

HTAWS alerting strategy

Professor Polly Dalton

Director, Attention Lab, Royal Holloway, University of London

Dr Matthew Greaves

Head, Cranfield Safety and Accident Investigation Centre

Background

- Aim to improve attention-getting qualities of HTAWS alerts where possible
 - *“The earlier audible alerts may have also been announced, but not ‘heard’ by the pilots, because of inattentive deafness or the effects of overload on the pilots’ capacity to process auditory cues. The visual cues appeared not to be especially attention-getting, being small and presented only as illuminated script in small lit push-buttons.”*

(AAIB Bulletin, G-WIWI, 2014)



<https://www.youtube.com/watch?v=ubNF9QNEQLA>

Inattention effects

- Increasing the demands of a focal task reduces detection of concurrently-presented stimuli:
 - Visual (Macdonald & Lavie, 2008)
 - Auditory (Dalton & Fraenkel, 2012; Dehais et al., 2013; Raveh & Lavie, 2015)
 - Tactile (Murphy & Dalton, 2016)
- When attention is focused elsewhere, even highly salient stimuli can go unnoticed



False alarms

- Higher false alarm rates lead to reduced response rates – the ‘cry wolf effect’
- Also slower responding in cases where responses are made

(e.g. Bliss, Gilson & Deaton, 1995; Getty, Swets, Pickett & Gonthier, 1995)



Auditory alerting

- Alert user to situation requiring attention
- Provide information about nature of situation
- Guide operator towards appropriate course of action



Stanton & Edworthy (1999)

Combining “attenson” with speech

- Can design abstract sound to reduce the chances that it will be masked
 - Four or more components spread across the spectrum at levels that are appropriately high (Patterson, 1990)
- Can also design abstract sounds to deliver different levels of urgency
- Combination with spoken alert removes the need for learning (but increases total duration of alert)

Repeat behaviour of auditory alerts

- Patterson (1990) alerting approach
 - Bursting warning signal, varying in intensity
 - Starts loud (but ramped on and off to avoid startle)
 - Reduces to level where conversation between operators can take place
 - Increases again (to even louder level than before) if no action has been taken after a certain time

Visual alerting

- Visual alerts should not interfere with perception of other relevant information, yet should be sufficiently salient to attract attention
 - Abrupt onset
 - Fast flash rate

Crébolder & Beardsall (2009)

- For high priority warnings, visual alerts often recommended as supplementary to auditory or tactile

Campbell et al. (2009)

Tactile alerting

- Tactile stimuli argued to be prioritised because they occur in peripersonal space

Ho & Spence (2009)

- Tactile information can be used successfully to improve complex performance

Craig et al. (2004)



Multisensory alerting

- Under high workload, multisensory cues might capture attention more effectively than unimodal cues

Santangelo, Ho, and Spence (2008)

- Should not assume that different senses have separate processing resources, because research does not agree on this

(e.g. Driver & Spence, 1998; Gallace & Spence, 2007; Wickens, 1984)

Development of candidate auditory alerts

- Created seven new alerts, designed to be clearly detectable over cockpit background noise
- Predicted to elicit differing levels of urgency and annoyance
- 12 experienced pilots and 12 non-pilots rated alerts in terms of urgency and annoyance

Urgency



Annoyance



Testing of candidate auditory alerts

- Four candidate alerts and existing spoken “caution” and “warning” messages used as “targets” for high priority response
- Presented at 15dB(A) above background cockpit noise while 20 non-pilots carried out a battery of “pilot-like” tasks

Multi Attribute Task Battery II 01-24-2011

File Help

SYSTEM MONITORING

F5 F6

F1 F2 F3 F4

TRACKING

MANUAL

SCHEDULING

Elapsed Time 00:00:26

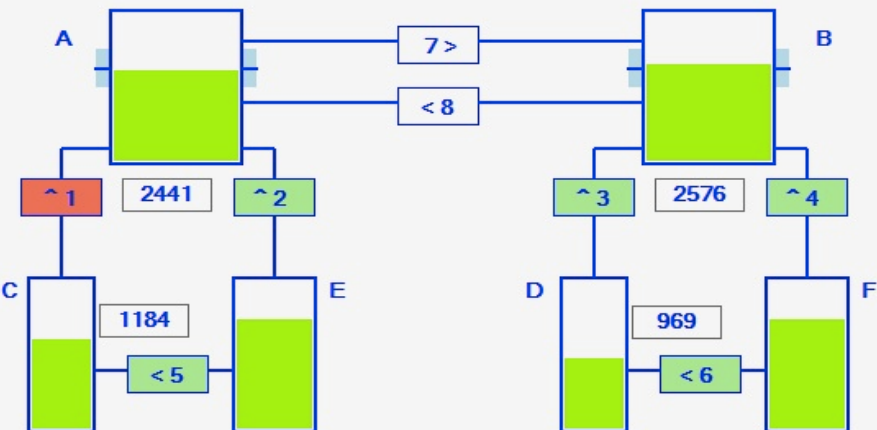
COMMUNICATIONS

Call Sign NASA504

- NAV1 112.500
- NAV2 112.500
- COM1 126.500
- COM2 126.500

ENTER

RESOURCE MANAGEMENT



A B

C E D F

7> <8

^1 2441 ^2

^3 2576 ^4

1184 <5 969 <6

PUMP STATUS

FLOW RATES	Value
1	0
2	600
3	800
4	600
5	600
6	600
7	0
8	0

Testing of candidate auditory alerts

- Four candidate alerts and existing spoken “caution” and “warning” messages used as “targets” for high priority response
- Presented at 15dB(A) above background cockpit noise while 20 non-pilots carried out a battery of “pilot-like” tasks
- Performance was excellent for all alerts, with no significant advantage for any of the alerts tested

Alert presentation levels

- 15dB(A) above background is in line with the recommendations
- Are HTAWS alerts presented at this level in operational contexts?
- Work is ongoing to measure alert levels in flight
- Seems likely to identify variability, supporting the use of supplementary alerting in other senses (e.g. tactile)

HTAWS alerting strategy

Professor Polly Dalton

Director, Attention Lab, Royal Holloway, University of London

Dr Matthew Greaves

Head, Cranfield Safety and Accident Investigation Centre