The Effect of Mild Motion Sickness and Sopite Syndrome on Multitasking Cognitive Performance

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Motion Sickness and Sopite Syndrome

- **Motion sickness**
  - A general term describing a constellation of symptoms including stomach awareness, yawning, disorientation, drowsiness, facial pallor, cold sweating, nausea and emesis
  - Neural mismatch (or sensory conflict) theory

- **Sopite syndrome** (identified by Graybiel & Knepton, 1976)
  - Another type of motion sickness
  - A symptom-complex characterized by drowsiness and lethargy related to motion sickness
    - Drowsiness; yawning; disinterest/ disinclination to work; lassitude; mood changes; withdrawal; mental depression
    - Independent of nausea & emesis
Human Performance and Hypothesis

- **Typical Human Performance Findings**
  - Cognitive performance not affected by motion per se
  - Severe motion sickness can result in cessation of performance
  - There have been very few studies on multitasking cognitive performance and motion sickness

- **Hypothesis**
  - Mild motion sickness and sopite syndrome deteriorate multitasking cognitive performance
Experimental Design: Groups and Sessions

(N = 51)

1st Experimental Session

Group A

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Group B

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Group C

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2nd Experimental Session

Group A

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Motion stimulus

Block Block Block Block Block Block
Experimental Design: SYNWIN Cognitive Multi-Task

- Counterbalanced (motion)
Results
Symptomatology
Incidence I (MSAQ)

- 23 “Symptomatic” participants
  - At least 1 symptom
- All 16 symptoms are reported
- Symptoms reported per Symptomatic participant
  - M=6.09 symptoms (SD=4.56, MD=5)

Average MSAQ Total per participant in motion conditions
Symptomatology
Incidence II (from MSAQ)

- **Gastrointestinal cluster**
  - Ready to vomit
  - Sick to the stomach
  - Nauseated
  - Queasy

- **Central-related**
  - Faint-like,
  - Like spinning
  - Lightheaded
  - Disoriented
  - Dizzy

- **Peripheral-related**
  - Clammy/cold sweat
  - Hot/warm
  - Sweaty

- **Sopite syndrome-related**
  - Drowsiness
  - Annoyance/irritation,
  - Fatigue
  - Uneasiness

Symptoms frequency of occurrence in symptomatic participants

[Graph showing frequency of occurrence for various symptoms]
Symptomatology, Performance and Session
# Symptomatology, performance, and session Scores vs Motion Sickness

## Performance vs subjective metrics

<table>
<thead>
<tr>
<th>SYNWIN Scores</th>
<th>Experimental Session 1</th>
<th>Experimental Session 2</th>
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</thead>
<tbody>
<tr>
<td>Composite</td>
<td></td>
<td>✓ MSAQ Total ✓ MSAQ S ✓ MSAQ C</td>
</tr>
<tr>
<td>Memory task</td>
<td>✓ MSAQ Total ✓ SSS</td>
<td>✓ MSAQ Total ✓ MSAQ S</td>
</tr>
<tr>
<td>Arithmetic task</td>
<td>✓ MSAQ P</td>
<td>✓ MSAQ Total ✓ MSAQ S</td>
</tr>
<tr>
<td>Visual task</td>
<td>✓ MSAQ S</td>
<td>✓ MSAQ S</td>
</tr>
<tr>
<td>Auditory task</td>
<td>✓ MSAQ S</td>
<td>✓ MSAQ S</td>
</tr>
</tbody>
</table>

Multitasking performance decrement is MAINLY associated with:
- MSAQ Total
- Soporific symptoms
- 2nd session

## Performance scores vs psychophysiological metrics (EGG power)

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<tr>
<th>SYNWIN Tasks</th>
<th>Experimental Session 1</th>
<th>Experimental Session 2</th>
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<tr>
<td>Composite</td>
<td></td>
<td>✓ (&gt;4 cpm)</td>
</tr>
<tr>
<td>Memory task</td>
<td>✓ MSAQ S</td>
<td>✓ MSAQ S</td>
</tr>
<tr>
<td>Arithmetic task</td>
<td>✓ MSAQ S</td>
<td>✓ (&gt;4 cpm)</td>
</tr>
<tr>
<td>Visual task</td>
<td>✓ MSAQ S</td>
<td>✓ MSAQ S</td>
</tr>
<tr>
<td>Auditory task</td>
<td>✓ MSAQ S</td>
<td>✓ MSAQ S</td>
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Performance decrement is associated with:
- Shift of gastric power to higher frequencies (tachygastria)
- 2nd session

