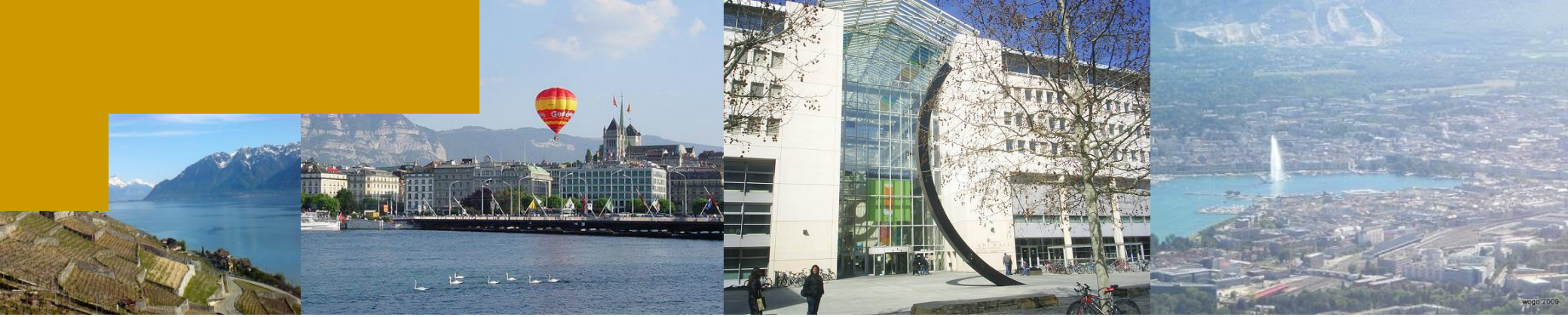

Cognitive development across the lifespan: Conceptual, methodological and analytical challenges of a lifespan approach – Part 2

Matthias Kliegel

University of Geneva

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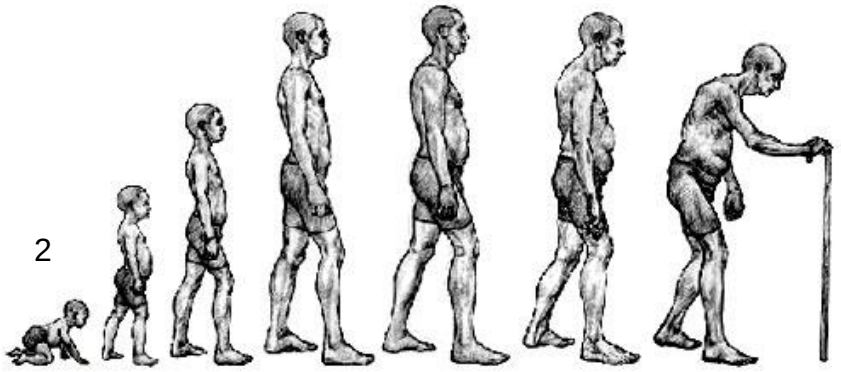
Fundamental question(s) of Lifespan Psychology

What develops when how and why ?

- **What** → **Developmental domain**
- **when** → **Developmental phases**
- **how** → **Developmental trajectories**
- **why** → **Developmental mechanisms**



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What is the developmental domain?

Some examples to start with:

This function is involved in …

… remembering to take medicine according to schedule

but also in

… removing the pot before it boils over

… remembering to feed the cat before going out to play

… remembering to make a phone call at 5:30 pm

… remembering to take back a signed letter to school

or in general…

… remembering to resume an activity after being interrupted

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What is prospective memory (PM)?

Processes associated with "remembering to do something"
Kliegel, M., McDaniel, M.A., & Einstein, G.O. (Eds.) (2008). *Prospective Memory: Cognitive, Neuroscience, Developmental, and Applied Perspectives*. Mahwah: Erlbaum.

- **Realization of delayed intentions** (Ellis, 1996)

- **Three key features** (Ellis & Kvavilashvili, 2000)
  PM = delay, no explicit reminder, ongoing task interruption

- **PM = dual-task situation requiring self-initiated task switching: ongoing task + prospective task**

- **Time-based versus event-based PM**
- **Prospective component versus retrospective component**

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Typical everyday life task

„Please remember to take your antibiotics every 12 hours“
„Please remember to check your blood pressure every morning”

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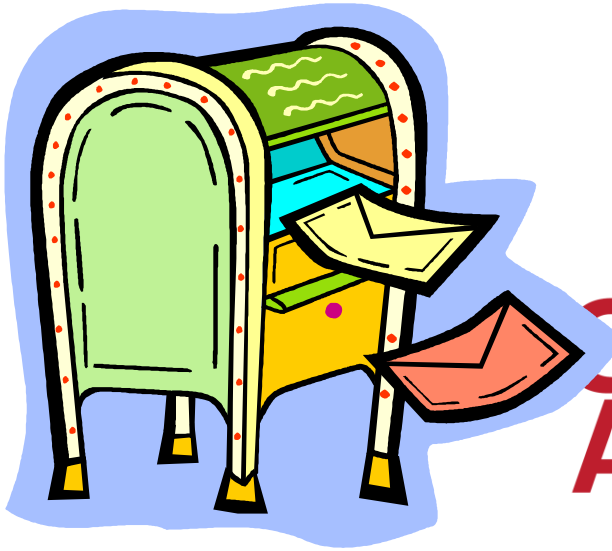
Typical naturalistic task

„Please remember to post a letter every Tuesday“
(e.g., Patton & Meit, 1993)



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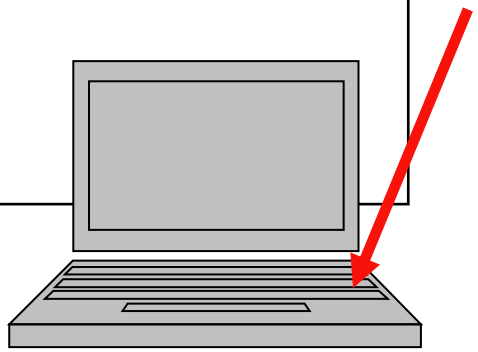
Typical laboratory task

Car
House
Dog
Tree
…



(e.g., Einstein & McDaniel, 1990)

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Relevance for developmental psychology?

Highly relevant to everyday life

50-80% of everyday memory problems across the lifespan are prospective memory problems ➔ Development and maintenance of independence

High clinical relevance across the lifespan

- ✓ **Autism** (Altgassen, Williams, Bölte & Kliegel, 2009; Altgassen et al., 2010)
- ✓ **ADHD** (Kliegel, Ropeter & Mackinley, 2006; Zinke et al., 2010)
- ✓ **Depression** (Altgassen, Kliegel, & Martin, 2009; Altgassen et al., 2011)
- ✓ **TBI** (Kliegel, Eschen, Thöne-Otto, 2004; Henry et al., 2007)
- ✓ **Schizophrenia** (Altgassen, Kliegel, Rendell, Henry, & Zöllig, 2008; Henry et al., 2007)
- ✓ **Parkinson** (Kliegel, Phillips, Lemke & Kopp, 2005; Kliegel et al., 2011)
- ✓ **MCI / AD** (Eschen, Martin, Schreiter-Gasser, & Kliegel, 2009)

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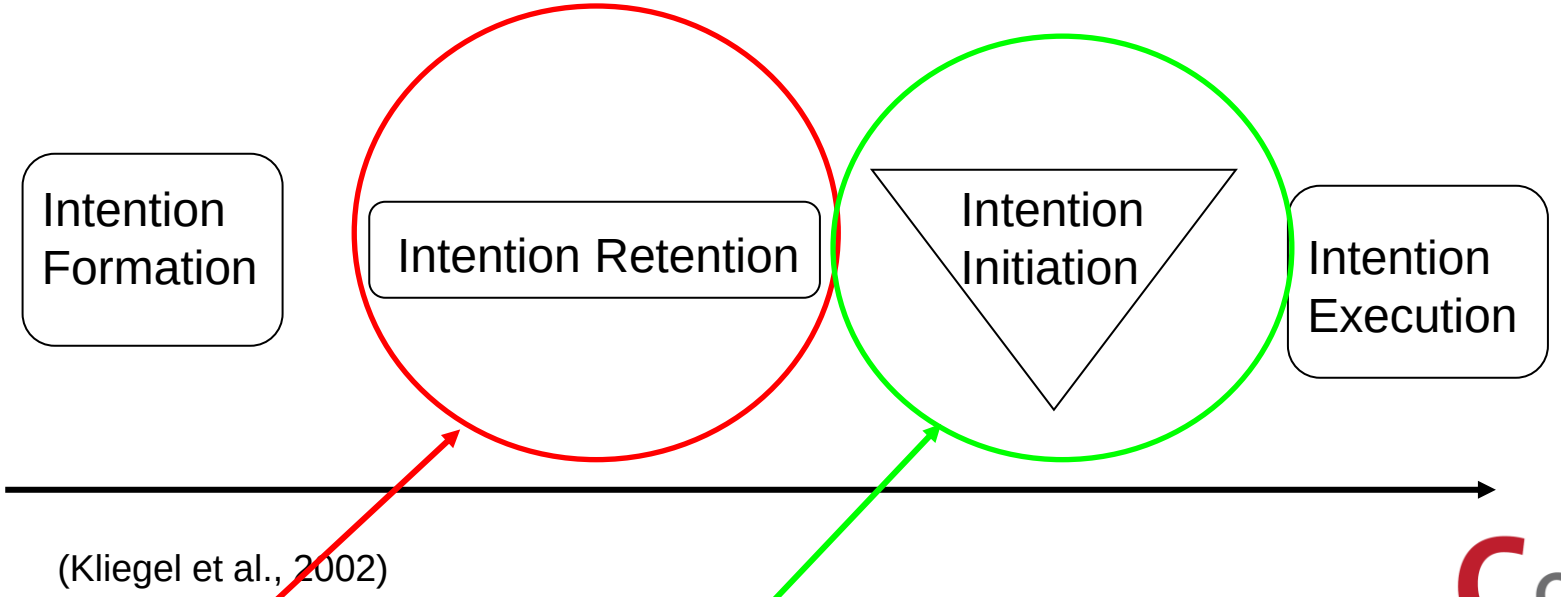
What is prospective memory (PM)?

