# Effects of Alerts on Army Platoon Leader Decision Making and Performance

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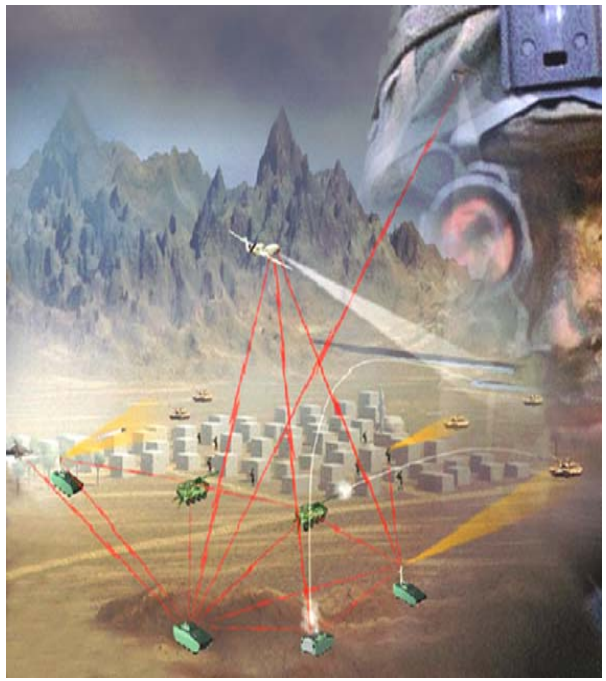
ICCRTS June 20, 2006

# Challenge



- Modern combat ……
  - Highly complex task environment
  - Stress and uncertainty of battle
  - Operational tempo
- Distribution of large amounts of information can lead to:
  - Cognitive overload
  - Information bottlenecks



# Approach



- Army Technology Objective (ATO)
  - Research centered on display designs
    - Reduce the potential workload of soldiers
    - Enhance information management and decision making

- Focus
  - Future Combat Systems (FCS)
    - Infantry Carrier Vehicle (ICV)
    - Platoon leader

# Objectives



Build task network model using the Improved Performance Research Integration Tool (IMPRINT) to identify instances of high workload

Identify candidate technologies and techniques for mitigation of workload peaks

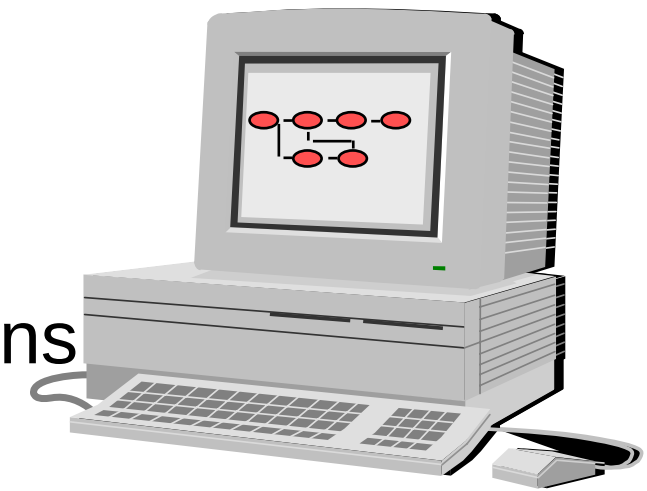
Conduct research to investigate techniques to mitigate workload and improve decision making of platoon leader

Display design guidelines for FCS

# IMPRINT Model



- Modeled tasks performed by five crewmembers in the IPLV
  - High mental workload
    - Tasks
    - Modalities
- PL overloaded:
  - Scanning display
  - Monitoring remote operations
  - Communications



