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 = 39)

1st Experimental Session

Group A

Block Block Block Block Block Block
1 2 3 4 5 6

Motion stimulus

Group B

Block Block Block Block Block Block
1 2 3 4 5 6

Group C

Block Block Block Block Block Block
1 2 3 4 5 6

2nd Experimental Session

Group A

Block Block Block Block Block Block
1 2 3 4 5 6

Group B

Block Block Block Block Block Block
1 2 3 4 5 6

Group C

Block Block Block Block Block Block
1 2 3 4 5 6
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
Symptomatology, Performance and Session
Symptomatology, performance, and session Scores vs Motion Sickness

Performance vs subjective metrics

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

Multitasking performance is MAINLY associated with:
• Gastrointestinal symptoms
• Soporific symptoms

Performance scores vs psychophysiological metrics (EGG power)

<table>
<thead>
<tr>
<th>SYNWIN Tasks</th>
<th>All</th>
<th>Experimental Session 1</th>
<th>Experimental Session 2</th>
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<tbody>
<tr>
<td>Composite</td>
<td>-</td>
<td></td>
<td>😕 (&gt;4 cpm)</td>
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<tr>
<td>Memory task</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Arithmetic task</td>
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<td>😕 (&gt;4 cpm)</td>
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<td>Visual task</td>
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</tr>
<tr>
<td>Auditory task</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

Performance decrement is associated with:
• Shift of gastric power to higher frequencies (tachygastria)

• Average values per participant in motion conditions
• Linear or logarithmic fit
• Regression analysis
Performance vs Motion Sickness

**Experimental Session 1**

- Composite
- Memory
- Arithmetic
- Visual
- Auditory

**Experimental Session 2**

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

• Average values per participant in motion conditions
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 I

Symptomatic individuals

Asymptomatic individuals

Multitasking Performance

Time

Severity of symptoms

Nauseogenic motion

Performance decrement

Adaptation

Hypothetical
Conclusions: Conceptual Modeling II

Multitasking Performance

Static

Nauseogenic motion

Asymptomatic individuals

Symptomatic individuals
1st Session

Symptomatic individuals
2nd Session

Practice Effect

Time

Severity of symptoms
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
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

1. **2 data collection phases**
2. **39 healthy participants**
   - 34 M – 5 F
   - Air Force=4, Army=6, Navy=22, USMC=1, Civilian=4, NOAA=1, Other=1
   - O2 to O5 (O2=4, O3=16, O4=14, O5=1)
3. **Equivalent participant groups in**
   - Demographics
   - Subjective (MSAQ, MISC, SSS, etc)
   - Psychophysiological (SC, ECG, EGG)
   - 33 of SYNWIN metrics
4. **Differences in visual task**
   - Group B resets more frequently than group A
     - Number of resets
     - Reset time
     - Reset position
5. **Inter-session interval**
   - M=6.51d, SD=1.45, MD=7

<table>
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<th>Parameters</th>
<th>M</th>
<th>SD</th>
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<tr>
<td>NEO</td>
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<tr>
<td>N</td>
<td>16.4</td>
<td>7.59</td>
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<tr>
<td>E</td>
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</tr>
<tr>
<td>O</td>
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<tr>
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<tr>
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<tr>
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