Conceptual approach: **Process model**

PM = multiphase process (Ellis, 1996; Kvavilashvili & Ellis, 1996; Maylor et al. 2002)



Forget ***what*** *to do*
Retrospective Component

Forget, ***that*** there was an intention
Prospective Component

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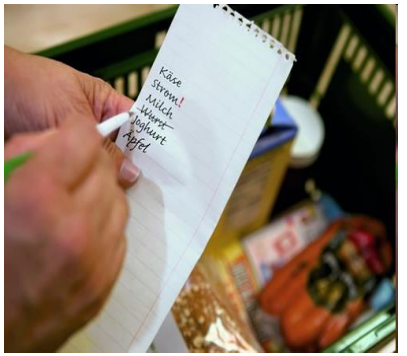
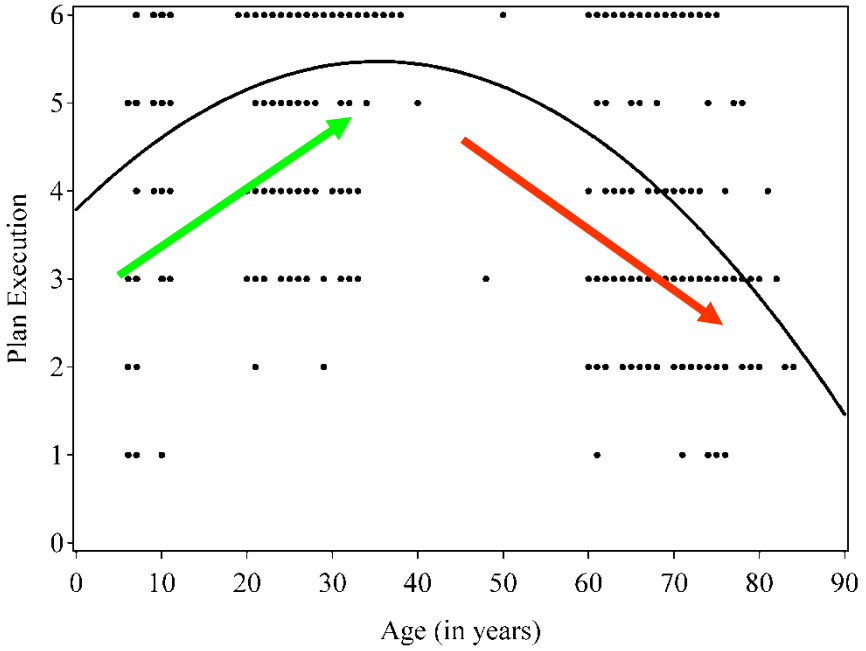
Developmental Questions



Are there age differences in prospective memory? What are the associated mechanisms?

Kliegel, Mackinlay & Jäger (2008):
Lifespan data (*N* = 557)



Why?
What are the developmental **mechanisms**?

➔ two main candidates:
episodic memory plus
cognitive control

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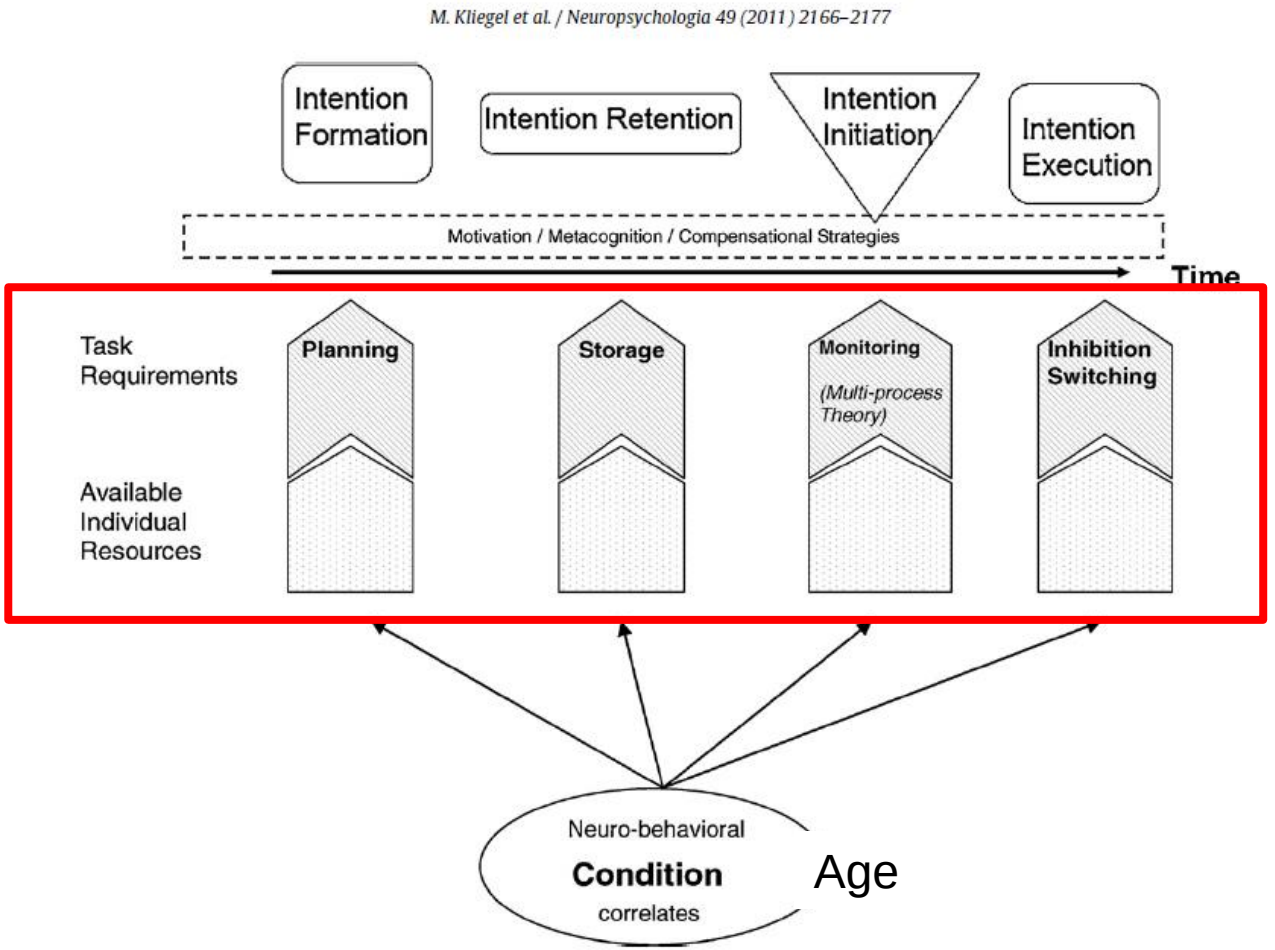
Research Model

- **Age effects are mediated by a mismatch between phase-specific task demands and individual differences in required cognitive resources**



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So far for the theory…

Now it's your time

Form three sub-groups and propose a concrete example of how to measure prospective memory (material, procedure, scoring)

(1) in pre-schoolers

(2) adolescents

(3) older adults

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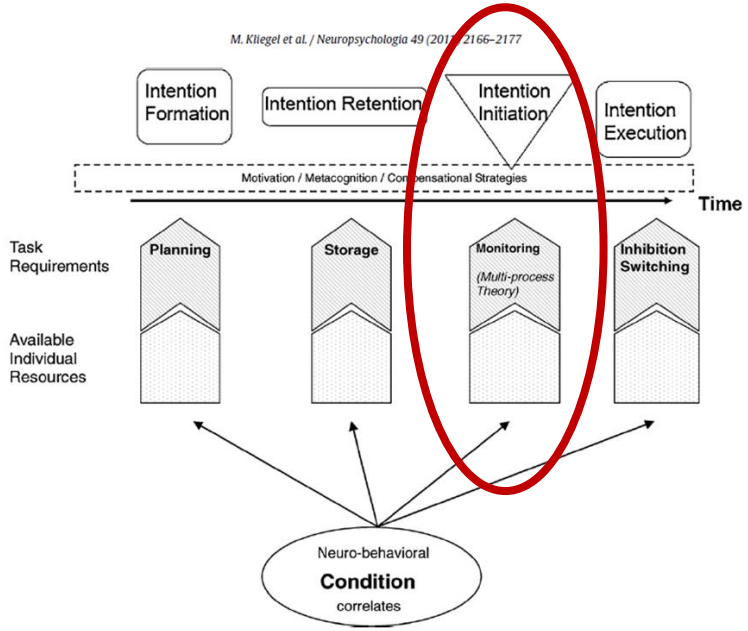
(A) Child development studies

Research strategies (experimental cross sectional studies):

1. Manipulating task demands of the PM task
2. **Using a dual-task approach to reduce available resources**



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Dresden Cruiser (Kliegel et al., 2013, *JECP*)

Age appropriate
ongoing task performance
No ceiling, floor effects
High motivation

Ongoing task (OT):
Driving without hitting other cars

PM: remembering to refuel
Event-based version: Flowers, cars
Time-based version: Fuel gauge

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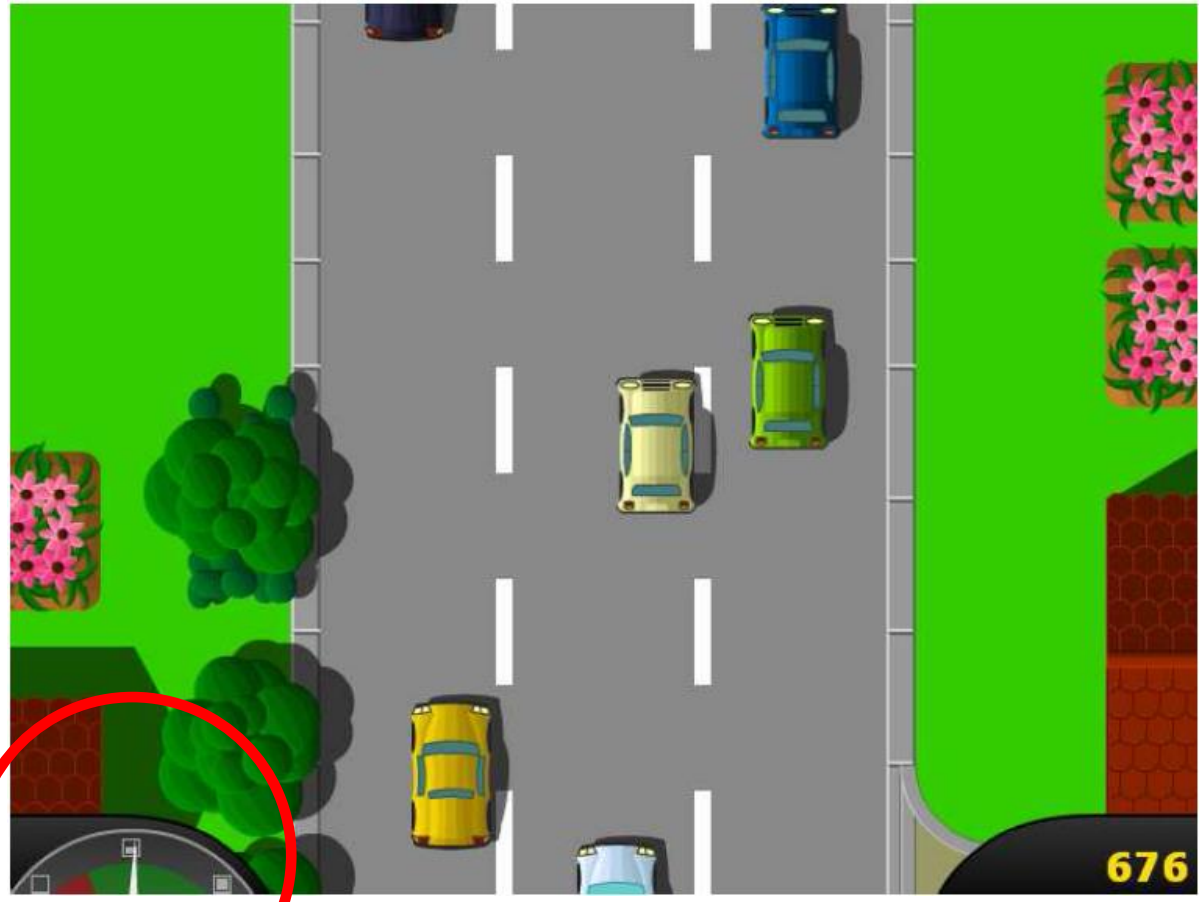
Dual-task studies

(Voigt et al., 2014, *Developmental Psychology*)

Participants

197 children aged 5 to 14 years (*M* = 9.04, *SD* = 2.79)
All children scored within ±1SD in a test of fluid and crystallized intelligence.