# Mitigation Techniques

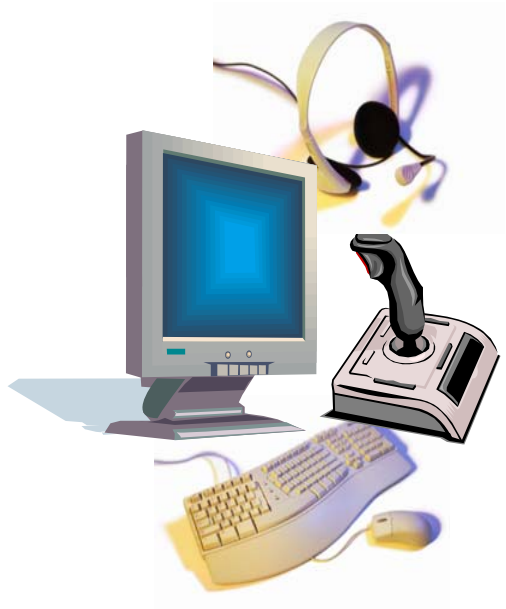


- Literature states that alerts may be effective aids for information management.
  - Helleberg & Wickens, 2001
  - Laughery & Wogalter, 1997
  - Haas & Edworthy, 2003

# Platform Description



- M-Body AEDGE® simulation platform
  - Developed by 21st Century Systems Inc. (21csi).
    - Decision support system
  - Phase III SBIR
  - Capabilities extended to include:
    - Tactile transducers
    - Data collection

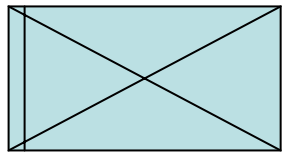


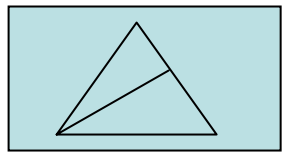
AEDGE = Agent Enabled Decision Group Environment

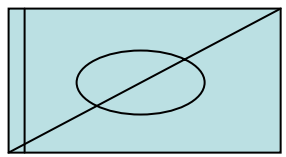
# Platform Capabilities



- Battlefield visualization
  - 2D & 3D maps, icons and graphics
- Dynamic scenarios
- Communications
  - Voice and digital
- Multi-sensory alerts
  - Visual, auditory, and tactile integration
- Data collection capability
  - Time stamps, events logged



