Low Control Beliefs as a Risk Factor for Memory: Anxiety and Cognitive Interference as Mediators

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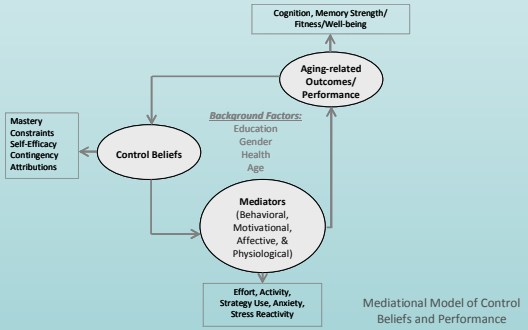
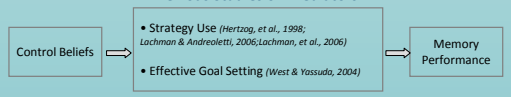
BACKGROUND

- There is robust evidence for individual differences in memory performance in middle and later adulthood *(Hertzog, Kramer, Wilson, & Lindenberger, 2008; Salthouse, 2009).*
- Personal control beliefs have been found to play a central role in maintaining and optimizing cognitive health in adulthood and old age *(Caplan & Schooler, 2003; Hertzog et al., 2008; Krause, 2007; Lachman, Andreoletti, & Pearman, 2006; Rowe & Kahn, 1998; Seeman, McAvay, Merrill, Albert, & Rodin, 1996; Windsor & Anstey, 2008).*
- Control beliefs have behavioral, motivational, cognitive, affective, and physiological consequences, which in turn impact a large spectrum of age-related outcomes, such as cognitive performance and physical health *(Lachman, Neupert, & Agrigoroaei, 2011; Miller & Lachman, 1999).*



Mediational Model of Control Beliefs and Performance

Previous Studies on Mediators



Anxiety and Task Interference as Potential Mediators

- Lower perceived control was shown to be associated with higher state anxiety *(e.g., Endler, et al., 2001).*
- Higher levels of anxiety are associated with poorer cognitive performance *(e.g., Beaudreau & O'Hara, 2009; Endler, Speer, Johnson, & Flett, 2001; Lupien, et al., 2005; Lupien, et al., 1997; Neupert, Stawski, & Almeida, 2008; Stawski, Sliwinski, & Smyth, 2006, 2009; Wetherell, Reynolds, Gatz, & Pedersen, 2002).*
- High levels of anxiety can result in cognitive interference *(e.g., Coy, O'Brien, Tabaczynski, Northern, & Carels, 2011).*
- Task interference was shown to mediate the relationship between anxiety and performance *(Coy, et al., 2011; Kurosowa & Harackiewicz, 1995).*
- The failure to inhibit distracting thoughts, which is characteristic of anxious individuals, is detrimental to maintaining attentional focus needed for successful cognitive performance *(Derakshan & Eysenck, 2009; Eysenck, Derakshan, Santos, & Calvo, 2007; Sarason, 1988).*
- The inhibitory deficit theory *(Hasher & Zacks, 1988)* suggests higher levels of difficulty in inhibiting task-irrelevant information underlie the broad spectrum of cognitive deficits in normal aging.

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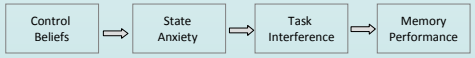
HYPOTHESES

- We predicted a three-path mediational model: those with lower control beliefs would experience higher levels of state anxiety, and anxiety would impair memory performance by increasing the likelihood of intrusive thoughts.



- We also examined whether the hypothesized relationships would show variations by age, as past research has shown age differences *(e.g., May, Hasher, & Kane, 1999; Stawski et al. 2006).*

METHOD

PARTICIPANTS

- N= 152 adults recruited from a probability sample (Survey Sampling International)
- Area: West suburban Boston
- Exclusion criteria:
  - poor self-rated health (compared to other people the same age)
  - low level of education attainment (no high school degree or General Education Diploma)
  - history of stroke in the last five years, serious head injury, Parkinson's disease, or other neurological disorders
  - non-native English speakers (or those who learned English after age 10)
  - more than two errors on the Pfeiffer Short Portable Mental Status Questionnaire *(Pfeiffer, 1975)*
- Respondents with complete data: *N* = 149
  - 22 to 84 years old (*M* = 57.25, *SD* = 15.57)
  - 45.6 % women
  - 12 to 20 years of education (*M* = 16.95, *SD* = 2.14); 82.5 % Bachelor's degree or higher

MEASURES

Control Beliefs

- Instrument: Personality in Intellectual Aging Contexts inventory (PIC, *Lachman, Baltes, Nesselroade, & Willis, 1982*; Cronbach's Alpha = .83)
- Subscales:
  - Internal (e.g., I know if I keep using my memory I will never lose it)
  - Chance (e.g., There's nothing I can do to preserve my mental clarity)
  - Powerful Others (e.g., I can only understand instructions after someone explains them to me)
- Range: 3.50 to 6; higher values = higher perceived control over cognitive functioning