Dresden Cruiser

Time-based version

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Voigt et al. (2014) *Developmental Psychology*

Dual-task studies

Performance Indicators

- Ongoing task: Not hitting other cars (difficulty level calibrated)
- Prospective memory task: Remembering to refuel in time-window

Possible Mechanisms

- Dual task approach: Parallel working memory task: (n-back auditory task) difficulty matched (younger children: same word, older children: same category with increasing number of categories)

- Time monitoring: Checking the fuel gauge

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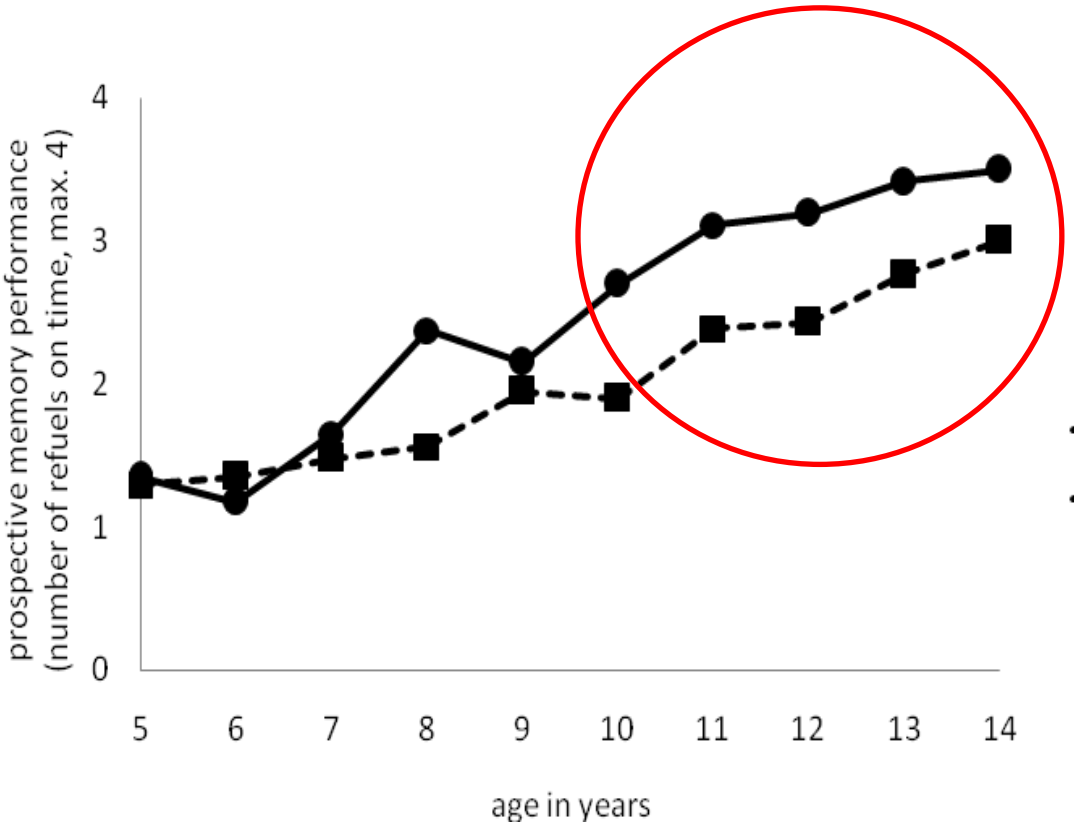
Voigt et al. (2014) *Developmental Psychology*

Results (time-based PM, dual task approach)

Prospective memory performance

Main effects of age, block and interaction (but…)



Ongoing task performance

Main effects of age, block and (trendwise) inverse interaction

Single: PM
Dual: PM + WM

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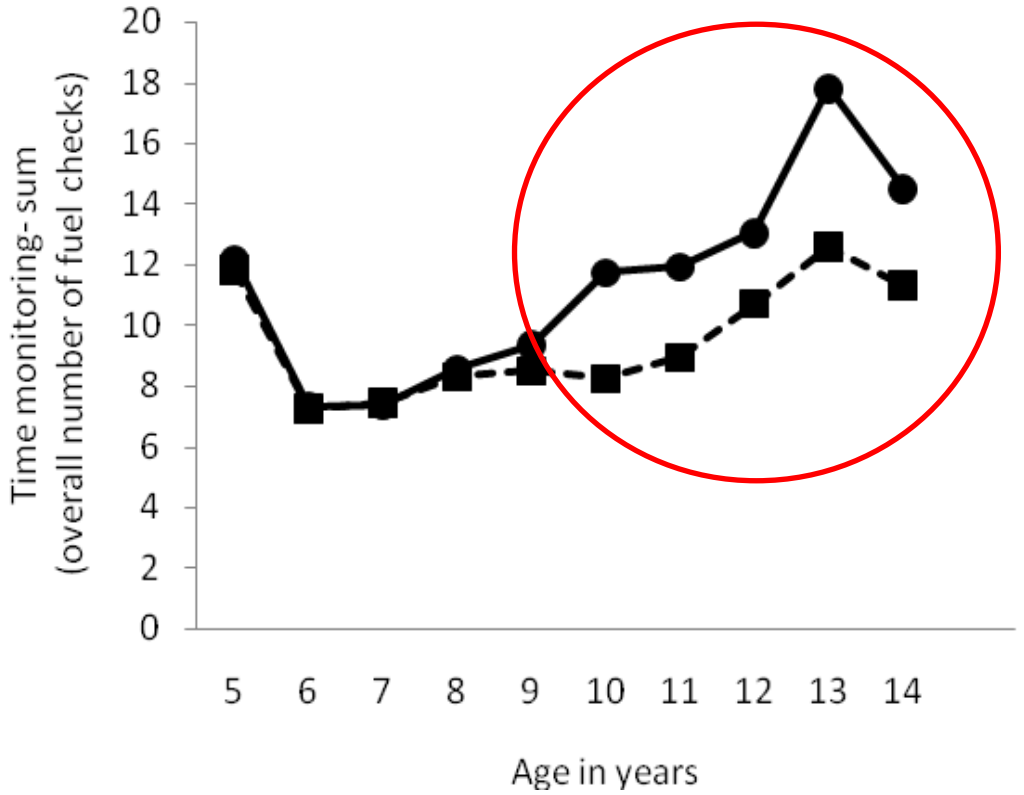
Voigt et al. (2014) *Developmental Psychology*

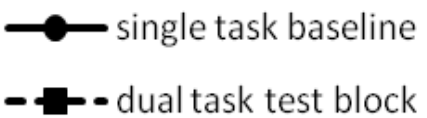
Results

Time monitoring (overall)

Main effects of block and interaction



Time monitoring predicts PM
But not in older children
when WM load is low



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Summary & Conclusions

Summary

- Developmental progress between 5 and 14
- Working memory updating affects time-based PM
- Interaction of WM load with age on PM: older children suffer
- Trade-off between WM, OT and PM

Conclusions

➔ older children use strategies for PM that require WM resources while younger children may rely on less efficient strategies that do not rely on WM resources

➔ Older children improve by using their increasing WM resources to strategically monitor time

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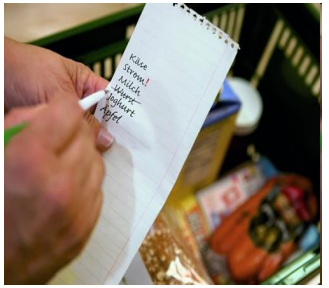
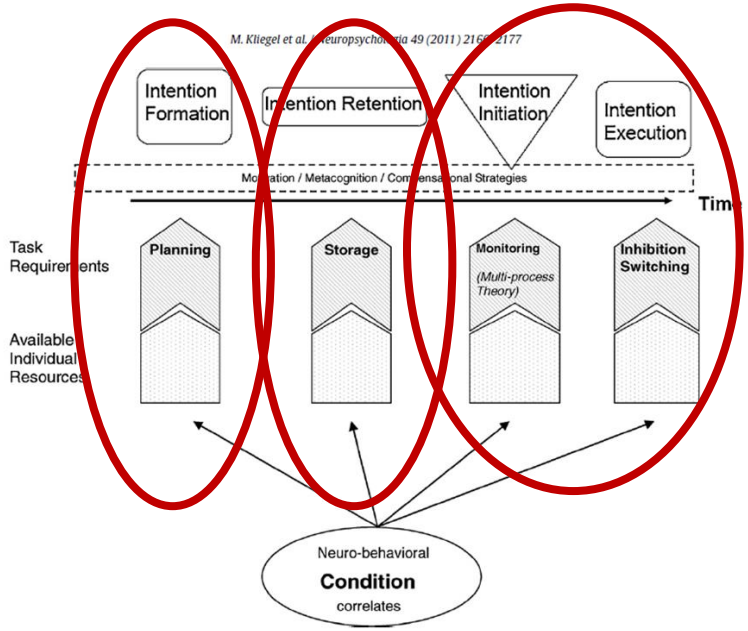


(B) Aging studies

Research strategies

1. Manipulating task demands of the PM task
2. Using mood induction / stress to reduce available resources
3. Using interventions to augment available resources



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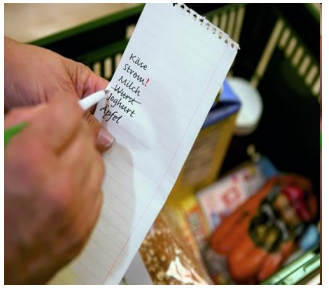

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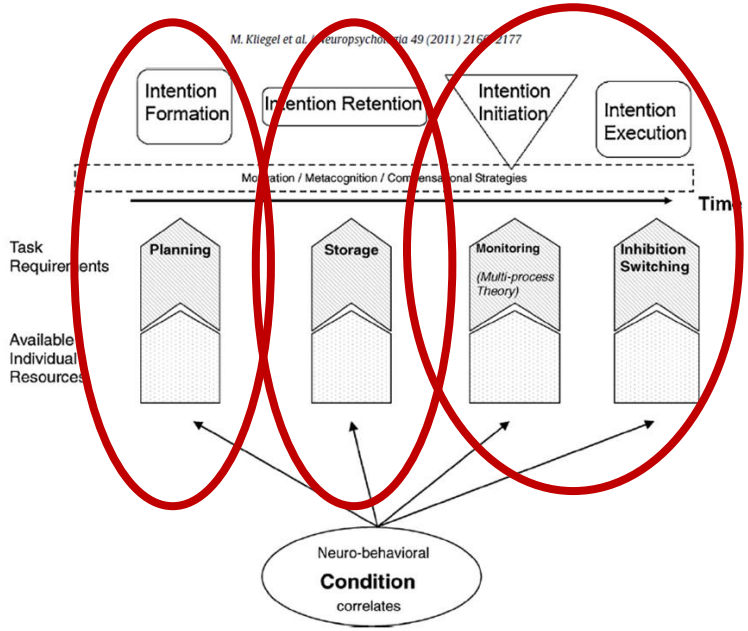

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① Effects of emotional cue salience on age-related prospective memory performance

Altgassen, Phillips, Henry, Rendell & Kliegel (2010) *QJEP*

Previous findings:

- Kensinger et al. (2005): Attention is directed to emotional information
- Positivity bias / preserved emotionally enhanced memory effect in old age

General hypothesis:

- Less attention needed for detection of PM cue due to enhanced cue salience

Participants: 82 participants: 41 young (M=25) and 41 old adults (M=70).

