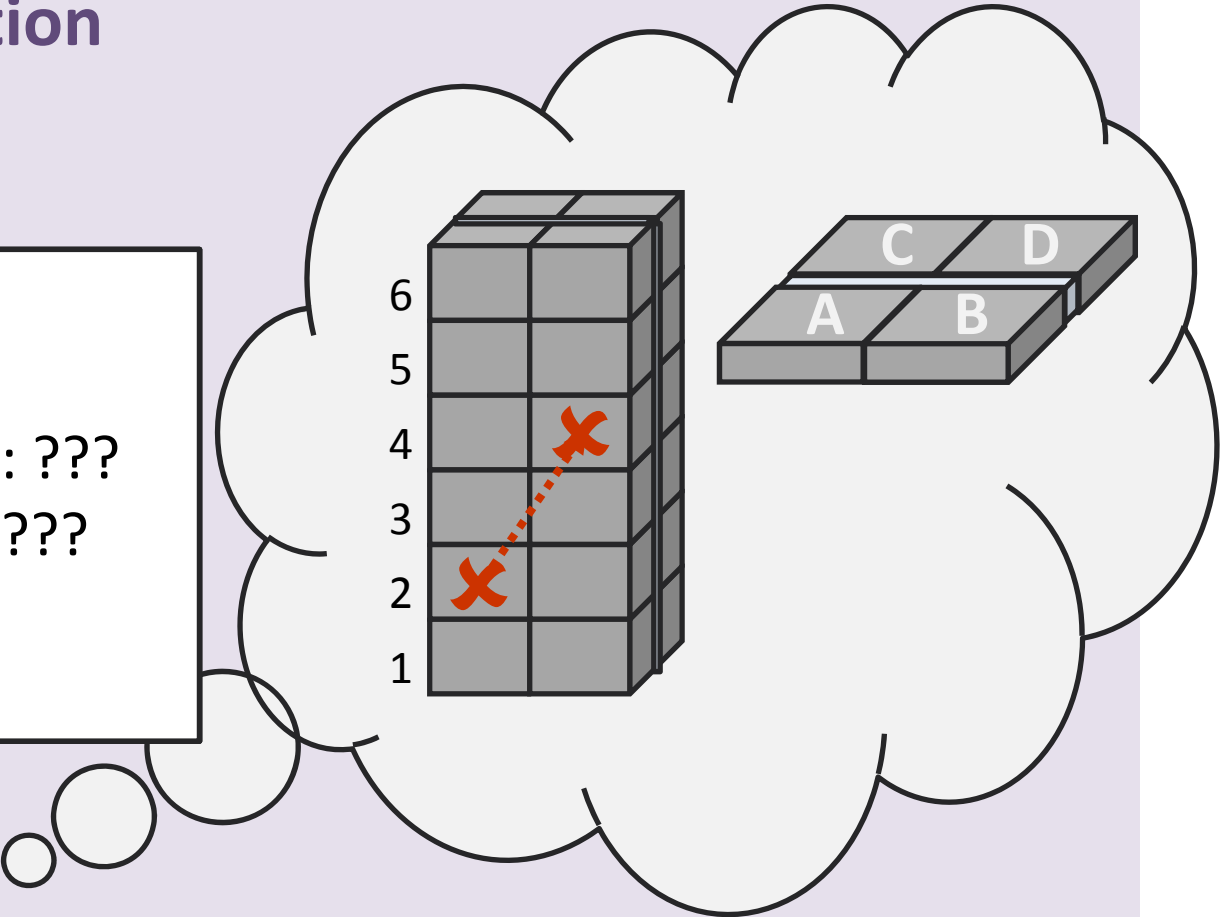
Oberauer et al. (2000; 2003)

