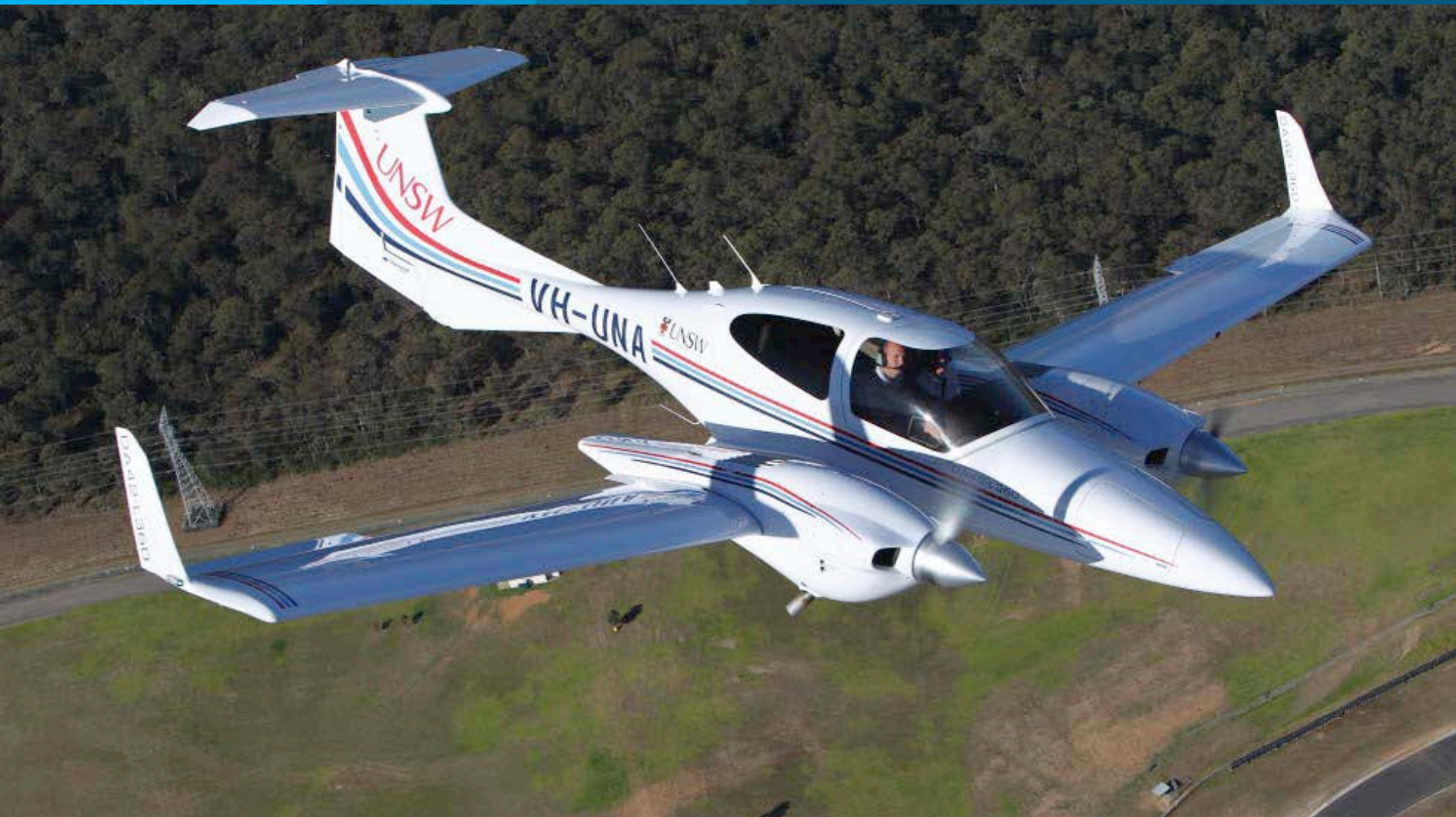
The Effect of Noise On Passengers' Ability to Recall Key Safety Related Information

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

Never Stand Still | Faculty of Science | School of Aviation



Objective

- Investigate the effect of noise on cognitive performance, and
- the effectiveness of countermeasures such as noise cancelling headphones in reducing its effect.

