Instrument Failure and its Effects on Pilot Performance, Attention and Cardiac Activity

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I will not discuss off-label use and/or investigational use in my presentation.
Focus of attention

**internal**

- Directing attention to one’s *movements, body parts, or the feel of the movement*

**external**

- Directing attention to the *effects* of one’s movements
- Better performance in running, soccer, volley, tennis, playing a musical instrument

*e.g. Wulf & Lewthwaite (2009); Schucker et al. (2009); Bell & Hardy (2009)*
Motor Performance & Cardiac Activity

- Performance...
  ...suffers from an internal focus of attention

  ...benefits from anticipatory control

  ...may suffer from high levels of workload ➔ reflected in cardiac activity

- Pilots: Changes in cardiac activity are dependent on flight experience and phase of flight

Objective

• Where should the pilot concentrate on for best performance?

• Does a switching focus lead to good performance, an internal focus to bad flight performance?

• How will focus of attention interact with instrument failure?
Design

- 24 pilots; VFR and IFR

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<tr>
<th>Attention</th>
<th>Less experienced</th>
<th>Expert</th>
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<td>Distal</td>
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<td>Switch</td>
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**Novice:** 1,000 hours of flight or less  
**Expert:** more than 1,000 hours of flight
Internal vs. Distal vs. Proximal

Distal environment

Proximal environment

Internal
Manoeuvers

✓ **Distal environment (Instrument failure)**
  = Do not trust in your instruments! (attention outside machine)

✓ **Proximal environment**
  = Trust in your instruments, it’s dark outside! (attention inside machine)

✓ **Internal**
  = Do not trust in your instruments and be cautious, it’s dark outside!
    (attention on feeling of movement)

✓ **Switch**
  = You will have to cope with instrument failure and poor visibility from
time to time!
    (switching of attention between distal, proximal and internal)
Results

• **Experienced pilots** show **better performance** than less experienced pilots, $p = .001$, $\eta^2 = .413$

• **Distal, Proximal and Switching focus** lead to better performance than an Internal Focus
Cardiac Activity

- Experienced pilots show lower mean heart rates over all manoeuvres, $p = .018$, $\eta^2 = .275$

- Heart rates are higher during manoeuvre Proximal compared to Internal, $p = .020$, $\eta^2 = .255$ and Switch, $p = .009$, $\eta^2 = .306$

- No significant differences regarding heart rate variability
Instrument failure and Cardiac Activity

- Heart rate increases by tendency for experts and decreases in less experienced pilots after an instrument failure (p = .057)
Summary & Discussion

• Attention and performance

  • More experienced pilots performed better than less experienced pilots

  • Expected differences between attentional conditions could be observed (worst performance: internal)

→ transfer of internal-external concept possible, but adapted:

  External focus often equals an anticipatory focus of attention; anticipations are said to be beneficial for performance
Summary & Discussion

• **Attention, instrument failure and cardiac activity**

• Experienced pilots show lower heart rates than less experienced pilots
  - in line with Dussault, Jouanin and Guezennec (2004)

• After an instrument failure increase of heart rate in experienced pilots, decrease in less experienced ones
  - experienced pilots may be common with consequences of a failure
  - different patterns of cardiac activity (Fenz & Epstein, 1967)
References