Influences of system response delay on elderly participants' performance in a virtual memory training

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Theoretical Background

Delay in technical systems

- Evidence on effects of delayed system reaction times is rather scarce and controversial and particularly the influence on cognitive performance has barely been inspected yet
- Results from exploratory study (Wirzberger, Schmidt, Rey, & Hardt, 2017) indicate decreased recall performance with increasing delays and influences of individual characteristics

Research Focus

- Replication of effects of delayed system response on memory performance in a virtual training scenario
- Considering individual characteristics such as older age as moderating factors

Methodology

Sample

- 62 native German speaking elderly participants
- M_{age} = 69.0 years, SD_{age} = 5.5, range: 60-81, 56.5% female
- 91% already retired for M = 8.38 years, SD = 5.91, range: 1-22
- 90% reported no prior involvement in comparable training settings

Task

- Memorizing lists of German substantives in three runs with increasing list length (5/ 7/ 9 words)
- Training with virtual agent in using method of loci (De Beni & Cornoldi, 1985) with fading instructional guidance before recall test

Fig. 1. Training procedure with virtual agent and fading instructional guidance.

Design

- **IV:** Continuously varied system delay between 0.5s and 5.5s (steps of 0.5s, equally distributed intervals)
- **DV:** Test performance from accumulated proportion of correctly recalled words (without considering word order)
- **Individual variables:**
  - Retentivity according to test performance from runs with 5/ 7/ 9 words prior to training
  - Affinity for technology (TA-EG, Karrer, Glaser, Clemens, & Bruder, 2009)
  - Frustration (subscale NASA-TLX, Hart & Staveland, 1988)
  - Subjective system evaluation (meCUE; Minge, Thüring, Wagner, & Kuhr, 2016)

Technical setup

- 1 = presentation screen
- 2 = participant working table
- 3 = participant seating area
- 4 = experimenter working table
- 5 = camera for audio recording

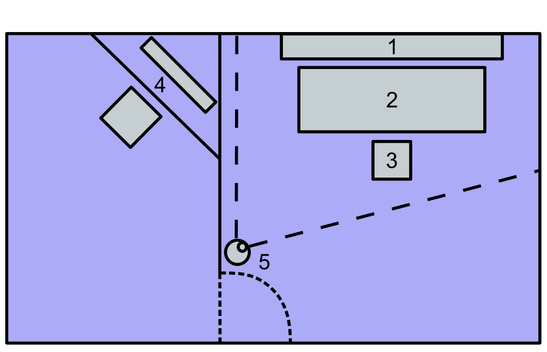

Fig. 2. Technical setup for the Wizard-of-Oz experiment.

Results

Direct effects

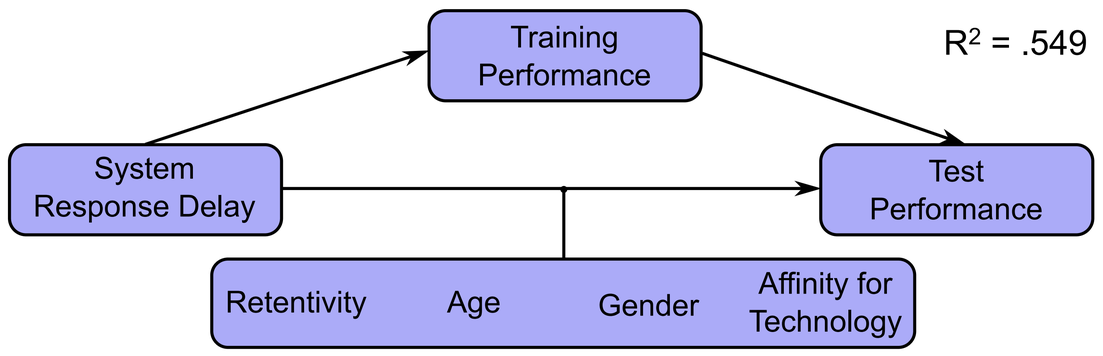

Fig. 3. Path model including mediation and moderation effects.