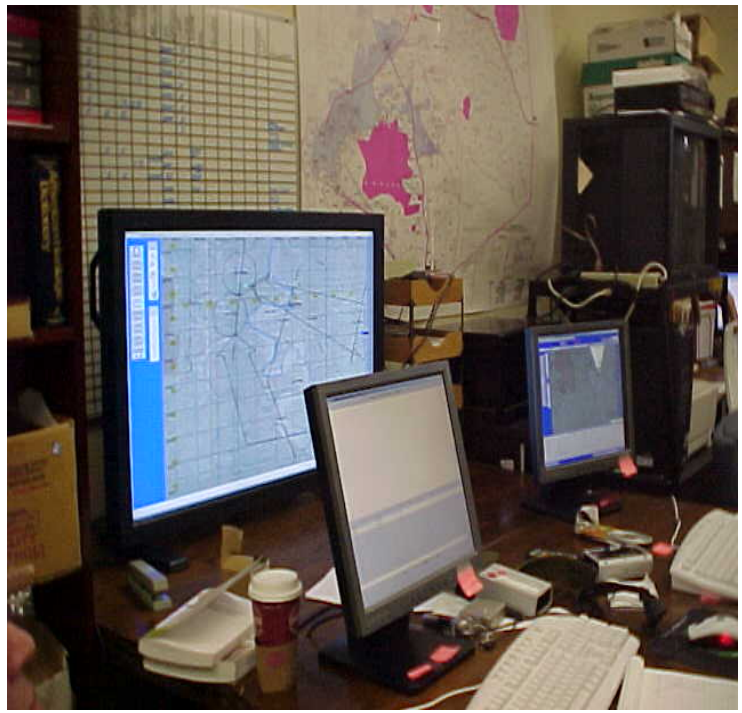




# Platform Description (cont'd)

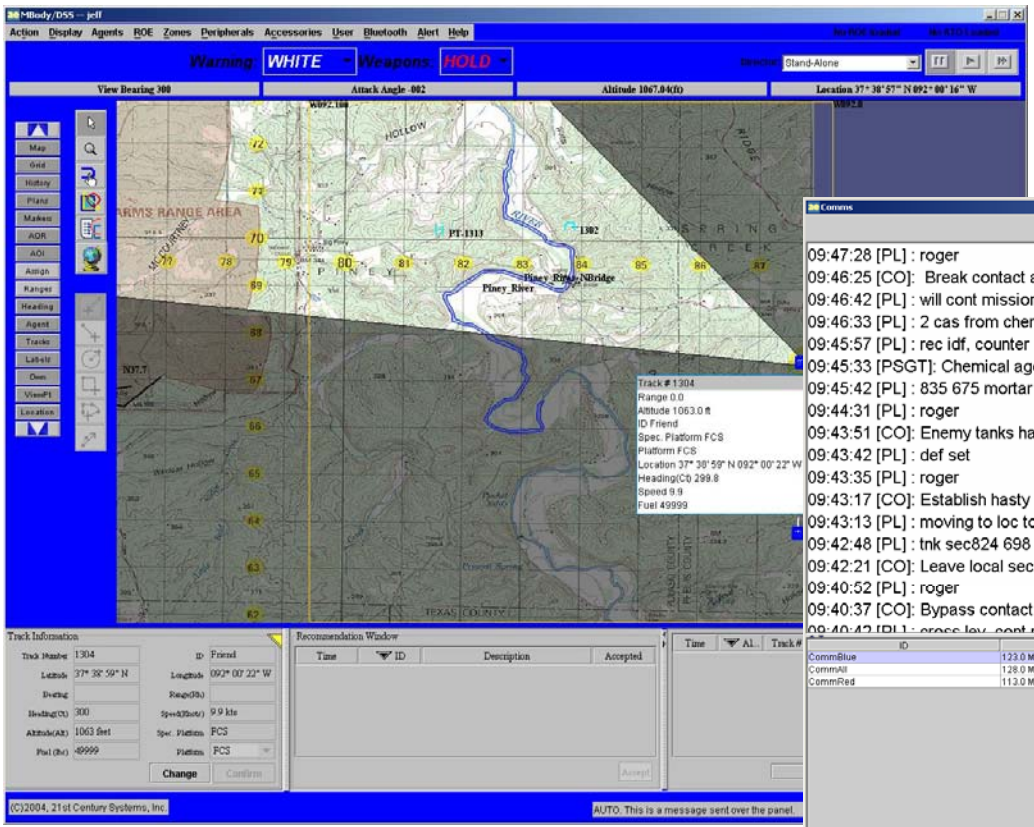


- Configuration
  - 2 interconnected workstations (client, server)
  - 2 – 17 inch flat panel displays (map & UAV views)
  - 1 – 48 inch wide screen display (map display)

