INTRODUCTION

Situations experienced as uncontrollable are associated with increased stress (Dikmen & Kemény, 2004) and poorer cognitive performance (Lachman, 2006). Seeman and colleagues (1999) suggested that situations which threaten one’s sense of control are likely to lead to increased physiological activation, especially for those with strong control beliefs.

Previous studies have found that older adults have a lower sense of control compared to younger adults and that lower control is related to poorer memory performance (Lachman, 2006). Strategy use, anxiety and task interference have been identified as possible mediators (Lachman et al., 2011). However, little is known about physiological processes that may contribute to differences in performance. Older adults typically show greater physiological reactivity than younger adults in challenging situations (Neupert, Miller & Lachman, 2006; Seeman & Robbins, 1994; Uchino, Birmingham, & Berg, 2010).

Previous studies have shown that higher levels of physiological reactivity are associated with better memory performance (e.g., heart rate: Jennings et al., 1990 - especially in older adults; cortisol: Domes et al., 2002; Nater et al., 2007).

Little is known about the relationship between control beliefs, situational control, physiological reactivity, and cognitive performance.

Our goal was to understand the physiological processes linking control and memory, and whether the relationships vary by age.

METHOD

Participants

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

ADDITIONAL MEASURES

• Participants were randomly assigned to one of two experimental driving conditions.

• Control Beliefs

- General Control Beliefs (Lachman & Wener, 1998)
- Completed at home prior to the lab session.

- 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?
- Completed after the experimental manipulation.

• Memory Performance

During the Experimental Manipulation (Divided Attention)

Number of streets correctly recalled
- “At the end of the driving period we will ask you a few questions about what you saw while you were driving, so please pay close attention.”
- “Please name as many of the streets as you can remember that you saw in the simulation.”

Logical Memory – story heard during driving/recall after driving (Wechsler, 1997)

After the Experimental Manipulation

Word List Recall (WLT - Immediate & Delayed; Weing, Donn, & Heach, 2006)

Verbal Paired Associates (VPA - Immediate & Delayed; Wech, Shee, 2007)

• Physiological Reactivity

During and After the Experimental Manipulation

• Saliva Samples (5 samples - Sarstedt Salivettes)

- Cortisol

- Electrolyphysiological Measures (11 trials - MIDSAC System/3 Neotek)

Skin Conductance [SC] Level & Heart Rate (HR)

RESULTS

Two measures of reactivity were computed for each measure:

- Reactivity 1 during the experimental manipulation

  Cortisol

  Skin Conductance and Heart Rate

  Reactivity 1 during the experimental manipulation

  sample #4 minus baseline (sample #2)

  the maximum value of trial 10 to 11 minus baseline (trial 2)

  Reactivity 2 after the experimental manipulation

  the maximum value of samples #4 and #5 minus baseline (sample #2)

  the maximum value of trials 10 to 11 minus baseline (trial 2)

- Question 1: Is a driving challenge an effective way to manipulate control in younger and older adults? Yes.

  • ANCOVA — (Experimental condition) X (Age: Y = 22-59; O = 60-84)

  • DV = Control during driving

  • Covariates = General control beliefs, Sex

  In comparison to the normal situational control condition, those in the low situational control condition reported less control over driving, supporting the effectiveness of the manipulation. (low control: M = 3.29, SD = .80; high control: M = 3.86, SD = .84; F(1, 136) = 16.87, p < .001)

  The experimental manipulation was effective for both younger and older participants.

- Question 2: Is physiological reactivity related to age, situational control and/or prior control beliefs? Yes for all.

  • ANCOVA — (Experimental condition) X (General control belief: lower and higher levels - median split) X (Age: Y = 22-59; O = 60-84)

  • DV = Reactivity during the experimental manipulation (cortisol, SC, HR)

  • Covariates = Sex

  In the low situational control condition, those with higher prior control beliefs reacted more than those with lower control beliefs for both cortisol and SC.

  F(1, 121) = 5.21, p = .024

CONCLUSIONS & FUTURE DIRECTIONS

The driving simulation is an effective paradigm for manipulating levels of control.

The low control situation has physiological consequences especially for those who typically experience high control. Those with higher control beliefs were more likely to react physiologically in a challenging low control situation than those lower in control beliefs.

Consistent with other research (e.g., Jennings, Nebes, & Yovetsich, 1983) older adults’ memory seems to benefit from greater SC and HR reactivity.

For younger participants, memory performance during driving suffered in the low control condition, perhaps as a sign of greater distraction.

Higher reactivity during a challenging situation seems to be beneficial in terms of memory performance.

Future research will aim to understand the processes linking control, reactivity, and memory.

Higher physiological reactivity may function as an adaptive response.

Reactivity in the HPA or ANS may be indicative of efforts to mobilize and engage resources for the task at hand in the face of a challenge. Those with higher control beliefs, especially older adults, may have demonstrated better recall because they rose to the challenge and were more invested in succeeding at the task.