- Better test performance with better **training performance**, β = .360, *SE* = .118 , *p* = .002
- Better test performance of **women**, β = -.387, *SE* = .115, *p* < .001
- Better test performance with less **negative perception of technology**, β = -.249, *SE* = .104, *p* = .017

Moderation effects

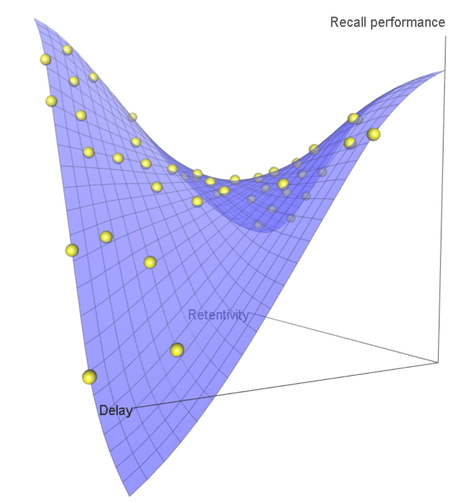

Fig. 4. Retentivity.

Higher **retentivity** compensates increasing delays, β = .279, *SE* = .108, *p* = .010

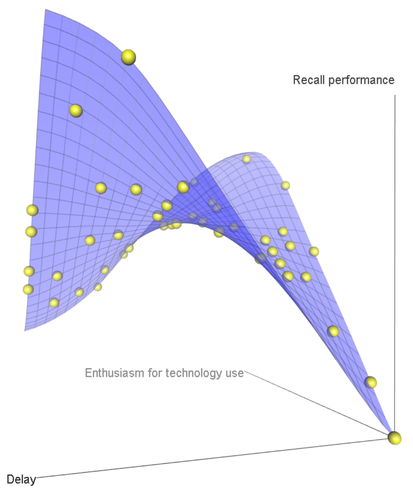

Fig. 5. enthusiasm for technology.

Higher **enthusiasm for technology** results in decreased test performance with increasing delays, β = -.527, *SE* = .163, *p* < .001

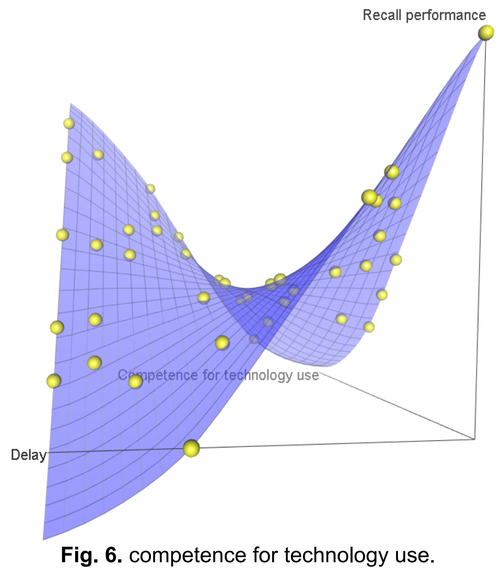

Fig. 6. competence for technology use.

Higher **competence for technology use** compensates increasing delays, β = .362, *SE* = .149, *p* = .015

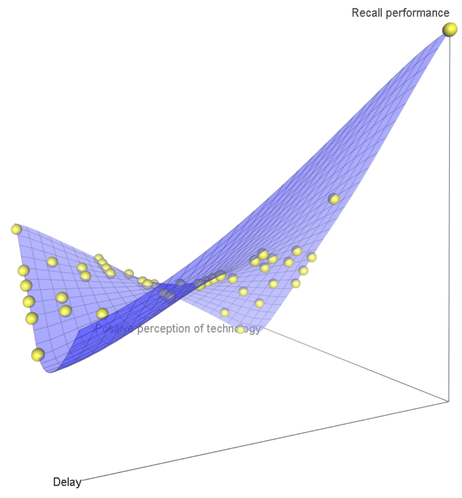

Fig. 7. Positive perception of technology.

Higher **positive perception of technology** compensates increasing delays, β = .283, *SE* = .108, *p* = .009

Discussion & Outlook

Implications

- Absence of direct effects of delay combined with compensating effects of retentivity suggests beneficial segmentation effects of longer delays
- Importance of considering individual differences like age, gender, or affinity for technology in interactions with technical systems

Limitations

- Elderly participants comprise more heterogeneous sample
- Less exposure of current elderly population to technology
- Existing limitations in dialogue opportunities and task setting

Perspectives

- Leverage system impact by increased dialogue opportunities
- Keep track of participants emotional states to broaden system scope
- More systematic comparison across age groups with different samples

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