Theory-Driven Task Selection

Relational Integration

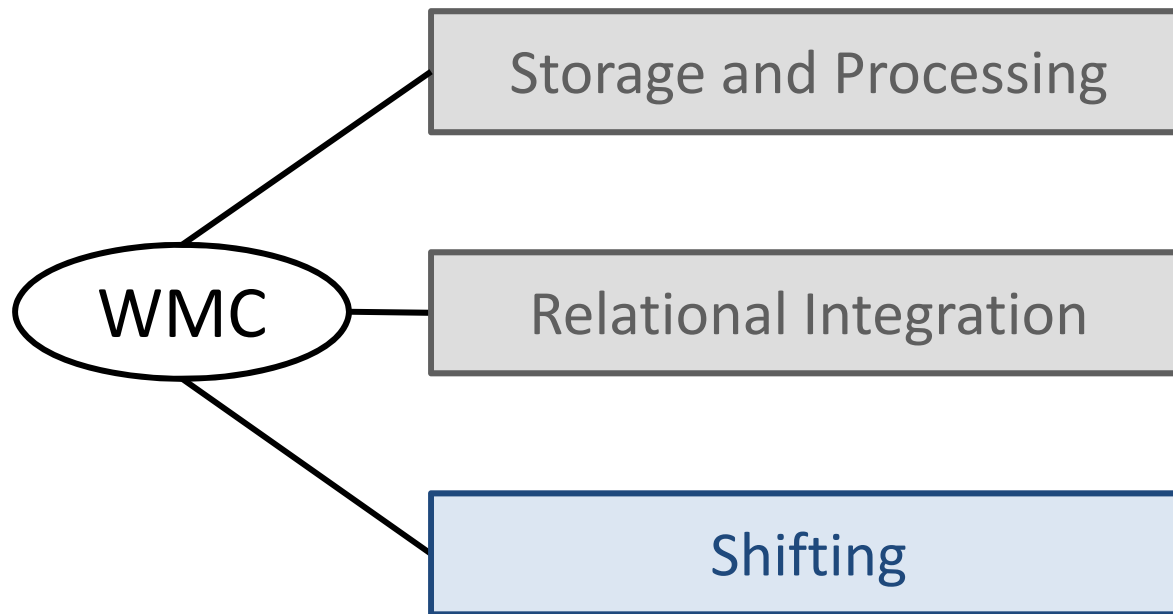
Tower of Fame

Tom Cruise lives in: ???
Brad Pitt lives in: ???



Theory-Driven Task Selection

Facet model of working memory capacity



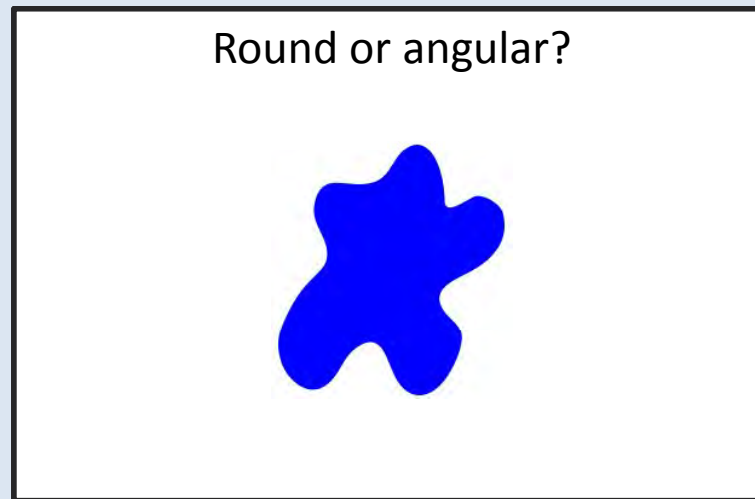
Selective activation of relevant and inhibition of irrelevant representations

Oberauer et al. (2000; 2003)

Theory-Driven Task Selection

Shifting

Task switching



Training WMC: Previous Results

Are there distinct transfer effects of training different facets of WMC?



- $N = 121$ ($M = 23$ years)
- 4 weeks, 20 sessions, each 30-40 min.
- randomized group assignment, double-blinded
- adaptive task difficulty
- experimental control via web-based monitoring with Tatool Online

Storage and Processing
Complex span

Relational Integration
Coordination tasks

Shifting
Task switching

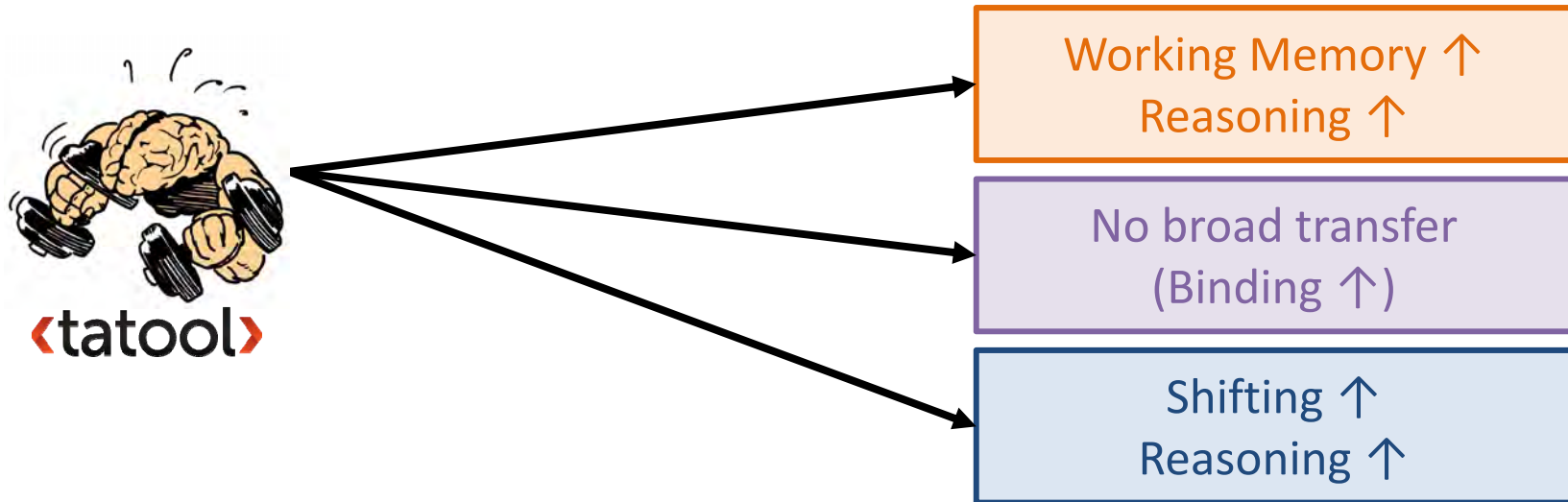
Active Control
Visual matching tasks

von Bastian & Oberauer (2013)