Methods:

Picture 1-back ongoing task (IAPS pictures): negative, neutral and positive stimuli mixed

PM: negative, neutral and positive cues

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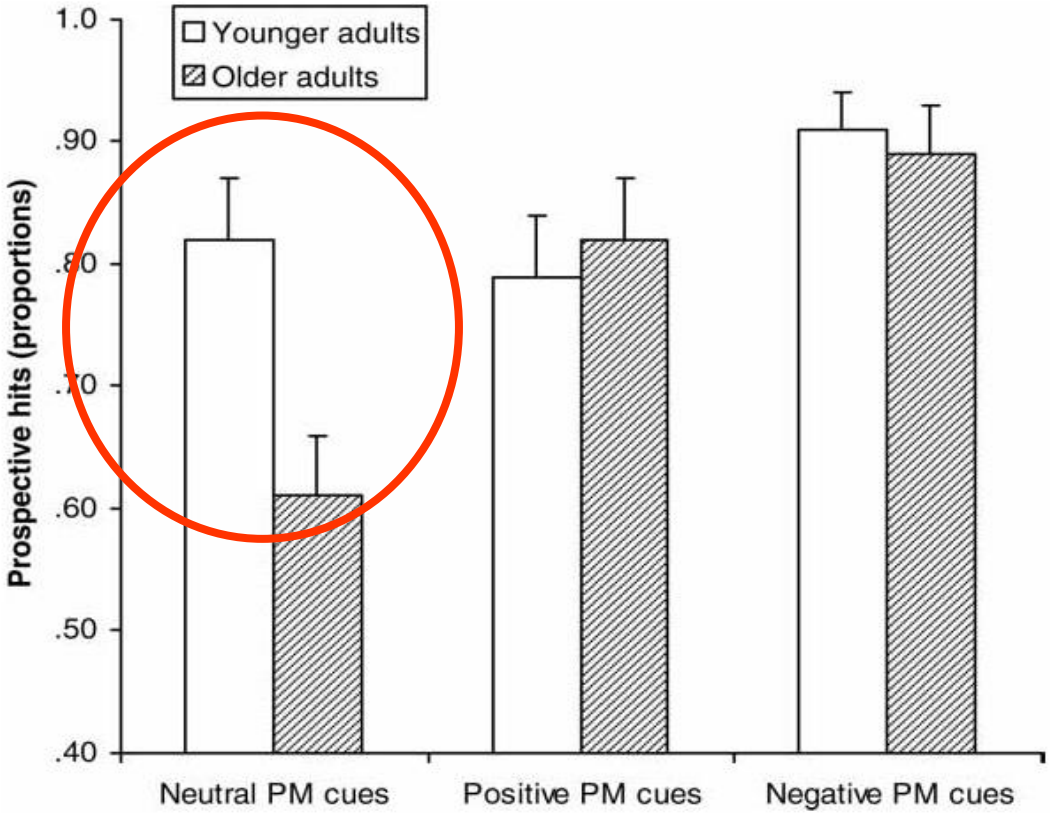
① Effects of emotional cue salience on age-related prospective memory performance

Altgassen, Phillips, Henry, Rendell & Kliegel (2010) *QJEP*



Summary:

- Emotional stimuli eliminate age differences
- Holds for both valence dimensions

Conclusions:

➔ Emotionally enhanced memory effect
➔ Extends to PM
➔ No sign of positivity bias
➔ EEM only in older adults

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(B) Aging studies

Research strategies

1. Manipulating task demands of the PM task
2. Using mood induction / stress to reduce available resources
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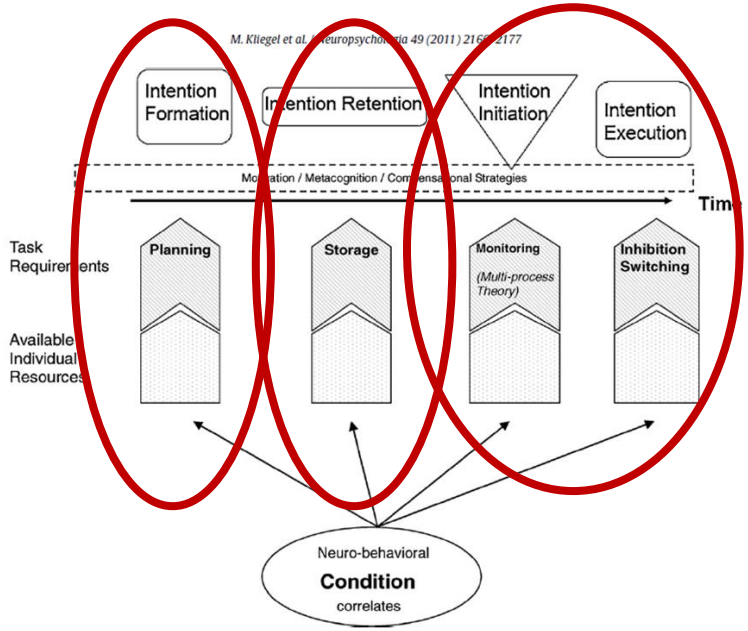

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Training studies

Two approaches:

“compensatory/strategy-based” vs “restorative/process-based”

- In episodic memory: Good evidence of successful strategy training: Method of Loci (Kliegl, Smith, & Baltes, 1989) but no transfer
- Recently, focus on process-based training with some promising results on proximal effects, but again very mixed findings on (lab) transfer and little knowledge on everyday transfer
  (Buschkuehl et al., 2008; Dahlin et al., 2008; Karbach & Kray, 2009; Li et al., 2008; Melby-Lervåg, & Hulme, 2013, Zinke et al., 2012, in press)
- In PM: No systematic training research in aging

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Research questions

1. Can training **improve** older adults' PM?

2. Can training **transfer** to everyday life PM tasks?

Two examples:

Process-based and combined process and strategy training in older adults

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PM training: Process approach
Train PM as holistic process

Participants

Group	N	Age	Education	Shipley	DAS
Virtual Week Training	18	66.9 (4.51)	15.8 (2.26)	17.1 (2.67)	3.2 (.70)
Music Training	14	66.4 (5.60)	15.1 (2.81)	16.9 (2.53)	3.0 (.47)
Control group	18	68.7 (4.41)	15.8 (2.00)	18.2 (2.16)	3.1 (.54)

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Design & procedure

Screen
- Phone screening

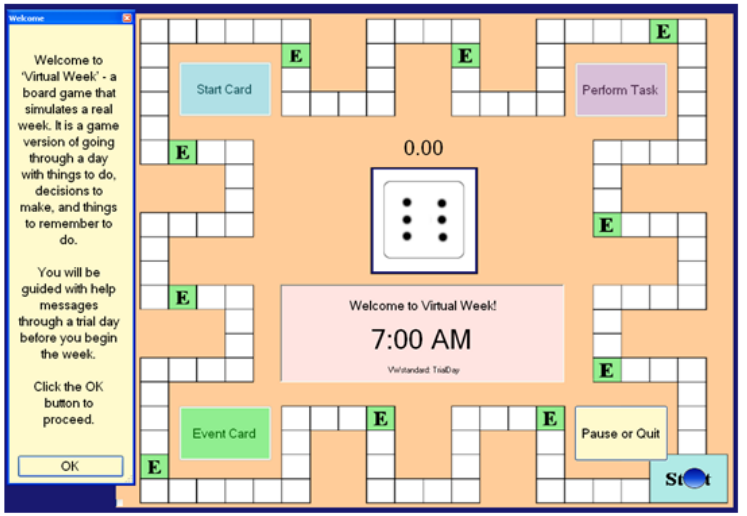
Pre-Test
- Outcome measures

Treat-ment
- PM Training (12 sessions within 4 weeks)
- Music Training

Post-Test
- Outcome measures

Virtual Week (Rendell & Craik, 2000)

- Computerized board game
- Simulates everyday activities of a week
- Prospective memory tasks are very everyday life like
- Differentiation in
  - Event-based tasks
  - Time-based tasks
    - Related to real time: stop clock
    - Related to virtual time
  - Repeated or non-repeated tasks
- Very entertaining
- **Performance is depending on working memory**



(Rose, Rendell, McDaniel, Aberle, & Kliegel, 2010, *Psychology and Aging)*

Virtual Week TRAINING

- 3 sessions of 1 hour / week for 4 weeks (in total **12 training sessions**)
- 1 level = 1 virtual day = 1 board round, in total **24 virtual days**
- 24 different levels of **increasing difficulty**
  - Task number varies from 4 up to 12 tasks
  - Task changes of repeated tasks → interference at level 8
- **Difficulty adapts** to the participants performance:
  - Must achieve 75% criterion or repeat the level
- At the end of each training week: qualitative questionnaire about subjects performance and use of strategies

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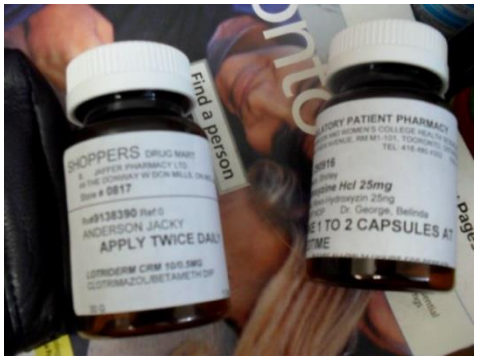
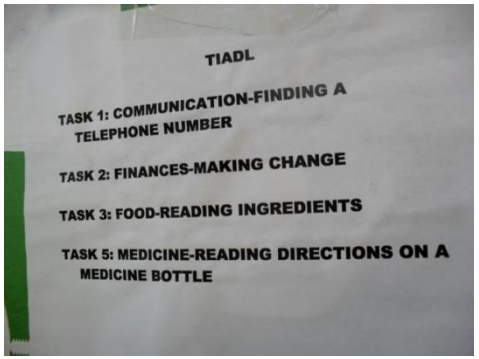
Outcome measures

TIADL (Owsley, Sloane, McGwin & Ball, 2002)
Timed Instrumental Activities of Daily Living