- Average values per participant in motion conditions
- Linear or logarithmic fit
Performance vs Motion Sickness

Experimental Session 1

- Composite
- Memory
- Arithmetic
- Visual
- Auditory

Score (INTRA)

• Average values per participant in motion conditions

Experimental Session 2

- Composite Δ=9%
- Memory Δ=25%
- Arithmetic Δ=13%

Score (INTRA)
Between-sessions

Performance $\Delta$ between the end of ES 1 and beginning of ES 2

This effect was NOT associated with:
- Motion in ES 1
- Development of mild motion sickness symptoms in ES 1
Conclusions
Conclusions

Overall

- Multitasking cognitive performance deteriorates even in mildly nauseogenic motion environments
  - Composite -9%, Memory -25%, Arithmetic -13%

- Mild motion sickness does not seem to interfere with the reminiscence effect in a novel cognitive multitasking environment
Conclusions

- **Order effect**
  - ES 1
    - Participants seem to overcome mild motion sickness
  - ES 2
    - Symptomatology takes a toll on performance

- **Probable explanations**
  - Task involvement/Task novelty
    - Mental activity reduces severity (Bos, 2011; Correia & Guedry, 1966; Griffin, 1990)
  - Self-motivation
    - Encouragement to suppress symptoms ("cognitive counseling") (Dobie et al., 1987; Dobie et al., 1989)
Conclusions: Conceptual Modeling

<table>
<thead>
<tr>
<th>Cognitive Multitasking Performance</th>
<th>Time --&gt;</th>
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<tbody>
<tr>
<td>Practice Effect</td>
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<tr>
<td>Symptomatic Individuals</td>
<td></td>
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<tr>
<td>Asymptomatic Individuals</td>
<td>or</td>
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<tr>
<td>Symptomatic Individuals 1st Session</td>
<td></td>
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<tr>
<td>Symptomatic Individuals 2nd Session</td>
<td></td>
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<tr>
<td>Performance deterioration</td>
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</table>
Why?

- **Background**
  - Simple tasks needing automated responses will suffer less from stress than performance in complex task (Yerkes & Dodson, 1908; van Hiel & Mervielde, 2007)
  - Mental tasks decrease motion sickness severity (Bos, 2011; Correia & Guedry, 1966; Graybiel, 1968)
  - Postural control, sensory integration, and disorientation require cognitive and attentional resources
Why II?

- Previous research combined with our results suggest that:

Motion sickness acts as a *distractor* by absorbing or denying the use of attentional resources.
The End!

Questions?
Demographics

- 3 data collection phases
- 51 healthy participants
  - 45 M – 6 F
  - Air Force=4, Army=7, Navy=33, USMC=1, Civilian=4, NOAA=1, Other=1
  - O2 to O5 (O2=5, O3=22, O4=18, O5=2)
- Equivalent participant groups in
  - Demographics
  - Subjective (MSAQ, MISC, SSS, etc)
  - Psychophysiological (SC, ECG, EGG)
  - SYNWIN metrics
- Differences in visual task
  - Group B resets more frequently than group A
    - Number of resets
    - Reset time
    - Reset position
- Inter-session interval
  - M=6.61d, SD=1.28, MD=7

<table>
<thead>
<tr>
<th>Parameters</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>35.4</td>
<td>5.74</td>
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<td>Body Mass Index (BMI)</td>
<td>26.7</td>
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<tr>
<td>NEO</td>
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<td></td>
</tr>
<tr>
<td>N</td>
<td>15.6</td>
<td>7.58</td>
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<tr>
<td>E</td>
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<tr>
<td>O</td>
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<td>A</td>
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<tr>
<td>C</td>
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<td>MSSQ</td>
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