Tatool: von Bastian, Locher, & Rufin (2013)

Training WMC: Previous Results

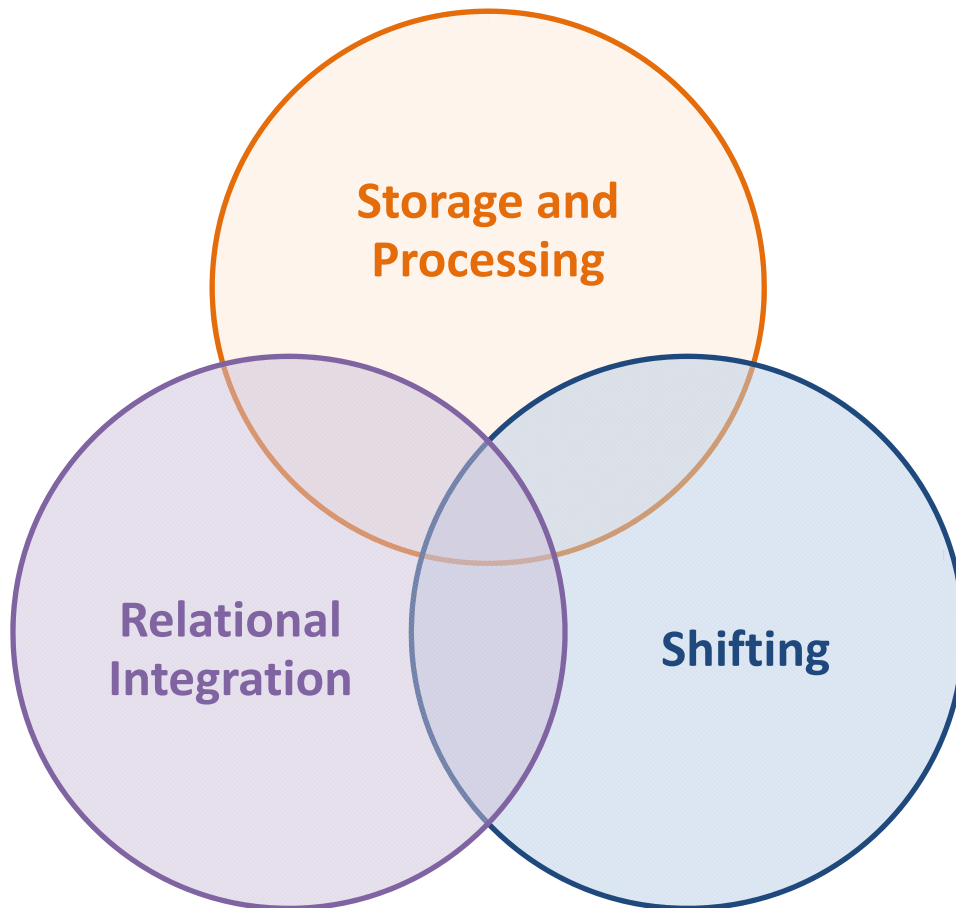
Are there distinct transfer effects of training different facets of WMC?



von Bastian & Oberauer (2013)

Tatool: von Bastian, Locher, & Ruflin (2013)

Maximising Transfer?