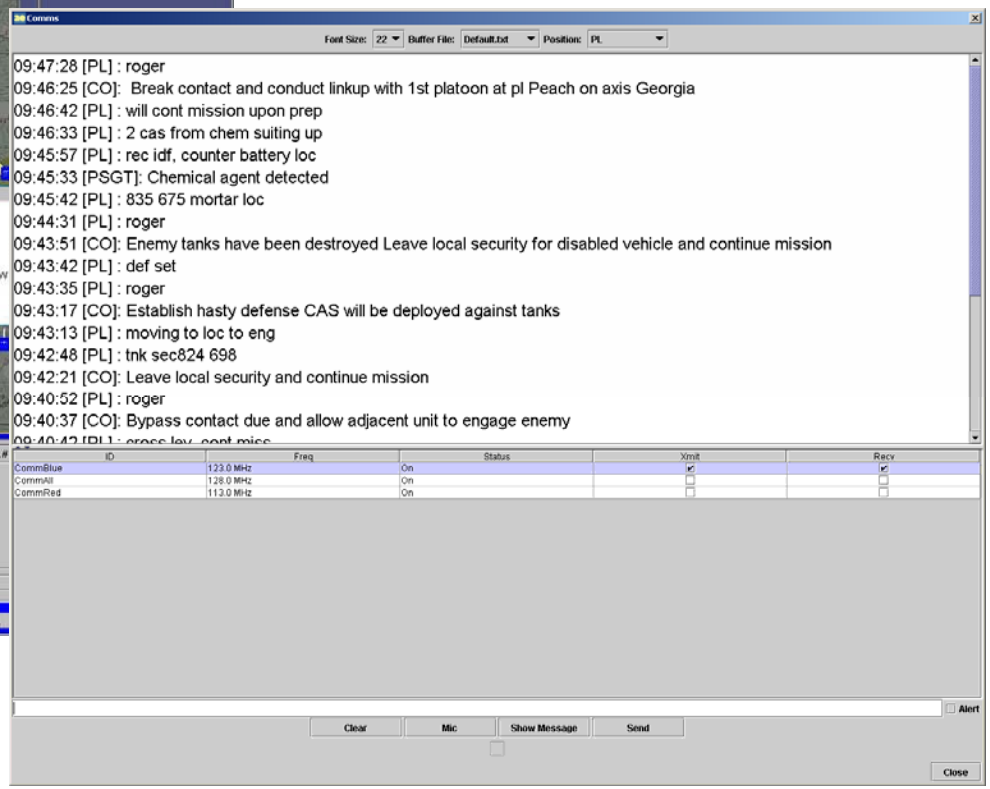


# Platform Description (cont'd)






2-D map display




Communications display

# Platform Description (cont'd)



- Data collection
  - User-defined
    - Event type
    - Frequency
  - Separate data files generated
    - Client
    - Communications
    - Event
    - Log

# Scenario Development



- Developed in collaboration with Subject Matter Experts (SMEs)
  - Mission relevance
  - Equivalent workload
    - Monitoring remote operations
    - Receiving and sending messages (digital and voice)
    - Scanning the battlefield
- Scenarios programmed into simulation

| Scenario | Description |
|---|---|
| 1 | Indirect fire, direct fire, danger area, & improvised explosive device (IED) |
| 2 | Direct fire, disabled ICV, danger area/chemical attack |
| 3 | Obstacle & direct fire, indirect fire chemical attack, mine field |

# Scenario Roles



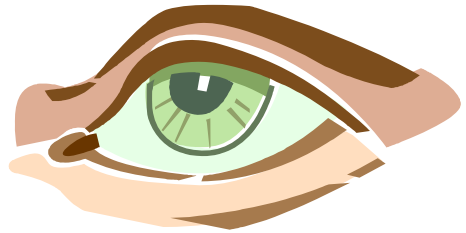
- 5 crew positions included in each scenario
  - Platoon leader
  - Company commander
  - Squad leader
  - Platoon sergeant
  - Robotics NCO
- Scripts created
  - Ensured consistency
  - Timing of alerts

SL (to PL): Roger, received FRAGO
SL (to PL): Enemy strong point destroyed
PL (to SL): acknowledges
PL (to CO): reports enemy strong point detected
SL (to PL): Enemy at 10 o'clock taking direct fire, we are engaging enemy
**PSG(to PL): FM commo down and we have 2 casualties requiring evacuation.**
1st SL (to PL): ICV disabled

# Research



- Focus
  - To examine the effects of alerts on the decision making and performance of a platoon leader during a mounted attack mission.
- Approach
  - Two simulation experiments
    - Unimodal alerts
    - Multimodal alerts