*using simulated aircraft noise

Pen and Paper

List the five senses in perceived order of importance

–Hearing

–Sight

–Smell

–Taste

–Touch

Pen and Paper

Which word is spelt incorrect?

–apple

–pear

–fig

–bannana

–orange

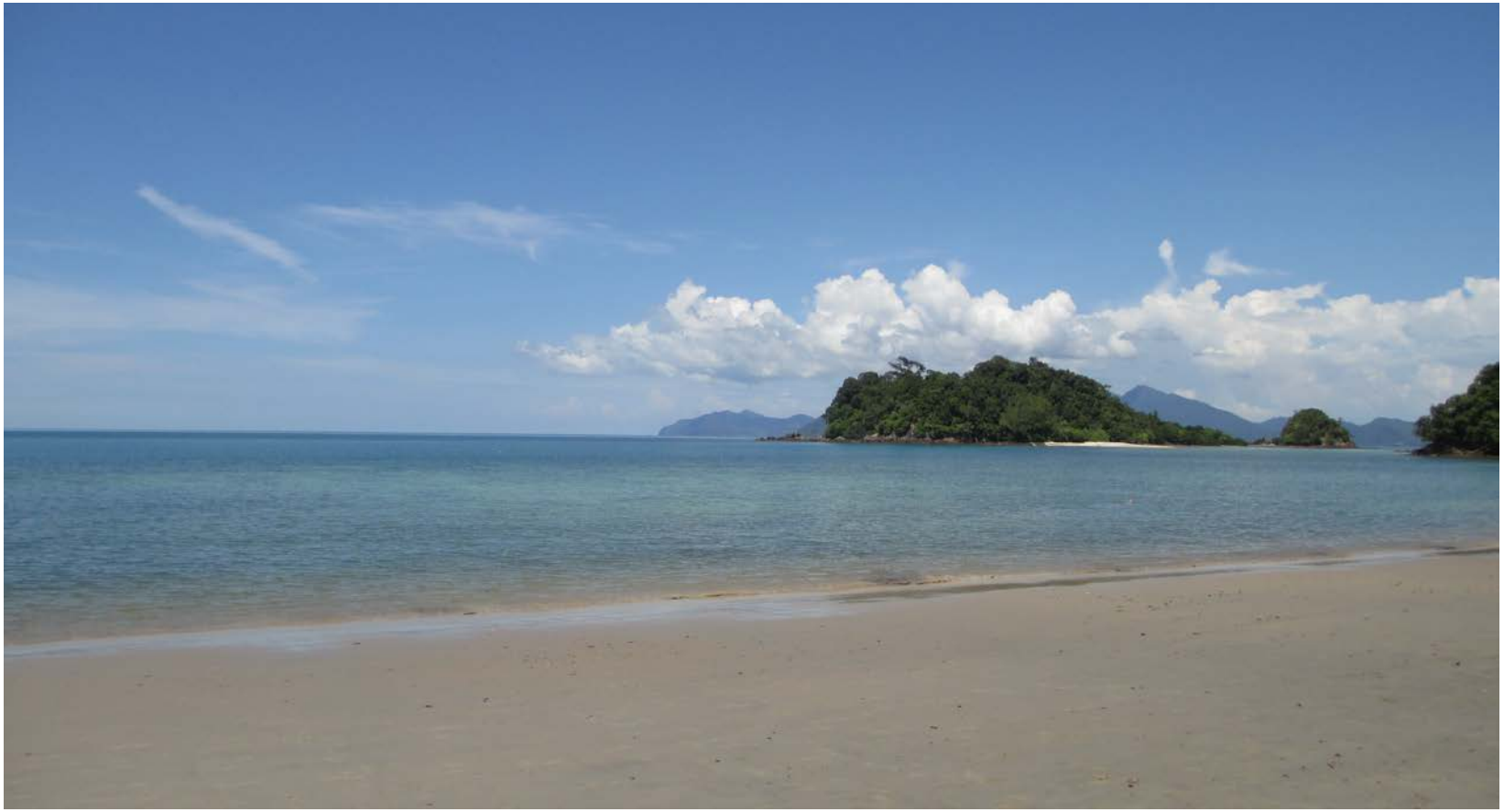
Pen and Paper

- Looking towards the front, write down the direction in which the sound originated from?