Multifunctional Training

Working Memory ↑↑

Shifting ↑

Binding ↑

Reasoning ↑

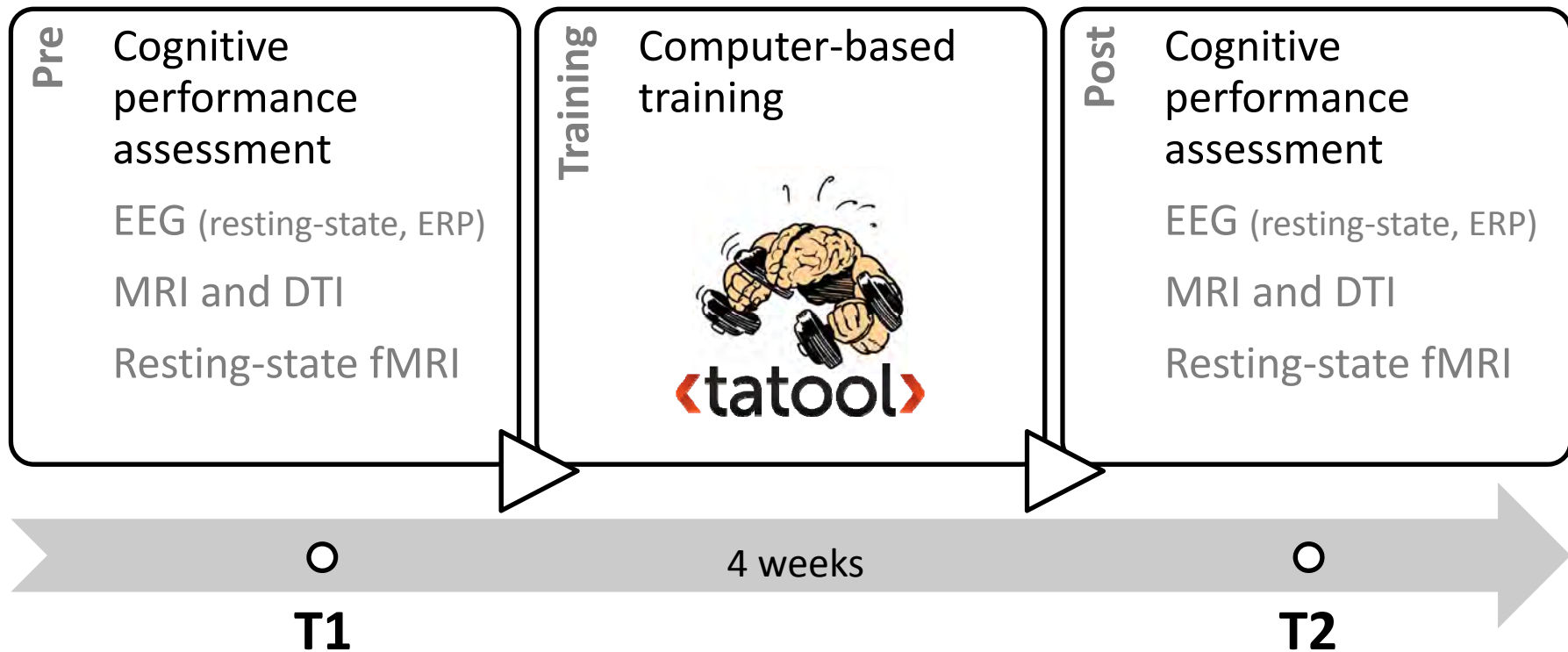
An intervention maximising transfer would be most useful to **counteract cognitive decline** in older age.

Goal of the Present Study

Investigating WM plasticity in young and old adults

- Does training all three functional categories at once lead to broad transfer effects?
- Does training induce improved performance not only in young, but also in old adults?

Design



Method: Training Intervention



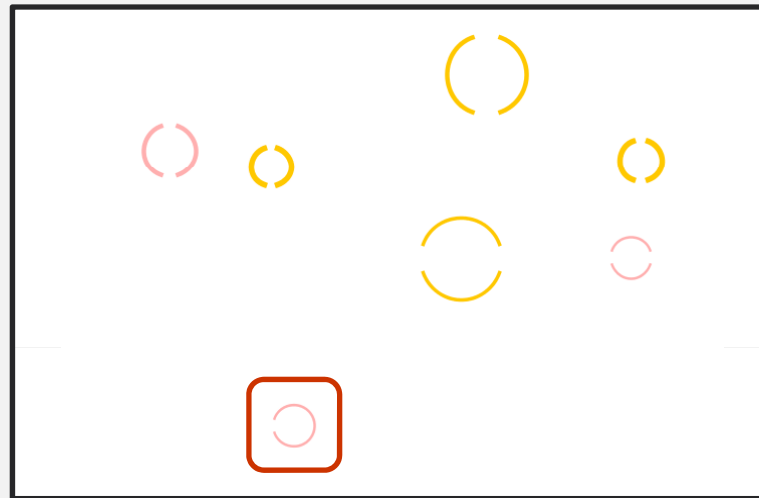
$n = 66$ young ($M = 23$ years),
 $n = 57$ older adults ($M = 69$ years)