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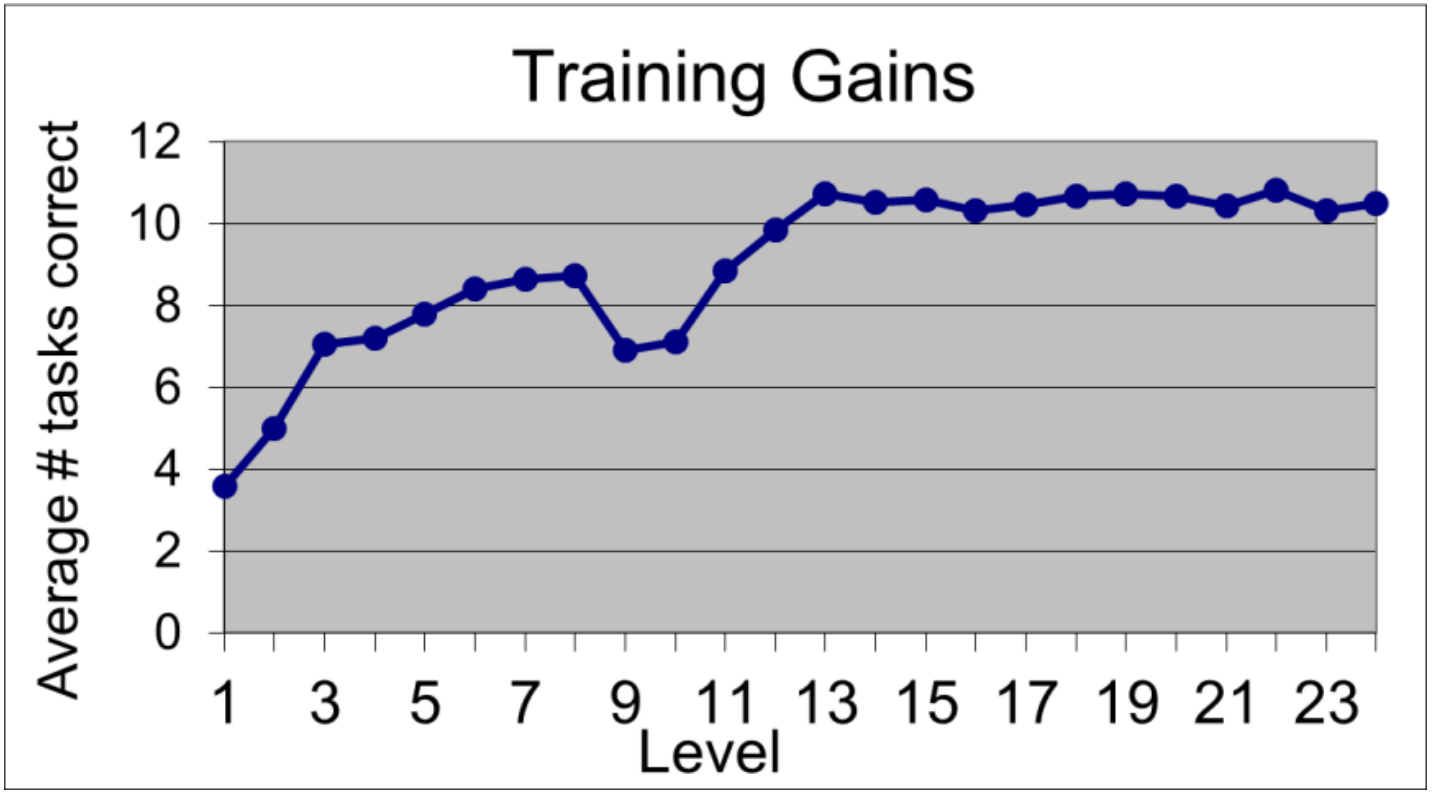
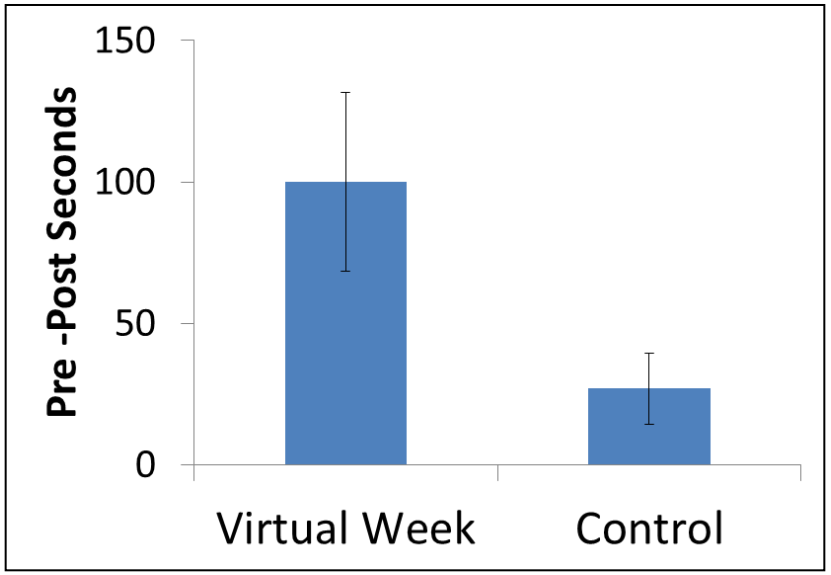
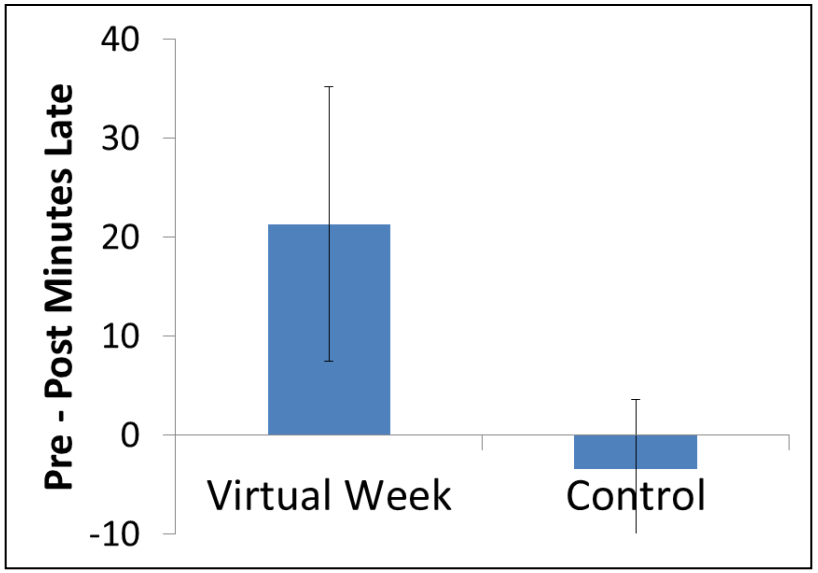
Results: Training



Results: Far (everyday life) Transfer



TIADL (sec.)



Call-back task

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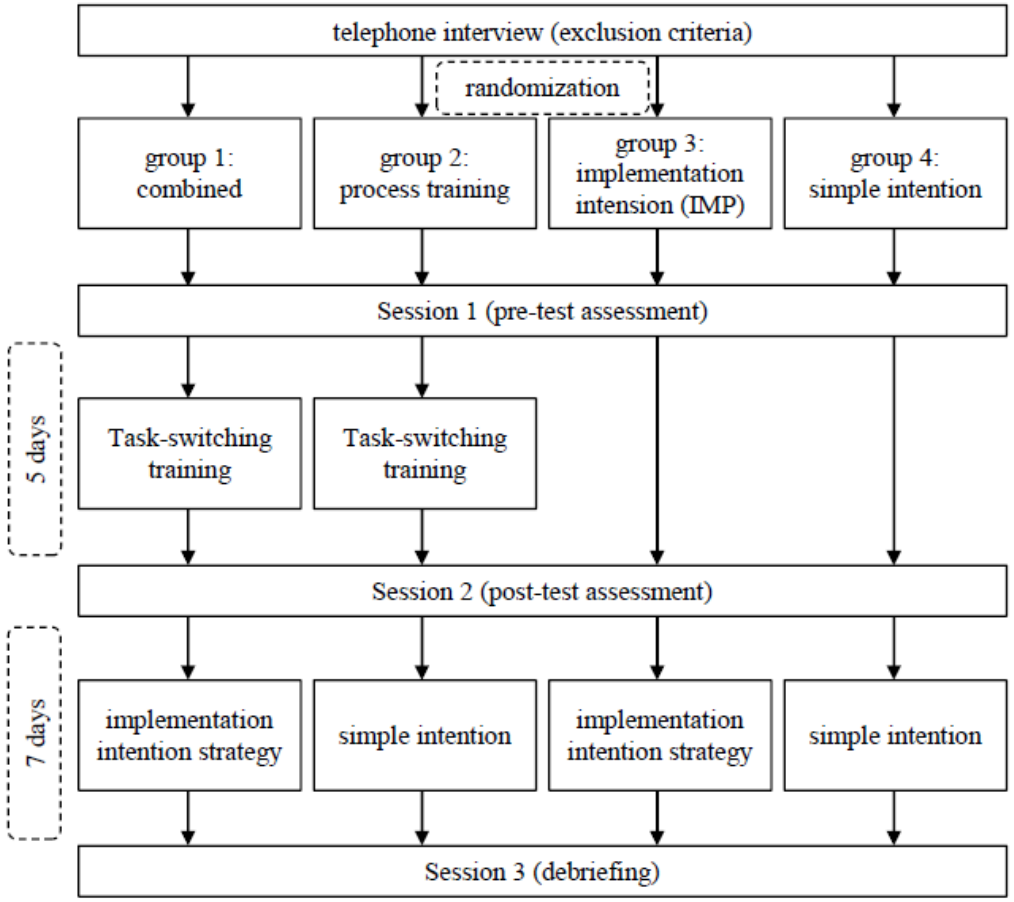
Brom & Kliegel (2014) *Psychology and Aging*

PM training: Process versus strategy

➔ Task Switching Training, Karbach & Kray (2009)
➔ combination with implementation intentions (Gollwitzer, 1999)
PM task: Blood pressure monitoring task in real life



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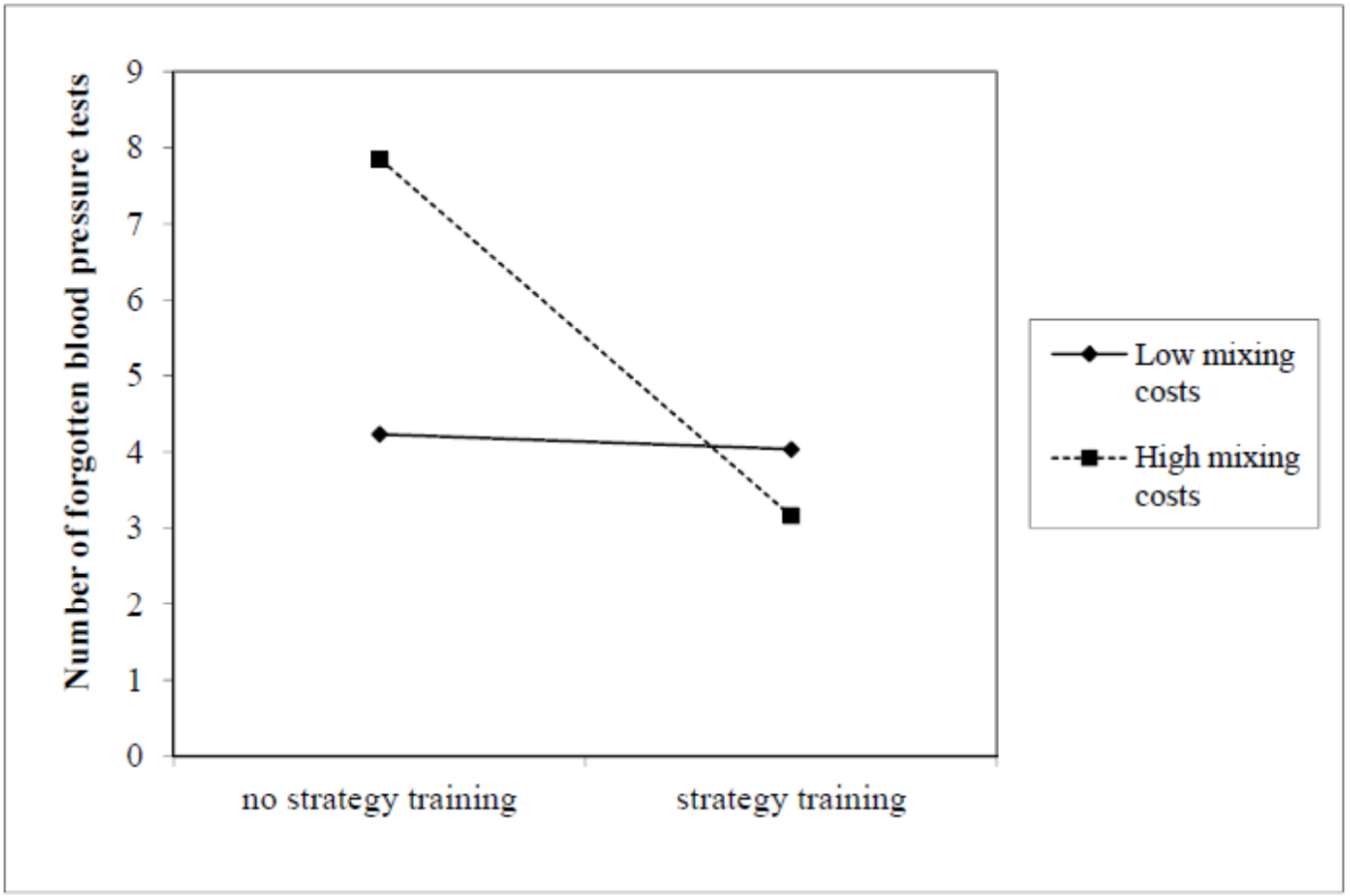
Brom & Kliegel (2014) *Psychology and Aging*