Pen and Paper

- Looking towards the front, which word is spelt incorrect from the list presented behind you?

What do you see?



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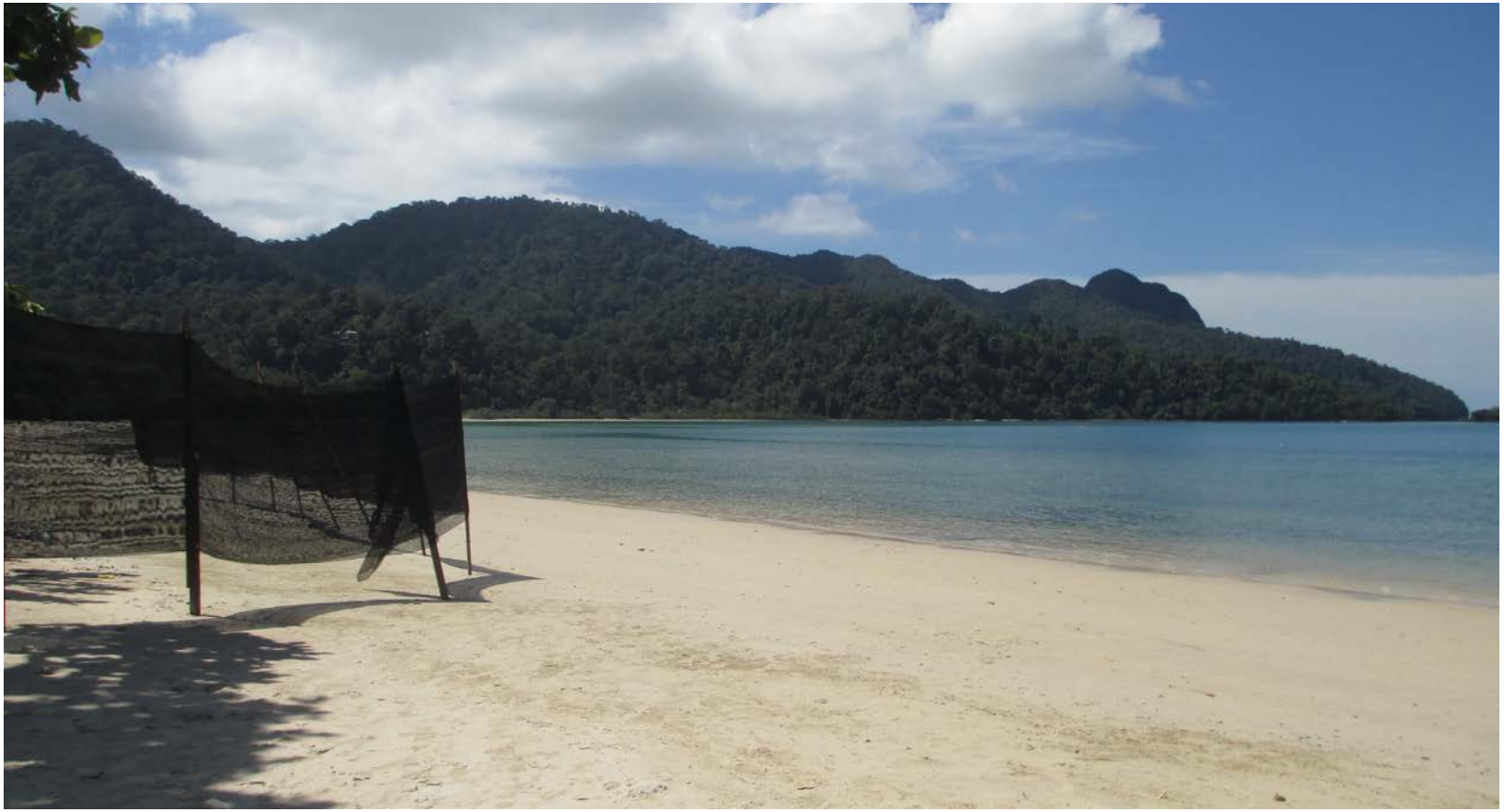


Sight vs. Hearing

Sight – unidirectional
Noise - omnidirectional

Sight – small changes hard to detect
Noise – small changes easy to detect

Sight – lack of light affects vision
Noise – light has no impact on hearing

Why Noise?