WM (young and old)
Storage and processing
Relational integration
Shifting

Active control (young and old)
Visual search
Counting
General knowledge

Method: Active Control Training

Visual search



Method: Active Control Training

Counting

333 22 666666 333 1
55555 2 4444 1 333
4444 1 666666

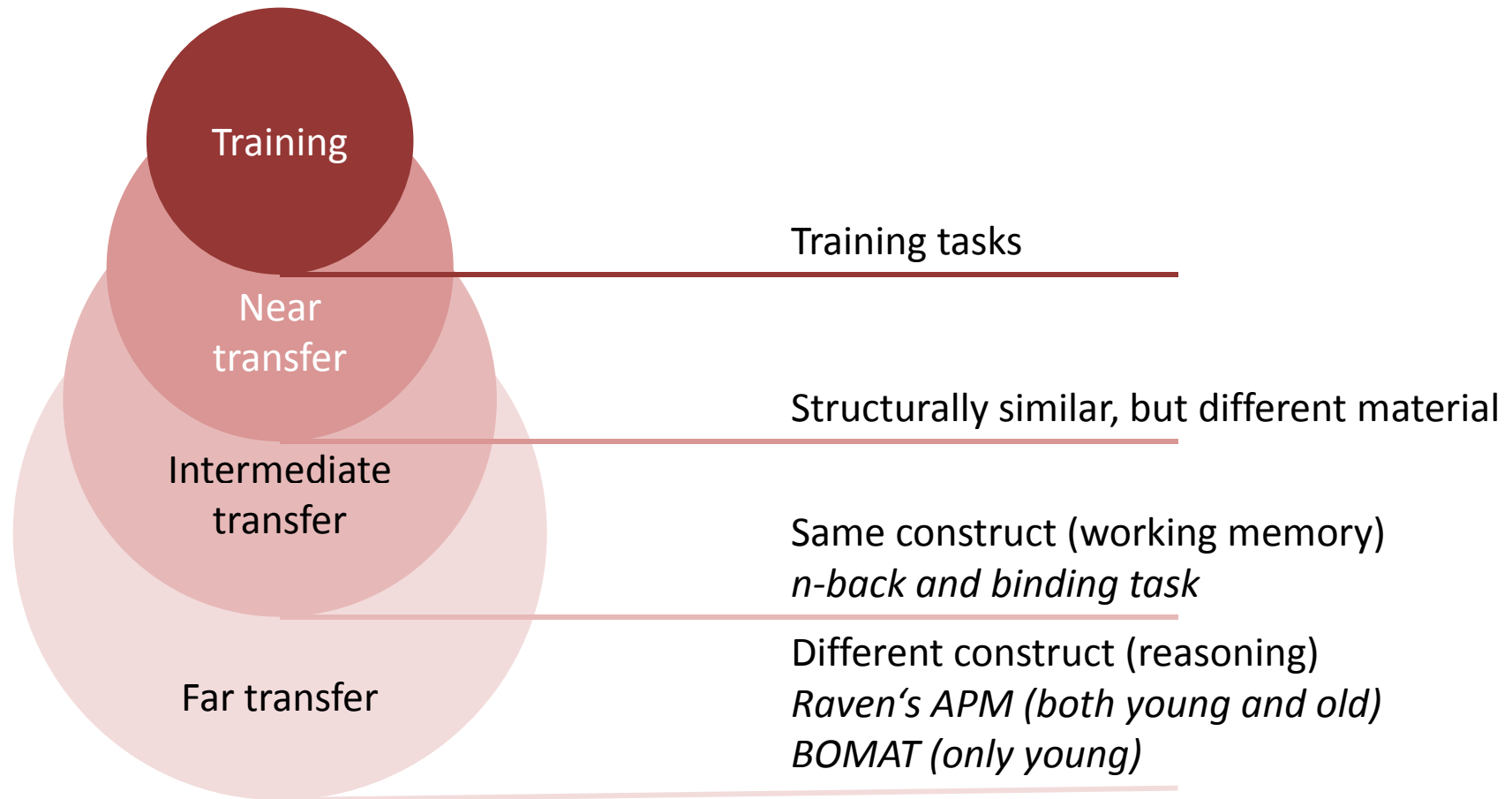
Method: Active Control Training

General Knowledge Quiz

Which Australian animal feeds mostly on eucalyptus leaves?