PM training: Process versus strategy

Testing the mismatch assumption



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Summary & Conclusions

- Strategy Training: Implementation Intentions improve PM in an everyday life task (➔ to be tested: transfer to other tasks?)
- Process Training (1): Performance on Virtual Week improves over the course of the training for the Virtual Week training group
- Training gains transferred to instrumental activities of daily living and real world PM, relative to controls
- Process Training (2): Task Switching training is effective; but does not transfer to everyday PM; yet, EF emegered as moderator of strategy effect

➔ **Strategy effect limited to implementation intentions?**

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Vol. 68, No. 1, 192–204, http://dx.doi.org/10.1080/17470218.2014.956127

Routledge
Taylor & Francis Group

Future thinking improves prospective memory performance and plan enactment in older adults

Mareike Altgassen[1,2], Peter G. Rendell[3], Anka Bernhard[2], Julie D. Henry[4], Phoebe E. Bailey[5], Louise H. Phillips[6], and Matthias Kliegel[7]

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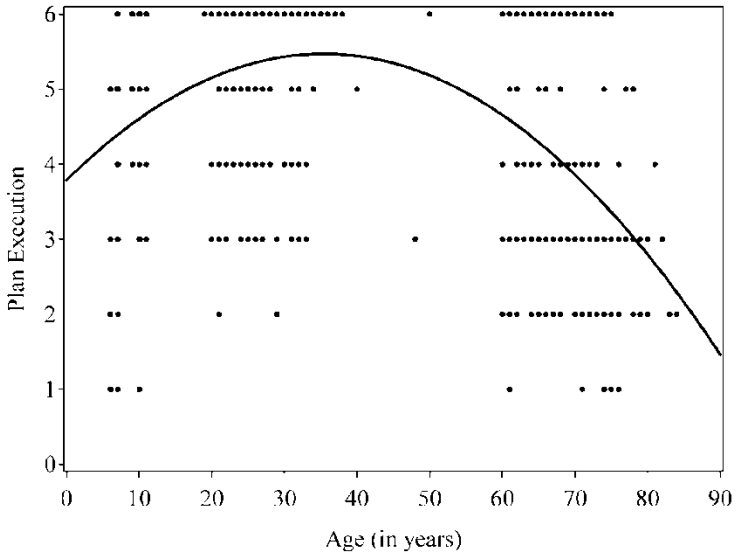
(C) Lifespan studies

Research strategies

1. EEG-Studies

(2. Individual differences)



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But before we get into the literature…

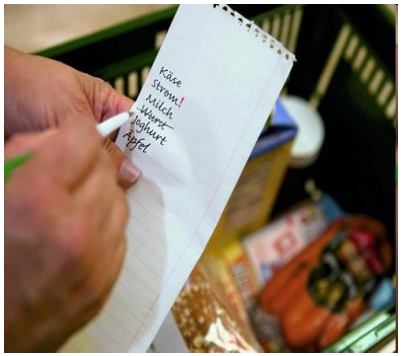
Again, it's your time

Form three sub-groups and propose a concrete example of a lifespan study on when, how and why prospective memory develops.

Consider

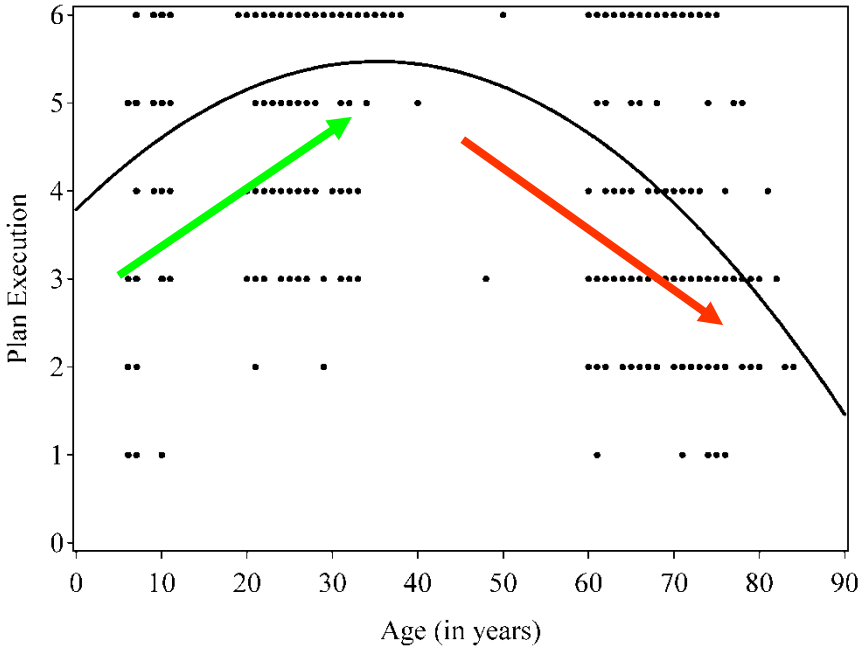
- which age groups,
- which PM tasks and scores
- which developmental mechanisms are (why and how) examined

Developmental Questions



Are there age differences in prospective memory? What are the associated mechanisms?

Kliegel, Mackinlay & Jäger (2008):
Lifespan data (*N* = 557)



Why?
What are the developmental **mechanisms**?
Same or different?

➔ two main candidates: episodic memory plus cognitive control

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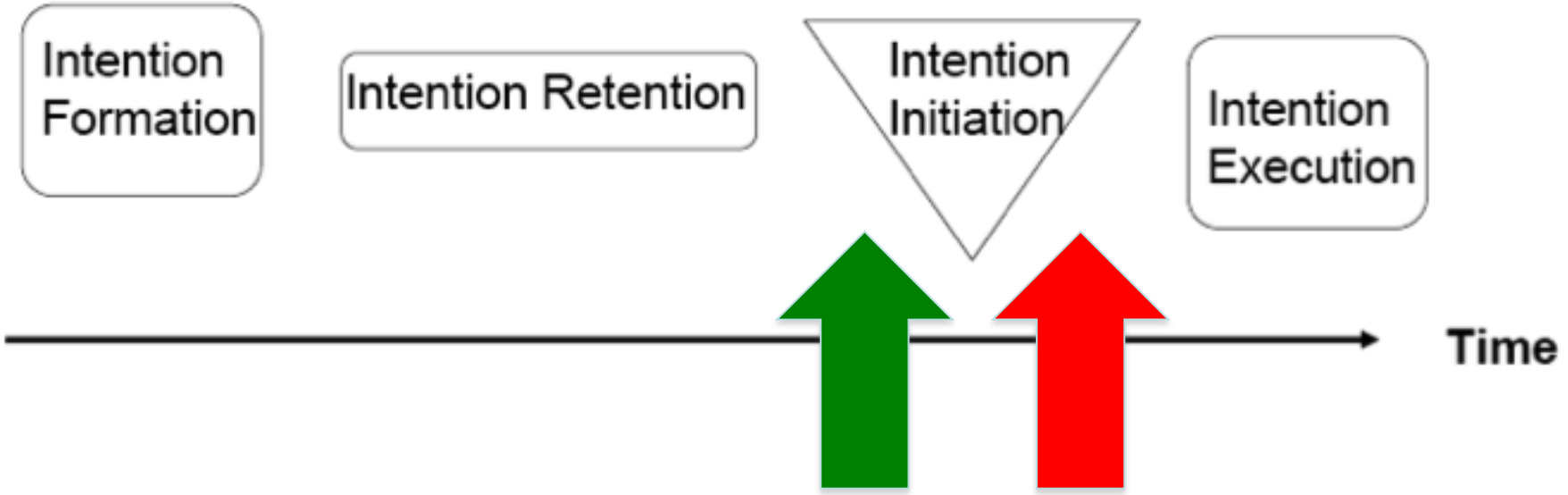
Components of PM



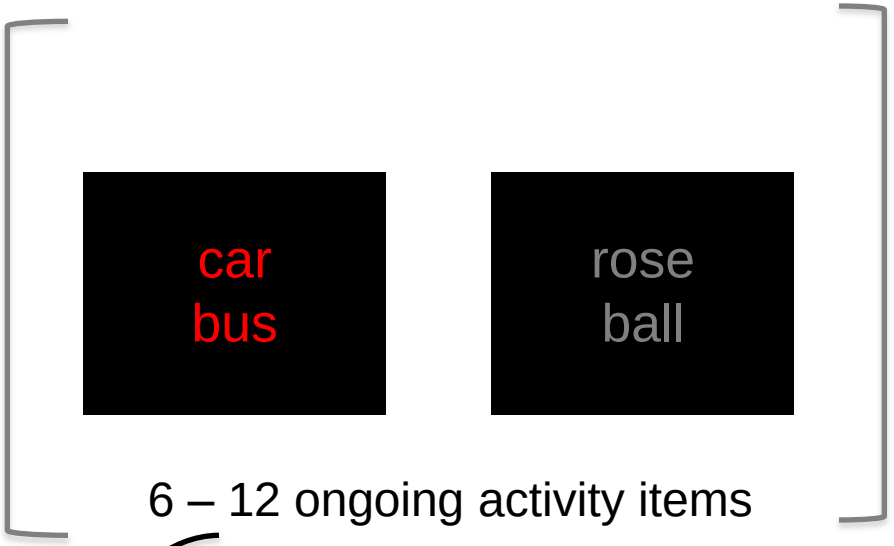
Prospective component: detection of PM cues
NOTICING
(Breneiser & McDaniel, 2006)

Retrospective component: retrieval from long-term memory
SEARCH
(Smith & Bayen, 2004)

Kliegel, Martin, McDaniel & Einstein, 2002
Kliegel, Altgassen, Hering & Rose, 2011

