



# Driven to Forget: Effects of Control Beliefs on Stress and Memory During a Driving Simulation

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## Introduction

- Sense of control is a protective factor for memory functioning (Riggs, Lachman, & Wingfield, 1997; Lachman, Neupert, & Agrigoroaei, in press). However, the mechanisms accounting for the control-memory association remain insufficiently explored.
- Past work, mostly based on correlational designs and self-report data, suggested the mediational role of strategy use (Hertzog, McGuire, & Lineweaver, 1998; Lachman & Andreotti, 2006), goal setting (West & Yassuda, 2004), and cognitive interference (Stawski, Sliwinski, & Smyth, 2006).
- There is also evidence suggesting a possible mediational role of stress and anxiety:
  - Stress and anxiety affect memory (e.g., Andreotti, Veratti, & Lachman, 2006; Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996; Lupien et al., 1997).
  - Individuals with high control beliefs are less reactive to daily stress (Hahn, 2000; Müller, Günther, Habel, & Rockstroh, 1998; Neupert, Almeida, & Charles, 2007).

### Individual Differences in Stress Reactivity

- Adults' stress reactivity is influenced by the personal characteristics they bring to the stressful situations (Almeida, 2005; Piazza, Charles, & Almeida, 2007; Dickerson & Kemeny, 2004; Stawski, Sliwinski, Almeida, & Smith, 2008).
- "Having strong internal control beliefs in situations which do not allow for such personal causation will tend to be detrimental in terms of physiologic activation" (Seeman et al., 1999).

## Current Study

The goal of this research is to examine the role that control (self-report measures and experimental manipulation) and stress & anxiety (self-report and physiological measures) play in memory functioning in adulthood and old age.

## Research Questions

- Is low control associated with higher stress & anxiety and worse memory performance? Does this association differ by age?
- Do pre-existing control beliefs moderate the effects of control manipulation on stress and memory?
- Is the effect of control on memory mediated by the level of stress & anxiety?

## Method

### Participants

- drawn from a Boston area probability sample
- inclusion criteria (e.g., Pfeiffer dementia screener, no stroke or brain injury, current drivers)
- 152 individuals aged 22 to 84 ( $M = 57.24$ ,  $SD = 15.63$ )
- 46.7% Women
- Education: 17.1% - less than college, 30.3% - college degree, 52.6% graduate school or higher

### Measures

#### Control Beliefs

##### Self-report Measures

- General Control Beliefs (Personal Mastery & Perceived Constraints; Lachman & Weaver, 1998)
  - about one week before the session
  - higher scores = higher control beliefs
- Control during Driving
 

"On a scale of 1 to 5 where 1 is no control and 5 is a lot of control, how much control did you feel you had during the driving segment?"

  - after the experimental manipulation

##### Experimental Manipulation of Control

(Funke, Matthews, Warm, & Emo, 2007)



##### Condition 1 – Normal Control

###### Normal driving conditions

- coefficient of friction on the road surface = .8
- no wind

##### Condition 2 – Low Control (ICY)

###### Wind & icy road

- coefficient of friction on the road surface = .4
- 18 instances of wind (10 to 25s. each)

### Cognition

- Word List Recall (Delayed)
  - 30 categorizable nouns (Hertzog, Dixon, & Hultsch, 1990)
  - after the experimental manipulation

### Stress & Anxiety

#### Self-report Measures

- State-Trait Anxiety Inventory (STAII; Spielberger, 1983)
  - during the lab session, before the control manipulation
  - higher scores = higher levels of anxiety
- Daily Stress
 

"We'd like to know if this was a typical day for you, compared to your usual workdays (or weekdays), in terms of how busy, pressured, or stressed you felt."

  - two days before, one day before, and end of the session
  - higher scores = higher levels of stress
- Physiological
  - Cortisol - Hypothalamic-Pituitary-Adrenocortical (HPA) System Reactivity = sample taken 20 minutes after the driving minus sample before the driving (baseline)
  - Electrodermal Activity - Skin Conductance during the experimental manipulation

## Hypotheses

- Hypothesis 1:** We expect those in the low control condition to experience lower control during the driving session, more stress, and to have worse memory performance, with stronger effects in older adults.
- Hypothesis 2:** Older people will be more physiologically aroused and have lower memory performance.
- Hypothesis 3:** We predicted an interaction of prior control beliefs and the control manipulation conditions on physiological reactivity and memory performance, such that people with high control beliefs in the low control condition will be more reactive and have worse memory performance.
- Hypothesis 4:** Control beliefs will be related to memory performance and this effect will be mediated by stress and anxiety.