- Noise is all around us
- Noise consumes our limited cognitive capacity
- Noise affects certain individuals more than others

Above all

- Noise degrades performance.

Noise and Performance

- High levels – cause hearing loss
- Classroom babble – detrimental to academic achievement (Shield & Dockrell, 2008)
- Road & Aircraft noise (overhead)
  - Induce fatigue (Saremi et al., 2008),
  - Reduce concentration – Introverts (Belojevic et al., 2001),
  - Negatively affect memory (Miller, 1998),
  - Attention (Vertegall et al., 2006), and
  - Semantic processing (Smith, 1985)

Noise consumes our limited cognitive capacity

Cognitive resources = 200CR

Consumption

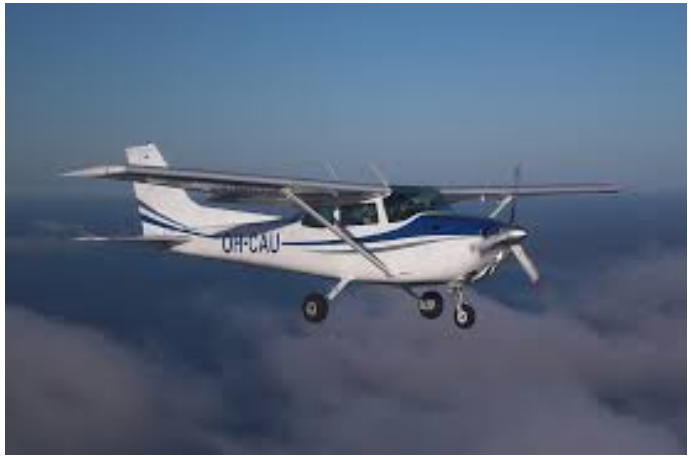
Visual	= 50
Tactile	= 10
Smell	= 3
Auditory	= 50
Taste	= 2
Cognition	= 75
Total	= 190
Noise	= 20

Aviation - Hearing

- Very important (auditory tests)
- Detect abnormal aircraft state
  - engine
  - airflow
- Perform duties
  - Respond to commands
  - Etc.
- Yet
  - Aircraft are loud

Focus on Noise – Why?

- Noise levels within aircraft are loud
- GA Cessna 172 during cruise – 95 dB(A)
- Commercial Aviation – Airbus A321 (Ozcan & Nemlioglu, 2006)
  - 80 dB(A) cruise
  - 65 dB(A) taxi



Noise is Problematic for:

Noise is particularly problematic for:

- Non-Native Speakers (Shimizu et al., 2002)
- Older adults (than younger adults) (Tun et al., 2002)
- The hearing impaired

- 1/3 of the world's population report English as their native language

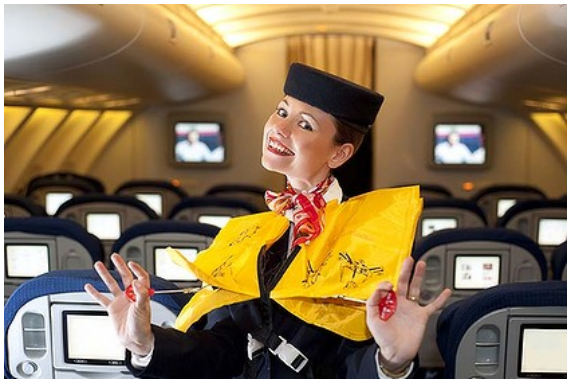
Aviation Safety - Noise

- Combined:
  - Passengers expected to acquire important safety related information in the presence of noise.
  - Many passengers native language is not English

Asia Pacific Cabin Safety Working Group - APCSWG

Taking matters into your own hands:

- Commercial business class passenger
- Noise cancelling headphones
- No external audio including music
- But, listen to pre-flight safety brief
- Threatened with refusal of carriage



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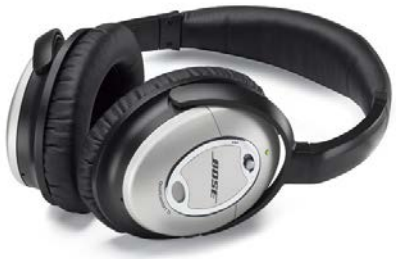
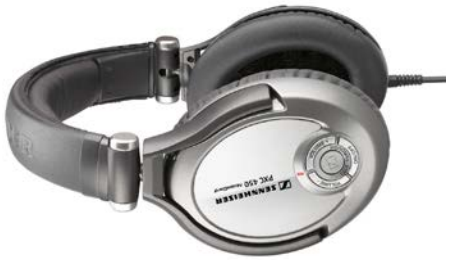
In-Cabin Noise and Cognition

Series of studies that compare performance in noisy conditions with and without noise cancelling headphones.



