Stress and Pressure: Differential Effects on Physiological Reactivity and Cognitive Performance

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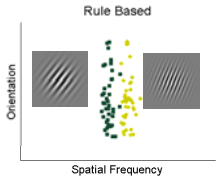
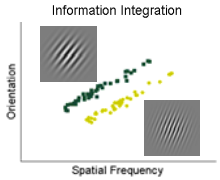
BACKGROUND

- Recent research in cognitive neuroscience has shown that pressure may impair or enhance category learning depending upon the cognitive system mediating task performance (e.g., Markman et al., 2006).
  - ***Rule-Based* (RB)** tasks (Ashby & Ell, 2001; Ashby & Maddox, 2005)
    - Learning mediated by hypothesis-testing system constrained to use explicit, verbalizable rules
    - More reliant on working memory and executive functions
    - Dependent upon a Pre-Frontal – Basal-Ganglia network



  - ***Information-Integration* (II)** tasks (Ashby & Ell, 2001; Ashby & Maddox, 2005)
    - Learning mediated by procedural-based system that gradually associates stimuli with a response
    - Less reliant on working memory and executive functions
    - Dependent upon a network between high level visual areas – posterior Striatum and high level Motor regions



•Pressure has been shown to affect learning on both RB and II tasks(Markman et al., 2006; DeCaro et al., 2011).

•Physiologically, the mechanism by which pressure may mediate these effects are unclear, but it has been suggested that pressure is stressful (e.g., Beilock & DeCaro, 2007).

•Stress affects the same structures that are thought to be critical for category learning (e.g. , Pre-Frontal Cortex, Arnsten et al., 2009; Barsegyan et al., 2010)

•In addition, reactivity to a psycho-social stressor was predictive of category learning performance (Ell et al., 2011).

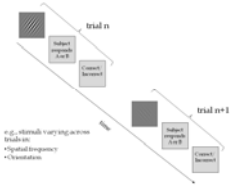
Present Research Questions

•Does pressure have an impact on category learning?

•Is pressure stressful?

Experiment 1 METHOD

- Stimuli and Procedure
  - Learn to classify stimuli varying along a single dimension by trial-and-error.

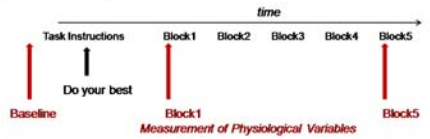


- Participants (n = 116 undergraduates)
  - Low Pressure: $n_{RB} = 23$, $n_{II} = 20$
  - High Pressure: $n_{RB} = 36$, $n_{II} = 35$

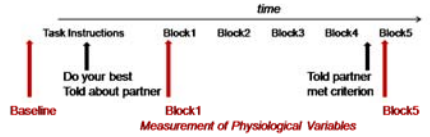
- Psychophysiological Measurement
  - **Heart-Rate** (HR)**:** beats per minute
  - **Mean Arterial Pressure** (MAP)**:** (2*Diastolic Pressure) + Systolic Pressure/3
  - *Emphasis on physiological reactivity (i.e., change from baseline) as there were no baseline differences between conditions.*

Outcome Pressure Manipulation

Low Pressure

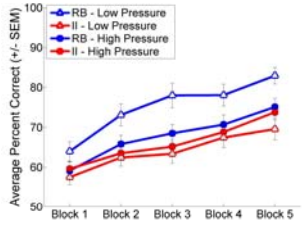


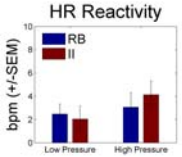
High Pressure

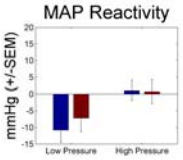


•A point meter indicating the participant's current accuracy, and the accuracy criterion, was continuously displayed

Experiment 1 RESULTS







•Outcome pressure impaired performance on the RB task only.

•Outcome pressure had no effect on pressure condition for HR reactivity

•A main effect of pressure condition was found for MAP reactivity
  •Not driven by an increase in MAP reactivity in HP

•No relationship between physiological reactivity and task performance was found (not shown)

•Outcome Pressure was not found to be stressful

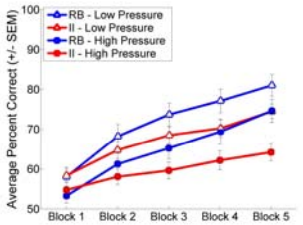
Experiment 2 METHOD

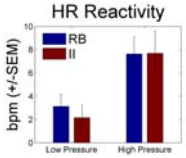
Outcome + Monitoring Pressure Manipulation

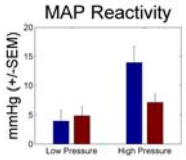
- Experiment 1 used outcome pressure
- Experiment 2 added monitoring pressure
  -i.e. possibility of social evaluation

- Participants (n = 103 undergraduates)
  - Low Pressure: $n_{RB} = 28$, $n_{II} = 23$
  - High Pressure: $n_{RB} = 26$, $n_{II} = 26$

Experiment 2 RESULTS







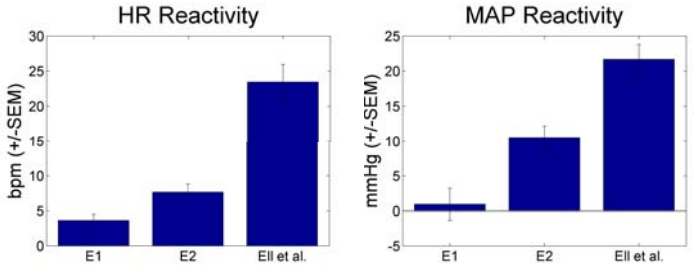
•Pressure impaired performance on both the RB and II tasks

• Pressure led to significant main effects of pressure condition for both HR and MAP reactivity

•No relationship between physiological reactivity and task performance was found (not shown)

•Outcome + monitoring pressure was moderately stressful

Is Pressure Stressful?



•Outcome + Monitoring pressure (E2) increased stress reactivity relative to outcome pressure (E1)

•Psycho-social stress reactivity (Ell et al.) far exceeds reactivity to pressure

SUMMARY

Does pressure have an impact on category learning?

- Pressure impaired performance on the RB task in both Experiment 1 & 2, and II task in experiment 2
  - Results imply that pressure is enough to harm WM processes in humans

Is Pressure Stressful

- Pressure is not necessarily physiologically stressful
  - Not stressful for outcome pressure, and only modest stress response for outcome + monitoring pressure
  - Outcome + monitoring pressure is far less physiologically stressful than psycho-social stress

- Outcome + Monitoring pressure and psycho-social stress may be mediated by the same neural mechanism (i.e. stress hormones acting within Pre-Frontal Cortex, Arnsten eta l., 2009; Barsegyan et al, 2010)

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REPRINTS

http://www.umit.maine.edu/~Shawn_Ell/Presentations.htm