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14. ABSTRACT

Army aviators require a level of hearing acuity to communicate in high operational tempos, which includes the use of multiple radios while performing flight operations. Military operations, including rotary-wing aircraft noise, present short-term risks to the communication abilities of Army aircrew and long-term risks to aviator hearing health in the form of hearing loss, which can be temporary or permanent. Hearing loss can render an aviator more susceptible to the adverse effects of degraded communication signal quality and consequently lead to an increased allocation of mental resources to hear, referred to as 'listening effort.' Army aviation hearing standards, which are primarily based on pure tone testing and speech recognition scores in quiet, do not necessarily predict the functional impact of hearing loss. Given this, the current study aimed to first determine the scope of hearing loss in Army aviators over the past five years and analyze the impact of current threshold requirements on in-flight performance data from pilots presented with simulated hearing loss.

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Hearing loss, aviator performance, fitness for duty standards

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The Effects of Simulated Hearing Loss on Aviator Performance and Cognitive Workload During Simulated Flight

Heath Jones[1], Kyle Hale[1,2], Kichol Lee[1,2], Paula Henry[1,2], JR Stefanson[1,2], Ryan Mackie[1,2] and Jennifer Noetzel[1]

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Background

Aviators face several challenges when listening to communications during flight.

U.S. Army pictures | Photos of Soldiers operating worldwide

- Aircraft are extremely loud environments.
- Multiple radio and internal communication channels are continually monitored.

Hearing loss can render an aviator susceptible to degraded communication signals.

- Consequently, this could also lead to an increased allocation of mental resources to hearing (referred to as listening effort).
- Understanding the hearing requirements needed in the aircraft can help identify and improve fitness-for-duty standards and guide aircraft communication systems design.

Hearing Standards for Army Aviators

Army hearing standards are primarily based on pure tone testing and speech recognition scores in quiet, which do not predict the functional impact of hearing loss.

- Aviators who do not meet the pure tone standards are granted waivers based on meeting a certain binaural word recognition in quiet criterion.
- The Army recently adopted a new Military Operational Hearing Test (MOHT) to assess the functional impact of hearing loss.

Current Army Hearing Profiles

DA PAM 40-502 Medical Readiness Procedures							
Profile		500Hz	1000Hz	2000Hz	3000Hz	4000Hz	6000Hz
H1	Better Ear	≤25	≤25	≤25	≤25	≤25	≤60
	Worse Ear	≤30	≤30	≤30	≤35	≤45	-
H2	Better Ear	≤25	≤30	≤25	≤40	≤60	≤70
	Worse Ear	≤40	≤40	≤60	-	-	-

Aeromedical Policy Letters (APL)						
	500Hz	1000Hz	2000Hz	3000Hz	4000Hz	6000Hz
Class 1	≤25	≤25	≤25	≤35	≤45	≤45
Class 2 3/4	≤25	≤25	≤25	≤35	≤55	≤65

Currently, no research exists that directly supports the predictive value of audiometric thresholds on aviator-related performance.

Study Aims

1) Quantify the impact of hearing standards on the current force of aviators.
2) Evaluate the predictive value of Military Operational Hearing Test (MOHT) scores on flight performance for varying degrees of hearing loss and increasing workloads.

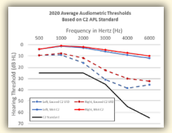
GOAL: Understand the current prevalence of hearing loss within Army Aviators and its impact on flight performance and cognitive workload

Scope of Hearing Loss in Army Aviators

- DOEHRS and AERO databases query and analysis of hearing loss in aviators according to current Army Readiness Standards and Aeromedical Policy Letters.

DOEHRS

Quantify the scope of hearing loss in Army aviators over the past five years



Army Aviators Exceeding C2 APL Standards		
CY	Total Counts	%
CY16	809	5.9%
CY17	848	6.3%
CY18	792	6.6%
CY19	803	6.2%
CY20	697	6.3%

- Based on current Army standards, a small number of aviators exceed C2 thresholds.

Aero Database

Quantify the number of pilots recommended for hearing-related waivers

Army Aviator Waivers 2020-2022 (AERO)		
	Class 1 (Applicants)	Class 2 (Rated Aviators)
New Waivers	116	163
Approved	107	143
Disqualified	5 (4%)	1 (<1%)
Waiver Continued	39	453
Continued	15	348
Suspended	0	0
Information Only	0	83
Disqualified lacking completed information	24	22

- <5% of new hearing losses are disqualified
- All continuing waivers are granted.
- No in-flight evaluations completed or systematically tracked.

More could be done to ensure aviators are operationally capable and mission-ready with the hearing loss they have.

Methods

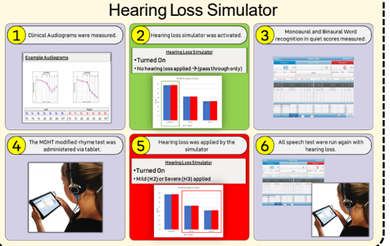
Participants 21 Army aviators (age criteria 19-59) with over 200 flight hours

- Audiometric thresholds ≤25 dB HL at all frequencies tested in both ears.
- Currently on flight status (20 UH-60 and 1 AH-64).

Simulated Hearing Loss: Conditions and Performance Metrics

Audiometric Testing Using Current Clinical Practices

Hearing Loss Simulator



Flight Performance Tested in NUH-60F Flight Simulator

- Four (4) flights with limited visibility
- Approx. 10 minutes with varying workloads
- How workload was increased:
  - More calls (target and maskers)
  - Increased turbulence
- Secondary task of pushing button on control when caution light came on

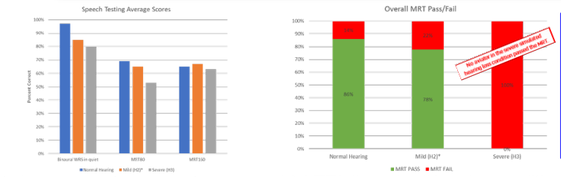
Cognitive Workload Measures

- Completed a NASA-TLX survey after each flight
- Pupillometry measurements

Results

Simulated hearing loss decreased all speech scores and increased the fail rate on the Modified Rhyme Test (MRT)

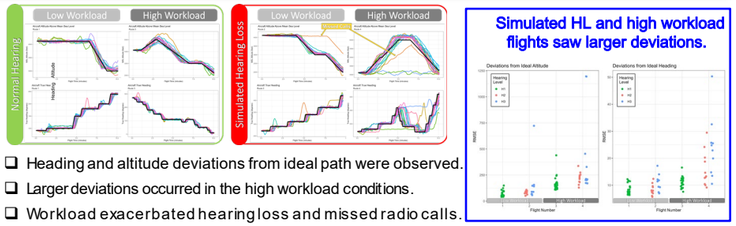
Audiometric Testing



- Word recognition in quiet decreased as a result of increased hearing loss.
- MRT failures in all hearing conditions suggest pure tone thresholds are not good predictors of auditory performance.

Flights during high workload were impacted more by simulated hearing loss

Flight Performance



- Heading and altitude deviations from ideal path were observed.
- Larger deviations occurred in the high workload conditions.
- Workload exacerbated hearing loss and missed radio calls.

Subjective assessments captured hearing loss and workload effects

Cognitive Workload

- NASA-TLX scores indicated simulated hearing loss increased aviator's effort, frustration, and temporal demands.
- The aviators' perception of their performance decreased when hearing loss was simulated and/or workload increased.

Conclusion... (To be continued)

Comparing flight performance and cognitive workload measures against audiometric testing and MOHT scores

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