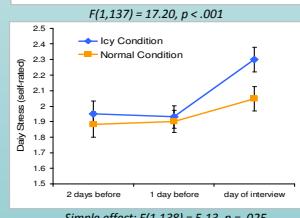
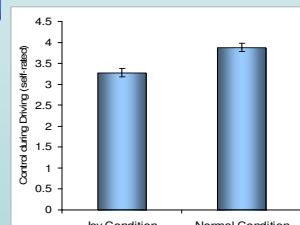
## Results

### **Hypothesis 1. - Effects of Manipulated Control**

Three ANCOVA Models (controlling for age, sex, education, and control beliefs)

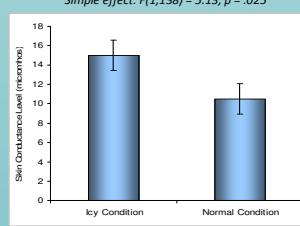
- Model 1: DV= Self-rated Control During Driving**

Consistent with our expectations, the participants in the low control condition (icy) reported significantly less control than those in the normal control condition, suggesting that our experimental manipulation was effective.



- Model 3: DV= Skin Conductance**

As shown by skin conductance levels, people in the low control condition (icy) were significantly more physiologically aroused.



### **Hypothesis 2- Age, Stress Reactivity, and Memory Performance**

- Multiple Regression Model (controlling for sex, education, time of interview, time elapsed between saliva samples, control beliefs, and experimental condition)
  - DV=Stress Reactivity (cortisol) - Older participants are more reactive than the younger ones.  $\beta = .31$ ,  $t(125) = 3.38$ ,  $p = .001$
- Multiple Regression Model (controlling for sex, education, control beliefs, and experimental condition)
  - DV= Word List Recall Delayed - Older participants have lower memory performance than the younger ones.  $\beta = -.27$ ,  $t(142) = -3.49$ ,  $p = .001$

## Results (cont'd)

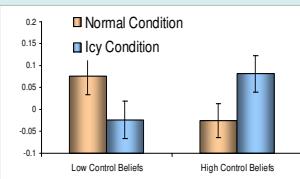
### **Hypothesis 3. - Consequences of Person-Environment Mismatch**

Two ANCOVA Models (controlling for age, sex, education, time of interview, and time elapsed between saliva samples)

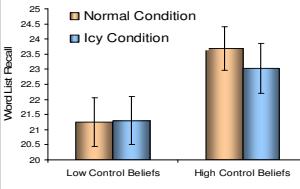
Note: The same patterns were obtained when adjusting for the side effects of different medications (e.g., beta blockers, corticosteroids, glucocorticoids, etc.) used by the participants.

- Model 1: DV= Stress Reactivity**

Consistent with our expectations, the stress reactivity is higher in those with high control beliefs in the low control experimental condition.



$$\text{Interaction} - F(1,124) = 6.20, p = .014$$



$$\text{Interaction} - F(1,132) = .20, p = .654$$

### **Hypothesis 4. - Mediation Model**

- Multiple Regression Models (controlling for age, sex, education, and experimental condition)
- High control beliefs were significantly associated with better memory performance. Moreover, this association was mediated by the level of state anxiety assessed before the control manipulation and memory testing.



## Conclusions

- Sense of control can be experimentally manipulated using a driving paradigm, with similar effects across adulthood.
- These situationally-induced effects on control were moderated by pre-existing control beliefs.
  - Those with high control beliefs in the low control condition were more physiologically aroused.
  - However, this did not interfere with their subsequent memory performance.
- The effect of control beliefs on memory was consistent across ages and experimental conditions, supporting the idea that high general control beliefs provide a positive context for memory performance.
- The association between control beliefs and memory was mediated by state anxiety. Those who have higher control beliefs are less likely to report anxiety, and in turn have higher memory performance.

## Future Perspectives

- In future work we will look at heart rate and alpha amylase assessments of sympathetic nervous system (SNS) activity and try to understand how different systems (HPA & SNS) and self report data come into play to facilitate or inhibit memory performance under different conditions of control.