State Anxiety

- Instrument: abbreviated version (the ten odd items) of the Spielberger State-Trait Anxiety Inventory (STAI, *Spielberger, Gorsuch, & Luskene, 1970*; Cronbach's Alpha = .85)
- Example items: I am tense, I am worried
- Range: 1 to 3.10; higher values = higher levels of anxiety

Task Interference

- Instrument: Cognitive Interference Questionnaire (*Sarason, Sarason, Keefe, Hayes, & Shearin, 1986*; Cronbach's Alpha = .86; 21 items)
- Example items: task-relevant worries (e.g., I thought about how poorly I was doing) and task-irrelevant thoughts (e.g., I thought about something that happened earlier today)
- Range: 1.14 to 3.86; higher score = higher interference

Episodic Memory

- Task: categorizable word list free recall task *(Hertzog, Dixon, & Hultsch, 1990)*
- Material: 30 words from five taxonomic categories (i.e., flowers, metals, trees, sports, and animals)
- Final score: the average of three trials (two immediate and one delayed)
- Range: 6.67 to 30

COVARIATES

Verbal Abilities

- Task: Extended Range Vocabulary Test from the Educational Testing Service Kit of Factor Referenced Cognitive Tests *(Ekstrom, French, Harman, & Derman, 1976)*
- Material: 24 multiple choice vocabulary questions
- Final score: sum of the individual scores
- Ranged from .25 to 24 ; higher score = higher verbal abilities

Self-rated Health

- Task: Rate the level of overall health on a scale from 0 (the worst possible health) to 10 (the best possible health)
- Range: 3 to 10

Depression

- Instrument: short form of the Geriatric Depression Scale *(Sheikh & Yesavage, 1986)*
- Examples: "Are you basically satisfied with your life?", "Do you often feel helpless?"
- Range: 0 to 14

PROCEDURE

- Participants recruited for study on problem solving and memory performance
- Control beliefs questionnaire - filled out at home before coming to the lab; state anxiety measure - at the beginning of the lab session; level of task interference - assessed retrospectively, after the memory task

DATA ANALYSIS

- All models were adjusted for age, sex, and verbal abilities*
- Three-path Mediational Model: the joint significance test approach *(Taylor, MacKinnon, & Tein, 2008)*

Model 1: State Anxiety = $ß_{01}$ + $ß_1$ Control Beliefs + ε_1

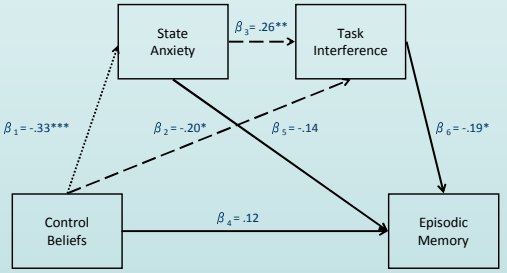
Model 2: Task Interference = $ß_{02}$ + $ß_2$ Control Beliefs + $ß_3$ State Anxiety + ε_2

Model 3: Episodic Memory = $ß_{03}$ + $ß_4$ Control Beliefs + $ß_5$ State Anxiety + $ß_6$ Task Interference + ε_3

- We also examined the total effect (IV → DV; *Baron & Kenny, 1986*)
- The total, direct, and indirect effects of control beliefs on memory performance were estimated by the MED3C SPSS macro *(Hayes, Preacher, & Myers, 2011)* which generates percentile-based bootstrap (1000 bootstrap samples) Confidence Intervals (CI)
- Moderation by Age:
  - Model 1: Age X Control Beliefs
  - Model 2: Age X State Anxiety
  - Model 3: Age X Task Interference

**when education, self-rated health, and depression were also included as covariates, the results were unchanged*

RESULTS



Standardized Regression Coefficients Corresponding to the Three-path Mediation Model

Dotted line = Model 1; Dashed lines = Model 2; Solid lines = Model 3
** p <.05; **p <.01; ***p <.001*

- The three paths of interest ($ß_1$, $ß_3$, and $ß_6$) were significant
- The total effect of control beliefs on memory was significant in the model adjusting for age, sex, and verbal abilities [ß = .22; t(144) = 3.05; p = .003], but was non significant in Model 3 when the mediators were included [direct effect: $ß_4$ = .12; t(142) = 1.59; p = .115]
- The total indirect effect (i.e., control beliefs → state anxiety → task interference → episodic memory) was significant {95% CI [.005, .498]}, providing evidence for full mediation
- None of the three paths of the mediational chain were moderated by age

DISCUSSION

- The results provided empirical support for the theoretically driven three-path mediation model: participants with lower control beliefs reported higher levels of state anxiety, which in turn increased the likelihood of distracting thoughts during the memory tasks.
- This model held across age and while controlling for verbal abilities, education, and sex.

Implications

- Results can be useful for informing interventions to prevent, remediate or minimize either the decrements in sense of control or the sequelae involving anxiety and rumination.
- We suggest supplementing traditional strategy training with enhancement of control beliefs and reduction of fear and anxiety to achieve more sustained effects, especially for the most cognitively vulnerable populations, that is the older adults and those with low control beliefs.

Limitations & Future Directions

- Future studies will include concurrent, behavioral measures of task interference.
- An experimental design will also be helpful for examining directionality and causality for the established associations.

(Memory & Cognition, in press)

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