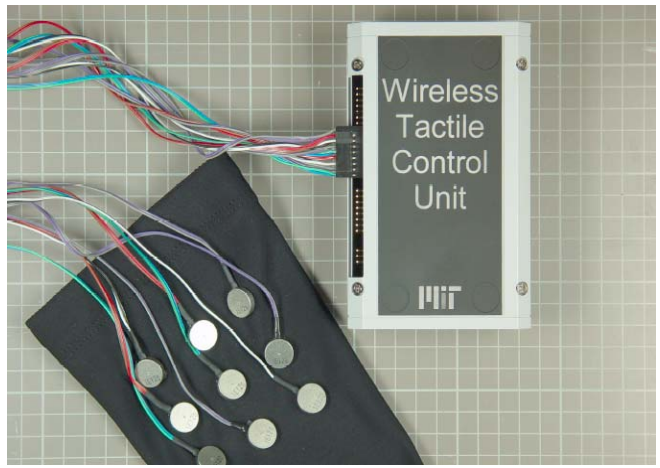


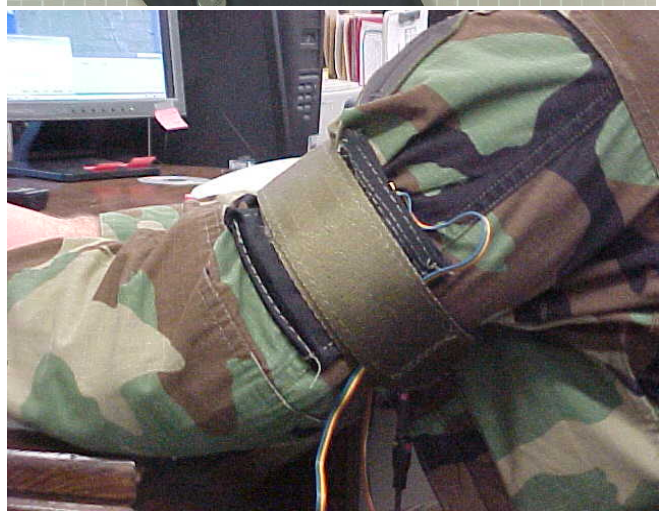
# Apparatus



- Equipment
  - MBODY AEDGE platform used to simulate three scenarios.

- Alerts (signaled incoming information)
  - Visual –
  - Auditory – “beep”
  - Tactile – vibration

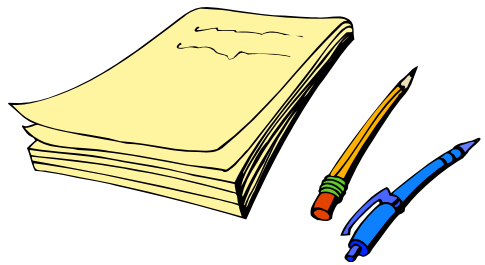


# Apparatus (Cont'd)



- Questionnaires
  - Alert rating (Likert scale)
    - Effectiveness
    - Helpfulness
    - Annoying



| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| **Strongly Agree** | **Agree** | **Neither agree nor disagree** | **Disagree** | **Strongly Disagree** |

  - Alert ranking (Scale 1 – 3)
    - Example: 1 = most effective, 3 = least effective

# Participants



- Experiment 1:  12 infantry officers (11A)
  - Mean age:  29.5 (S.D. = 3.3)
- Experiment 2:  11 infantry officers (11A)
  - Mean age:  29.6 (S.D. = 4.4)

# Experimental design



- One way within-subjects
  - IV = Alert type
    - Experiment 1: visual, auditory, tactile
    - Experiment 2:  visual, visual + auditory, visual + tactile
  - DV = Response time, ratings, rankings