PM paradigm

Ongoing activity



PM paradigm

Intention formation

Ongoing activity

cccc
cccc

car
bus

rose
ball

6 – 12 ongoing activity items

‘ C ’
green

PM paradigm

Intention formation

Ongoing activity

Intention execution

cccc
cccc

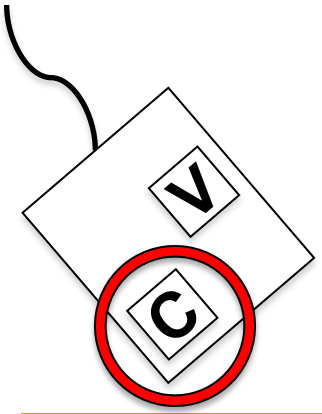
car
bus

rose
ball

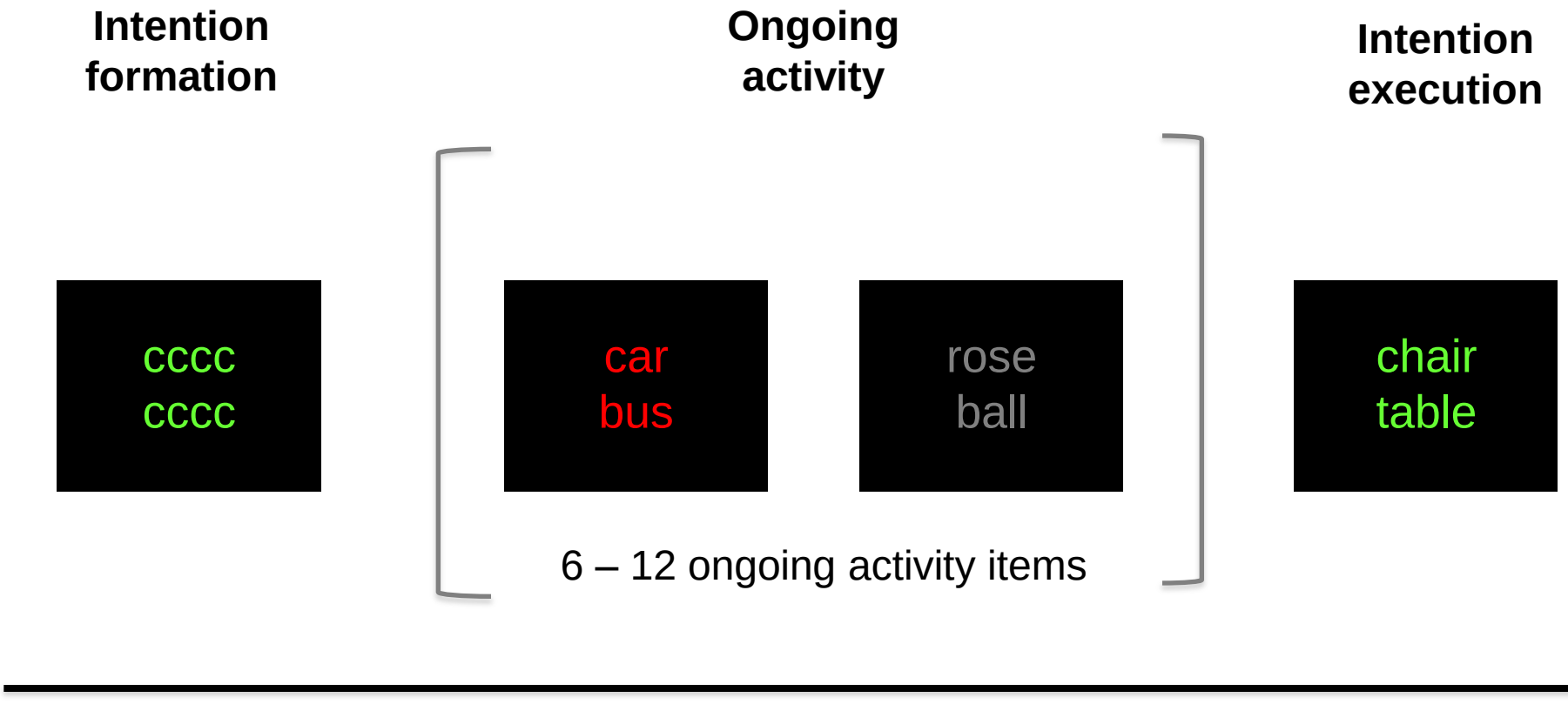
chair
table

6 – 12 ongoing activity items

‘ C ’
green



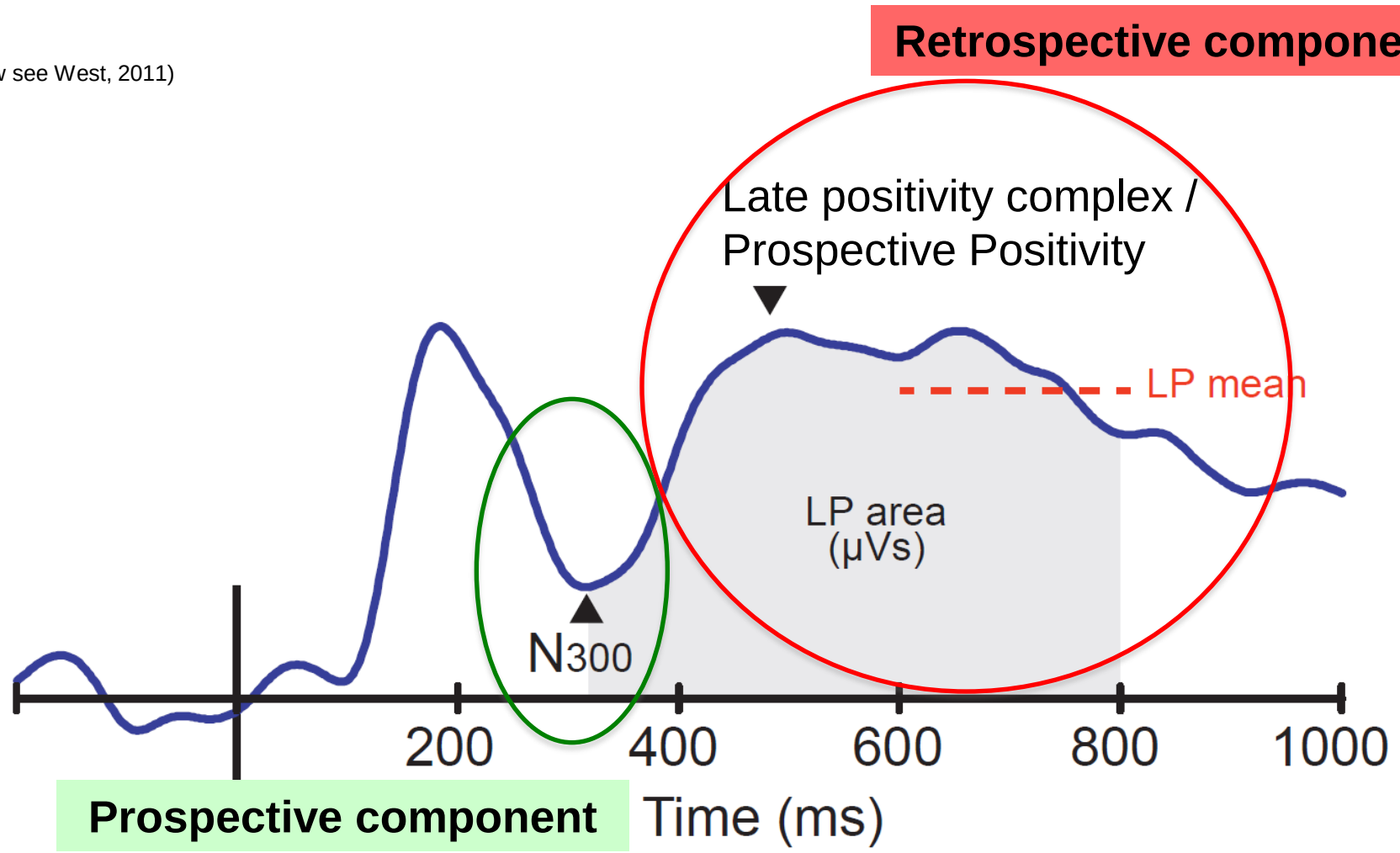
PM paradigm



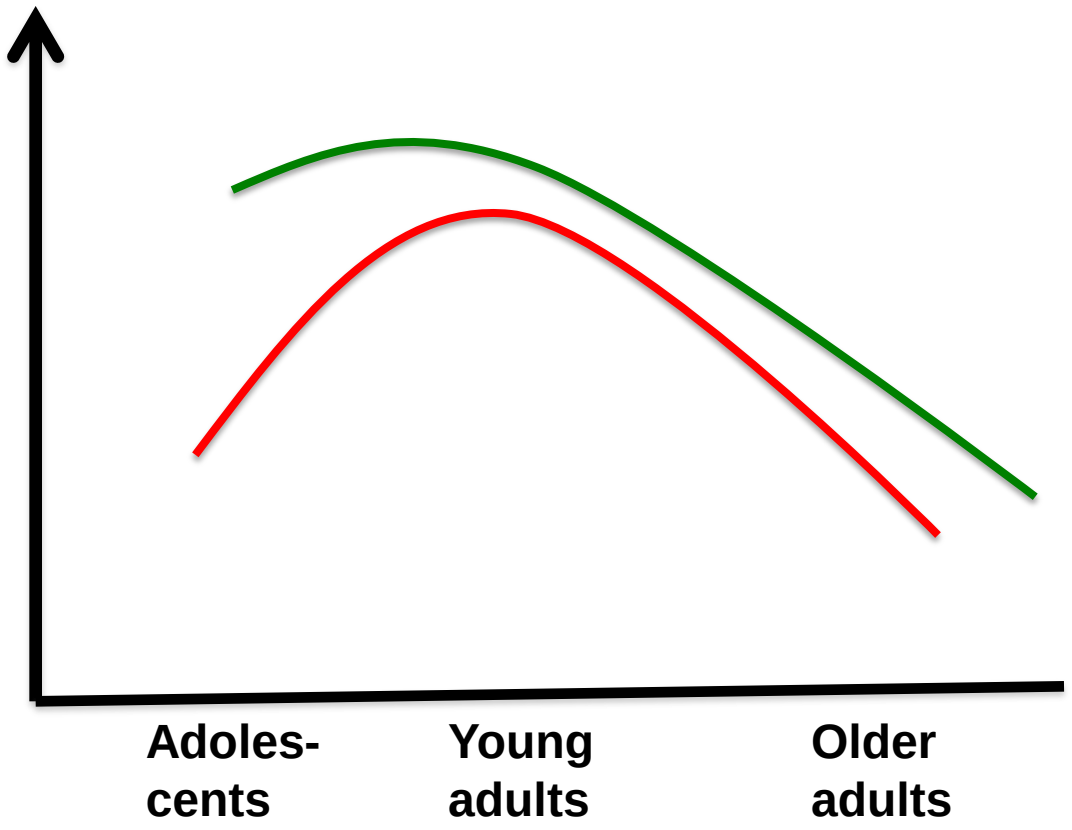
Prospective component: Omission errors (Ongoing task response)
Retrospective component: Confusion errors (wrong PM response)

ERP components of PM

(for a review see West, 2011)