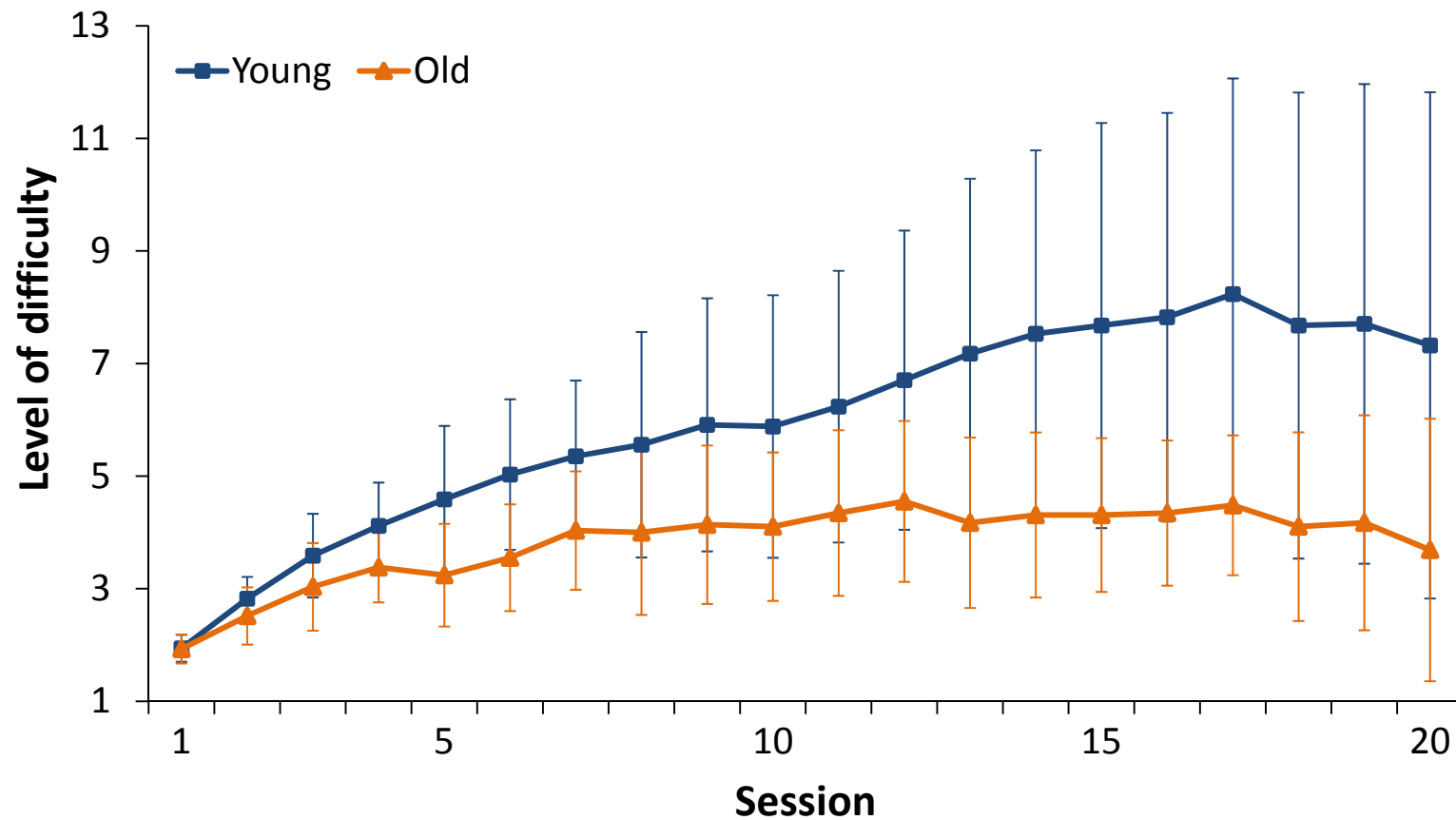
- (1) Koala**
- (2) Duckbill platypus
- (3) Kangaroo
- (4) Dingo