- Noise levels – 65 dB(A) – taxi
- Wideband noise (similar to jet turbine noise)
- University students
- Normal hearing



- DV – Memory and recall exercise (90s information about various aircraft)

In-Cabin Noise and Cognition

Noisy Conditions – Wideband Noise at 65 db(A)					
	1	2	3	4	5
	No Head-phones	Passive Head-phones 	N/C Head-phones (Sennheiser) 	N/C Head-phones (Bose) 	Noise + music in head-phones 
Memory and Recall	3.00 (2.36)**	2.84 (1.89)*/**	4.40 (2.24)*/**	3.92 (2.33)*/**	068 (1.07) **

Noise vs Music

Noisy Conditions – Wideband Noise at 65 db(A)				
	1	2	3	4
	No Head-phones	N/C Head-phones 	N/C Head-phones + Music 50db(A) 	N/C Head-phones + Music 70db(A) 
Memory and Recall	6.06 (2.15)*	7.03 (2.15)*	5.83 (2.05)	2.00 (1.96)

Noise vs Dual Task

Noisy Conditions – Wideband Noise at 65 db(A)				
	1	2	3	4
	No Head-phones + Single Task	No Head-phones + dual task	N/C Head-phones + Single Task	N/C Head-phones + Dual Task
		Name:_____ 7 x 1 = 4 x 6 = 6 x 4 =		Name:_____ 7 x 1 = 4 x 6 = 6 x 4 = 
Memory and Recall	5.72	5.36 (2.18)	7.85 (1.76)*	6.47 (1.24)*

Noise and Native Language

Noisy Conditions – Wideband Noise at 65 db(A)				
	1	2	3	4
	No Head-phones	Passive Head-phones + speaker	N/C Head-phones (audio through head-phones)	N/C Head-phones + speaker
English	7.88 (131)*	7.00 (1.71)	8.06 (1.61)	7.50 (1.63)
German	4.44 (2.03)*/**	4.00 (2.07)	6.56 (2.19)**	4.19 (2.54)

A User-Friendly Metric

Fact

- Non-meaningful noise is detrimental to performance
- More so, for non-native speakers than native speakers
- A user-friendly metric would be helpful
- The effect of alcohol on performance is well known
- Alcohol provides an easy comparative marker for the effect of noise on performance,
- Builds on similar research
  - Fatigue and Alcohol 17-18hrs of wakefulness = 0.05 BAC (Williamson & Feyer, 2000).

Noise vs Alcohol

Noisy Conditions – Wideband Noise at 65 db(A)				
	1	2	3	4
	No Head-phones	N/C Head-phones (audio through head-phones) 	No noise + BAC 0.05 	No noise + BAC 0.10 
Memory and Recall - All Participants	5.72 (2.68)*/**	7.85 (2.06) *	7.13 (2.12)**	6.34 (2.35)
English	7.75 (2.27)	7.75 (2.27)	7.63 (2.13)	7.13 (2.45)
Non-Native English Speakers	5.19 (2.34)*/**	7.34 (1.90)*	6.63 (2.06)**	5.56 (2.03)



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In Summary

- Noise negatively affects memory (recognition task)
- The effects of noise are worse for ESL speakers
- Noise cancelling headphones are beneficial
- Noise affects performance similarly to BAC 0.10 (ESL)

In Summary

Theoretical

- Human Factors – Designed for Human Use
- Errors can be induced by the environment

Applied

- Creating an environment that is conducive of learning
- Recall of information adversely affected by environment

In Practice

- A disconnect

A Scare Campaign or a Threat

- Noise Cancelling Headphones – Banned (PED)
- FAA and CASA – Airworthy Directive (Airline to decide)
- NASA 85 in-flight incidents (none fatal) that were unexplained, therefore PED (NASA, 2001)

Not Made any Easier

- Authoritative bodies (FAA & CASA) remain silent.
- NASA is vocal, although little evidence.
- US House of Representative hearing into cell phones, unable to duplicate such events.