# Video Highlights



# Experiment 1

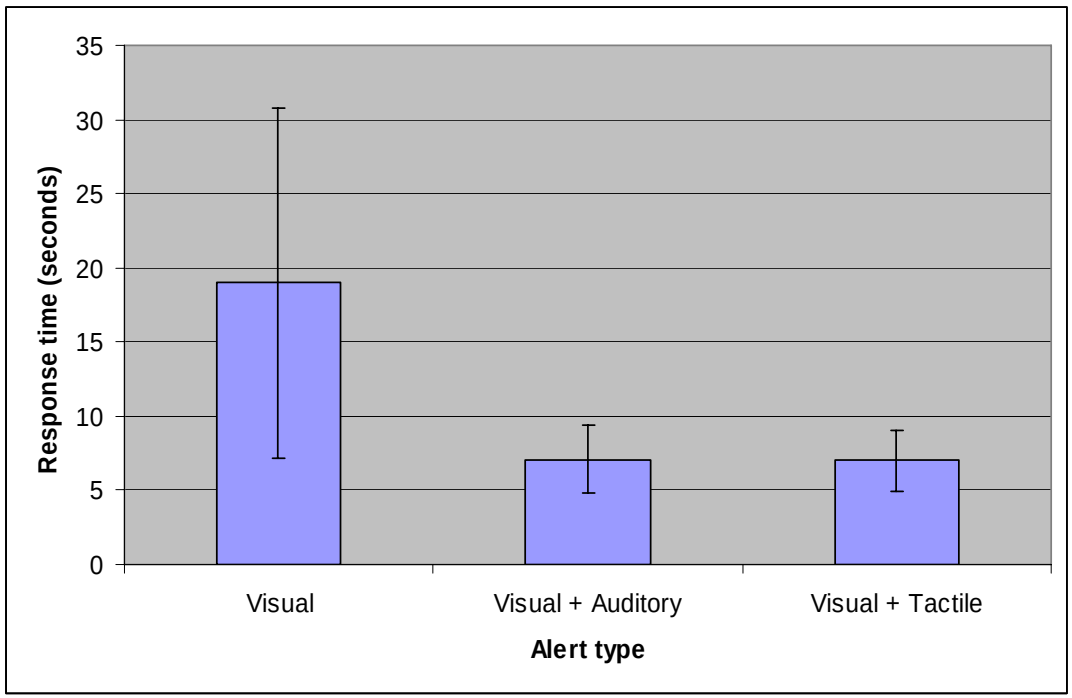


- Summary (2005 CCRTS Proceedings)
  - Visual alert:
    - 54% slower than auditory
    - 41% slower than tactile
  - Auditory & tactile alerts rated more helpful than visual alert
  - Visual alert ranked as worst choice for getting attention and was considered the least helpful

# Experiment 2 - Results



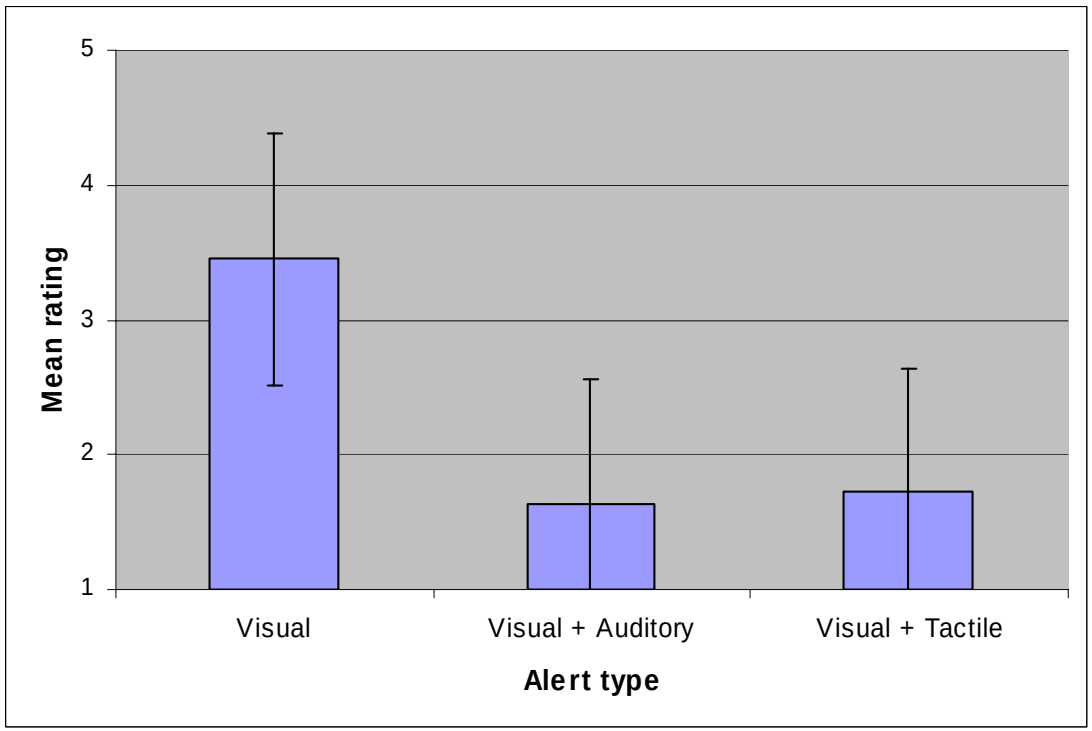
- Objective data (ANOVA)
  - Main effect of alert type ($p$ = .0002)
    - Visual alert response time significantly longer than response time for redundant alerts.