Method: Cognitive Assessment



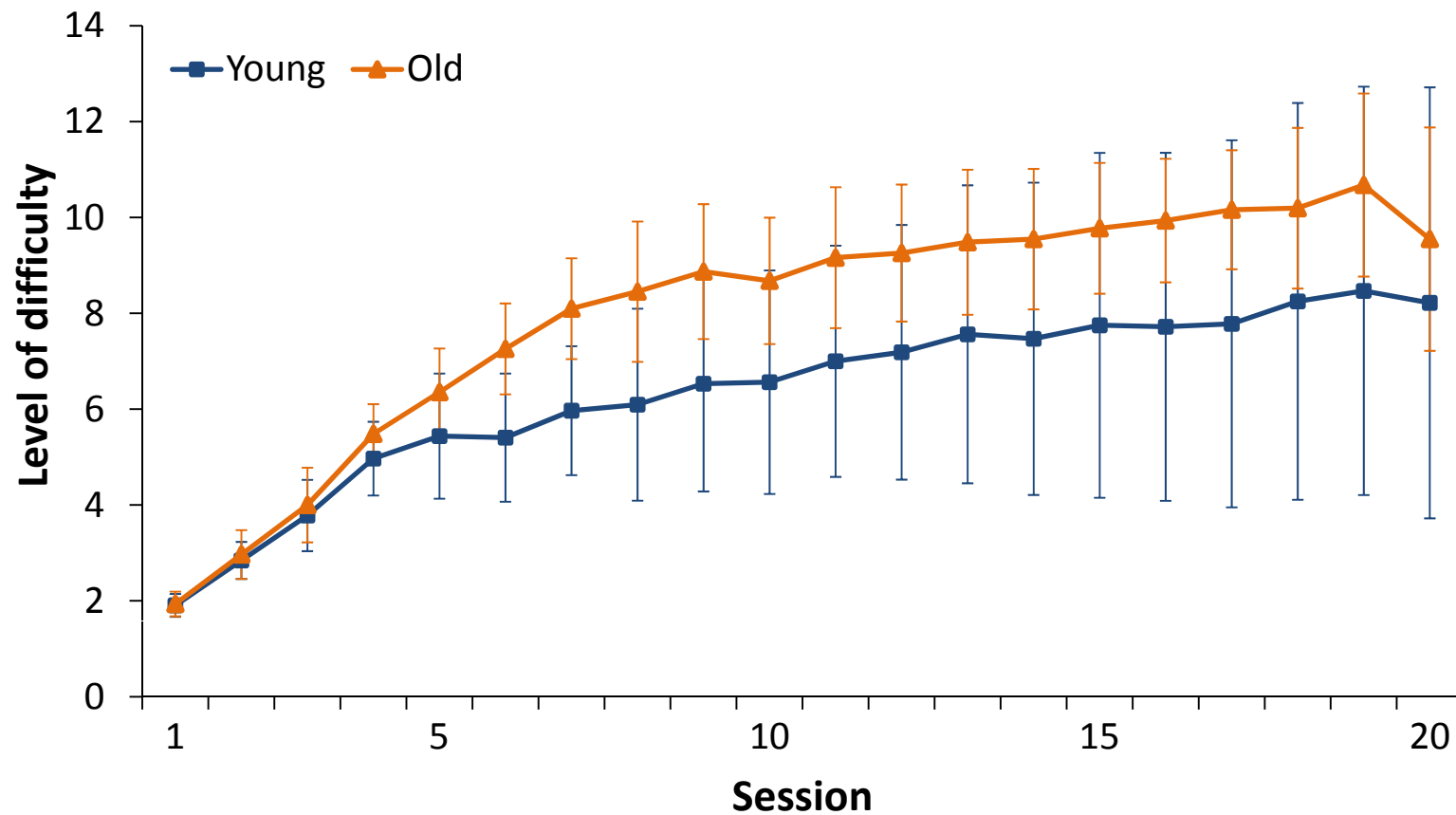
Results: WM Training Gains

Example: training gains for storage and processing

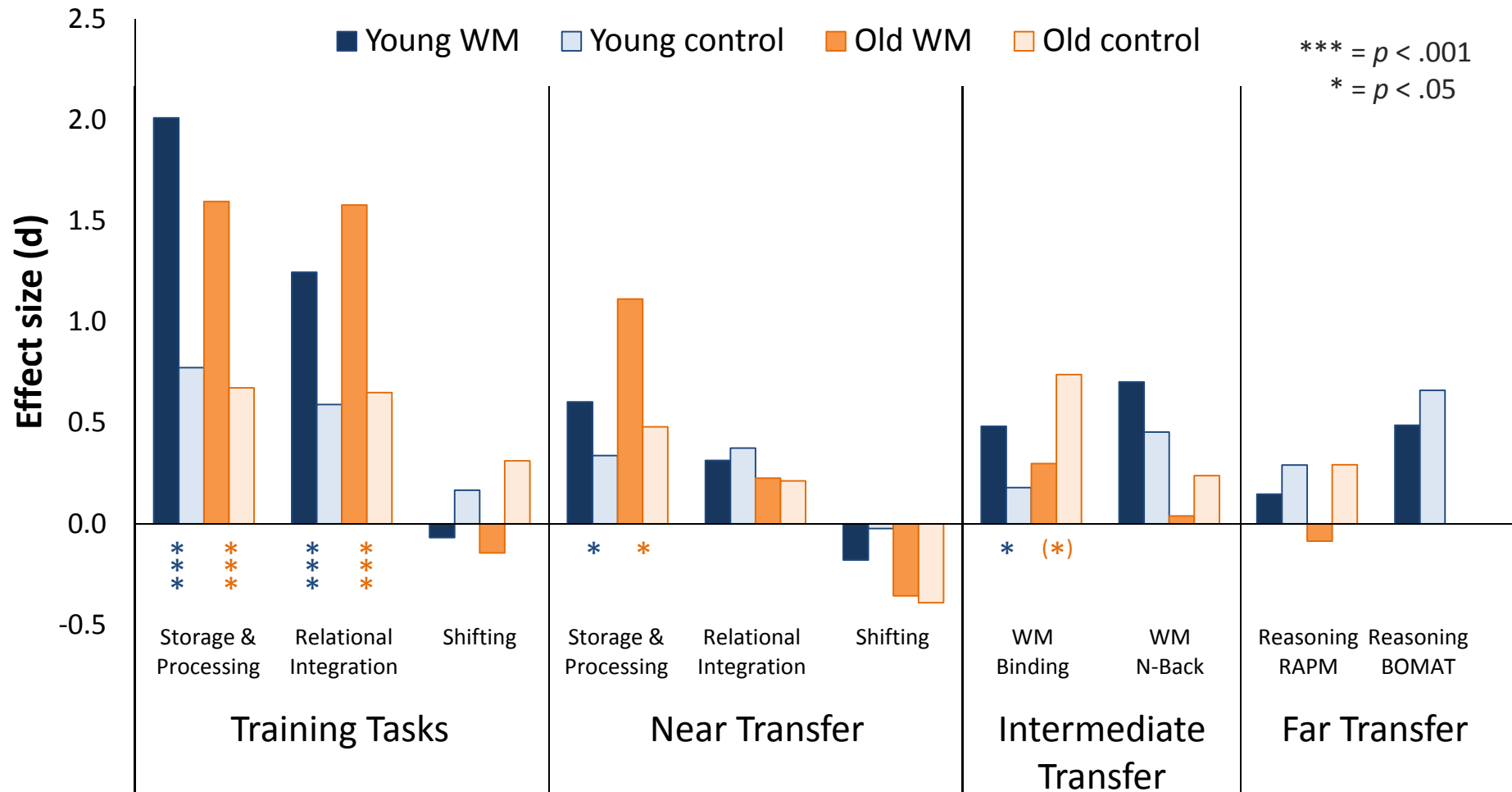


Results: Active Control Training Gains

Example: training gains for quiz



Results: Cognitive Assessment



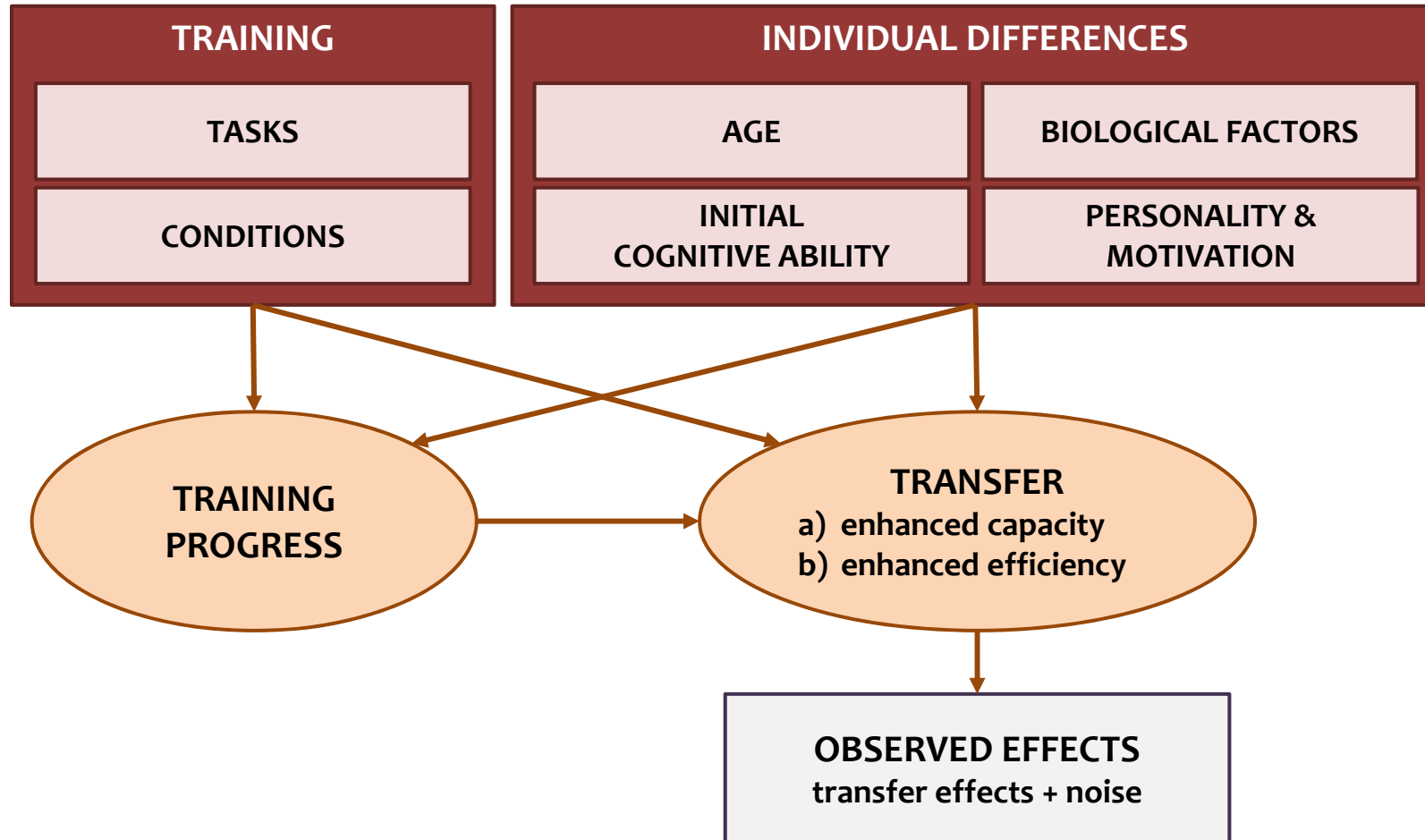
Summary

- Does training all three functional categories at once lead to broader transfer effects?
→ **No, transfer was less broad!**
- Does training induce improved performance not only in younger, but also in older adults?
→ **Yes, older participants improved as much as younger ones, except for transfer on binding.**

Conclusion

- Transfer effects are small, vary between individuals, and are difficult to replicate
- Intervention-specific features and individual differences may impact training and transfer gains
- Who profits from WM training under which circumstances?
 - Focus shift toward maximizing transfer by examining
 - ... who gains most?
 - ... which cognitive mechanisms are prone to change?

A Roadmap for Training Research



von Bastian & Oberauer (2014), Psychological Research

Outlook: Ongoing Work



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Differential malleability of working memory updating processes: retrieval, transformation, and substitution of information elements



Sabrina Guye

PhD student at the URPP "Dynamics of Healthy Aging", University of Zurich

Predictors of working memory training success in older adults: Cognitive abilities, personality, affect, and everyday-life activities

Thanks for Listening!

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Software Development

André Locher and Michael Ruffin

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Research Assistants

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