Results

Summary

- Noise impairs performance (repeatedly shown)
- Noise has a greater impact on ESL speakers, opposed to native English speakers
- Noise at 65 dB(A) impairs performance similarly to BAC 0.10 for all speakers
- System approach to noise reduction, includes quieter aircraft and noise cancelling headphones

Thank You

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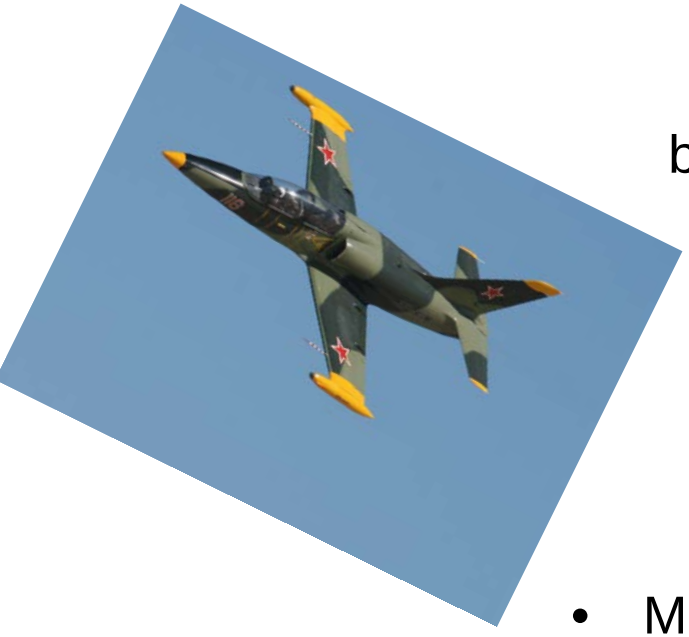

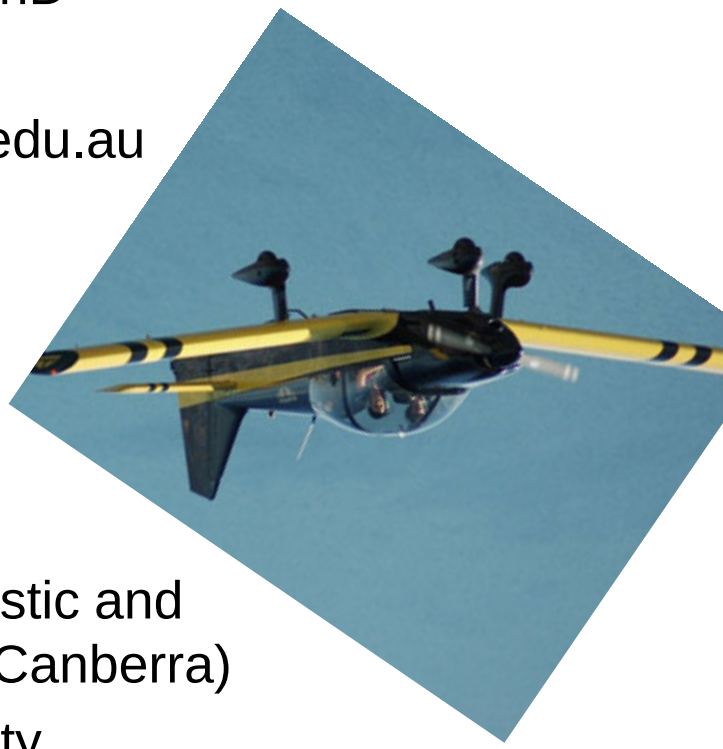

- Marion Burgess – Acoustic and Vibration Unit (UNSW, Canberra)
- Asia Pacific Cabin Safety Working Group

Noise vs Noise

Not all noise is the same

- Speech is more distracting than non-speech noise
- Noise that is loud is more distracting than soft noise
- Noise bursts more disruptive than continuous noise

(Jones et al., 1992)