# Experiment 2 - Results



- Subjective ratings (ANOVA)
  - Alert type had significant effects on getting attention ($p < .0006$)
    - Auditory & Tactile alerts rated more effective than visual alert



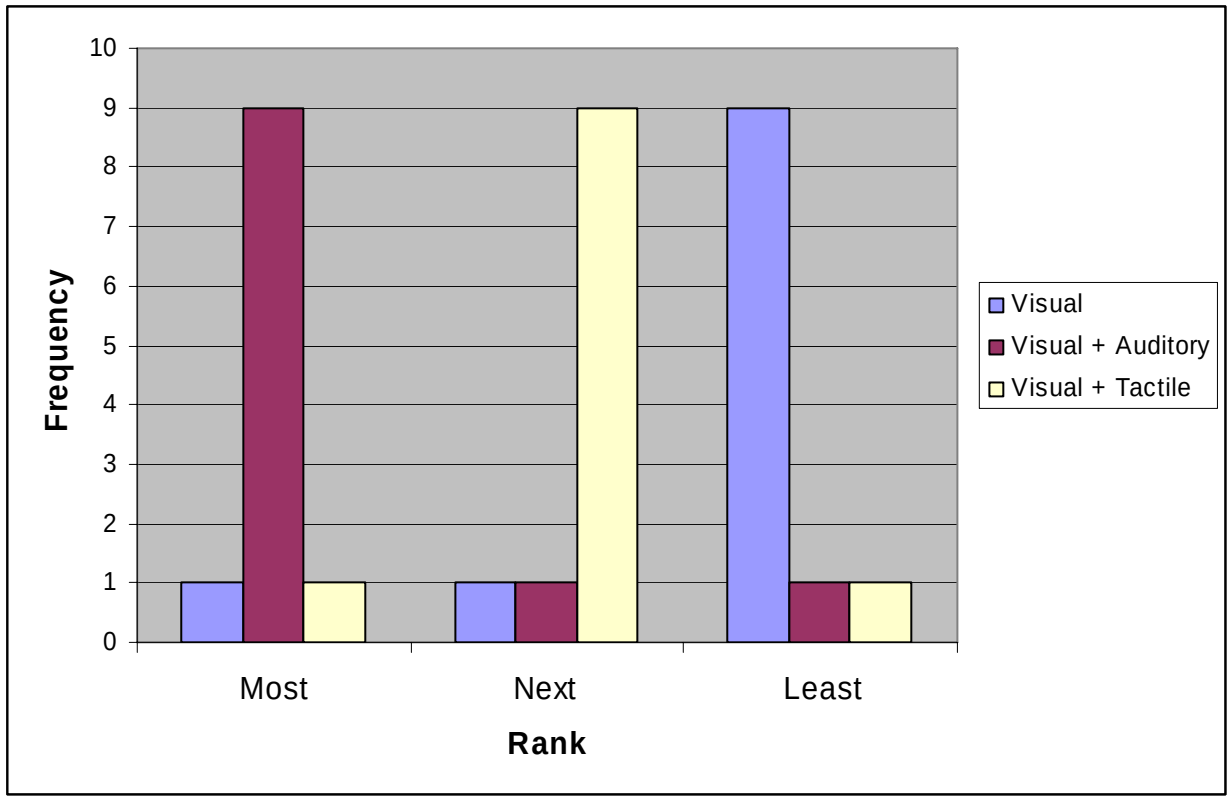
# Experiment 2 - Results



- Subjective rankings (Frequency count)
  - Getting attention
    - Most effective = visual + auditory
    - Second most effective = visual + tactile
    - Least effective = visual
  - Helpfulness
    - Most helpful = visual + auditory/visual + tactile
    - Second most helpful = visual + auditory
    - Least helpful = visual