Zöllig, West, Martin, Altgassen, Lemke & Kliegel (2007), *Neuropsychologia*



Older adults:
Impairment of **prospective** and **retrospective** component…

Adolescents:
Impairment of **retrospective** component…

… explains performance differences

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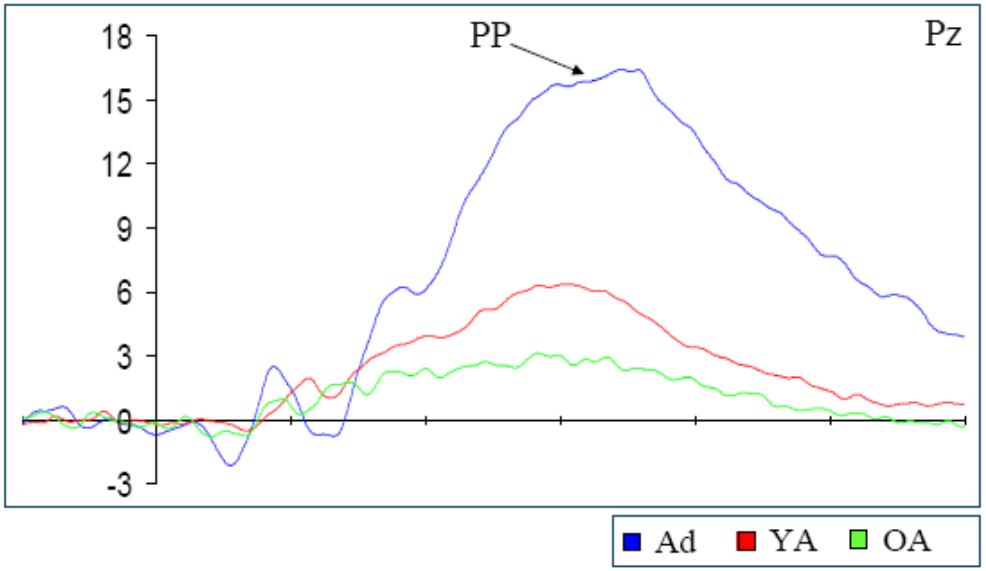
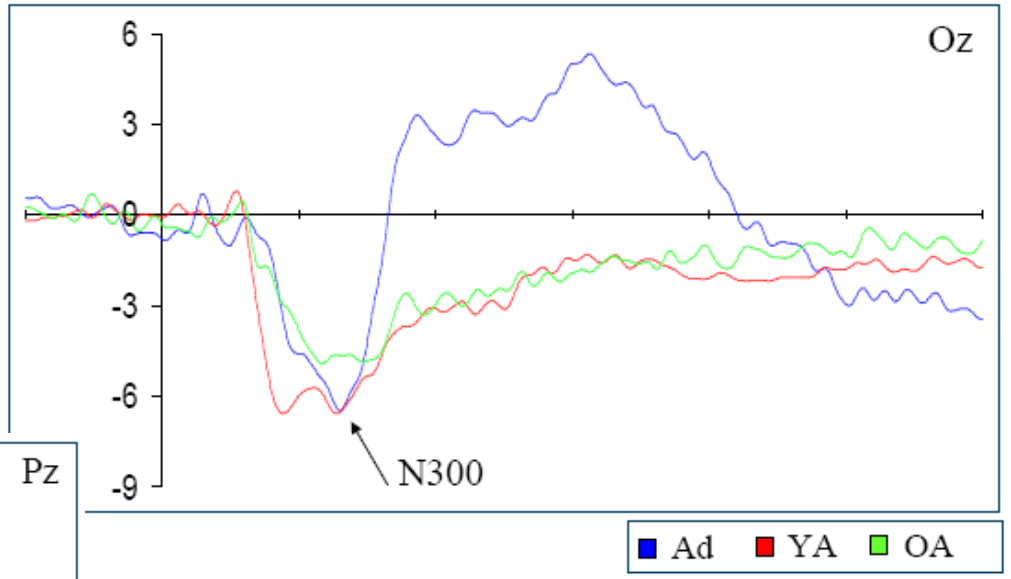
Zöllig, West, Martin, Altgassen, Lemke & Kliegel (2007), *Neuropsychologia*





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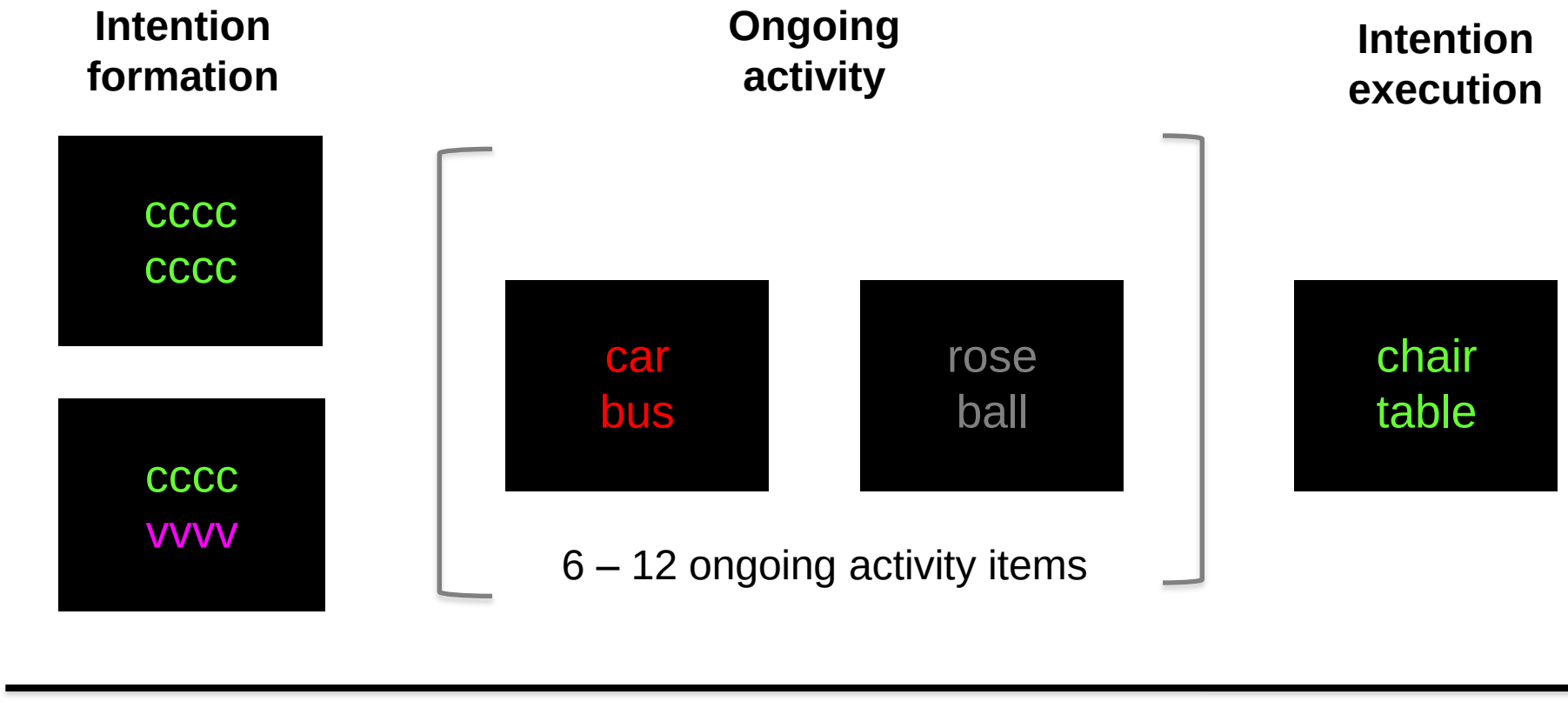
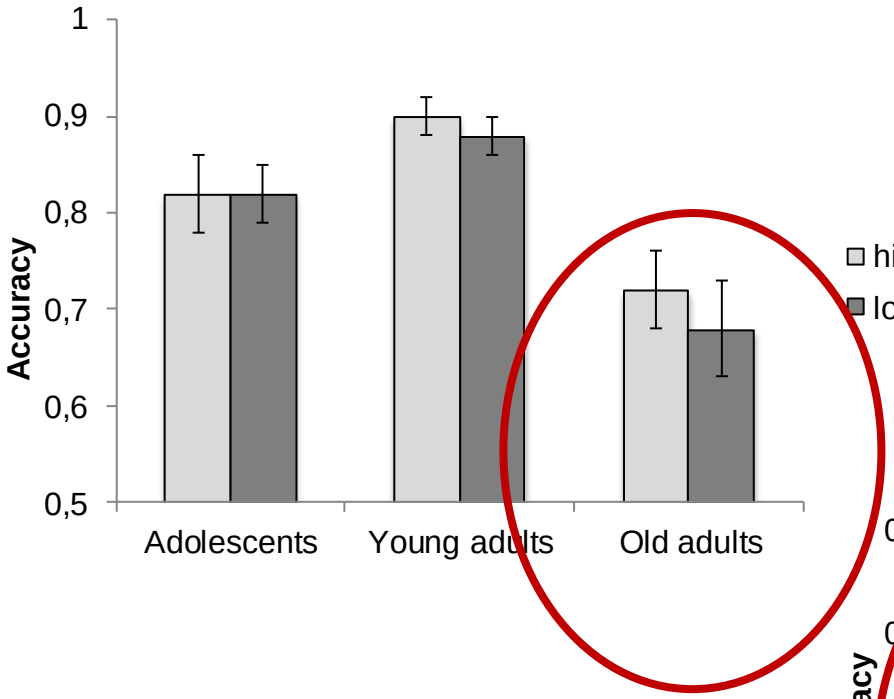
Novel *experimental* paradigm



Memory load:
1 vs 2 letter x color

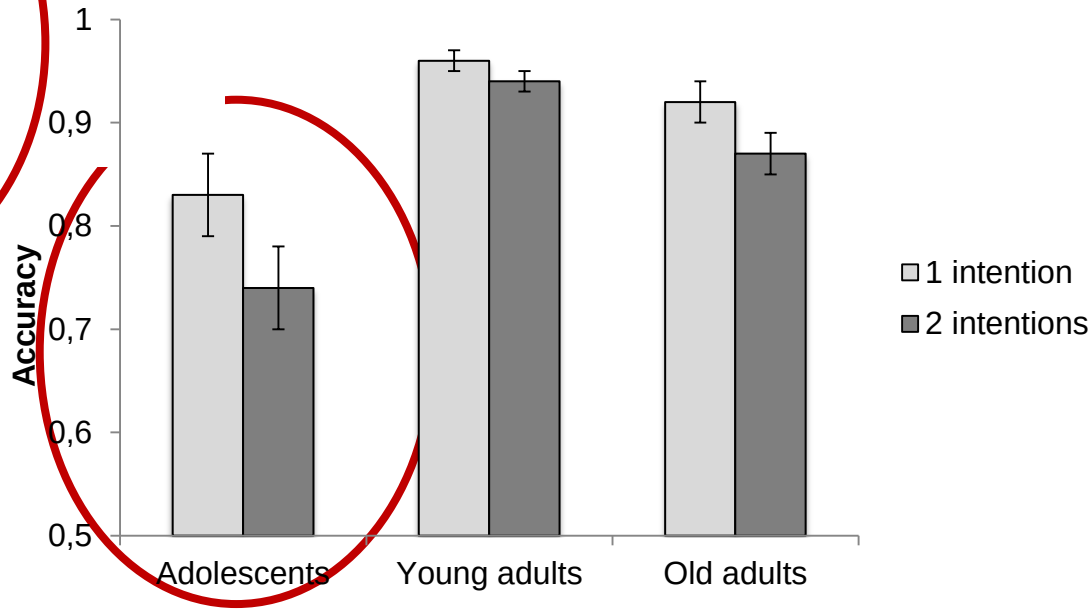
Salience:
2 vs 4 different colors for ongoing activity items

Results



Prospective Component

Retrospective Component



Conclusions

Across the lifespan:

➔ ***Older adults'*** **performance is mostly mediated by the** ***prospective*** **component**

➔ ***Children's / Adolescents'*** **performance mostly by the** ***retrospective*** **component**

Open question:

➔ **Relation to lifespan models of episodic memory**
➔ **Current study on retrospective component and its sub-components**

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Overall summary and outlook

Conceptual conclusions

- Prospective memory develops across the lifespan
- Developmental phases and trajectories vary
- An interplay of cognitive processes (more or less controlled) and task demands determine developmental differences

➔ Conceptual debate warranted on:
similarities / differences of PM, episodic memory, episodic future thinking, volition

➔ **Open issues (further ongoing research):**

- Specific effects in different phases of the prospective memory
- Specific effects of distinct executive processes?
- Longitudinal studies
- Neural correlates
- Individual differences

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