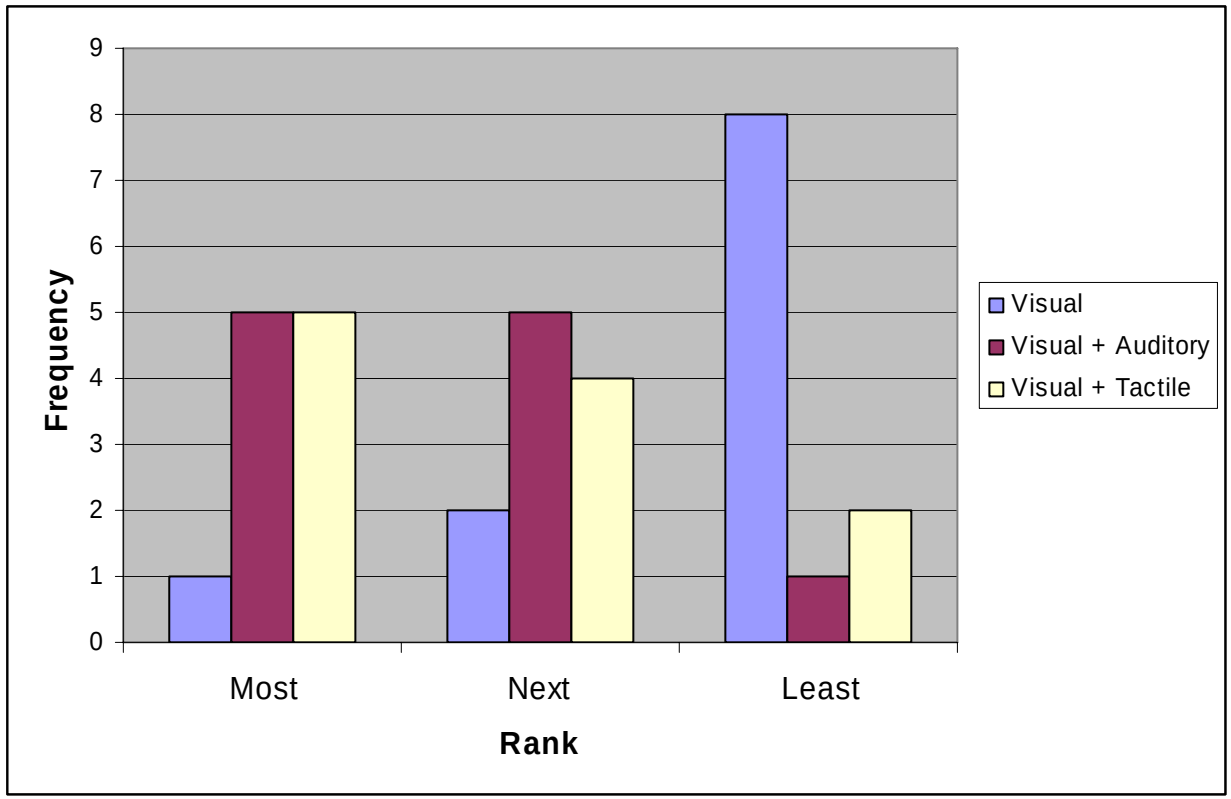
# Getting attention





# Helpfulness





# Conclusions



- Redundant alerts may enable platoon leader to better manage information than single alerts, thereby impacting decision making.
  - Limitations
    - Environmental noise
    - Vehicle vibration

# Future Work



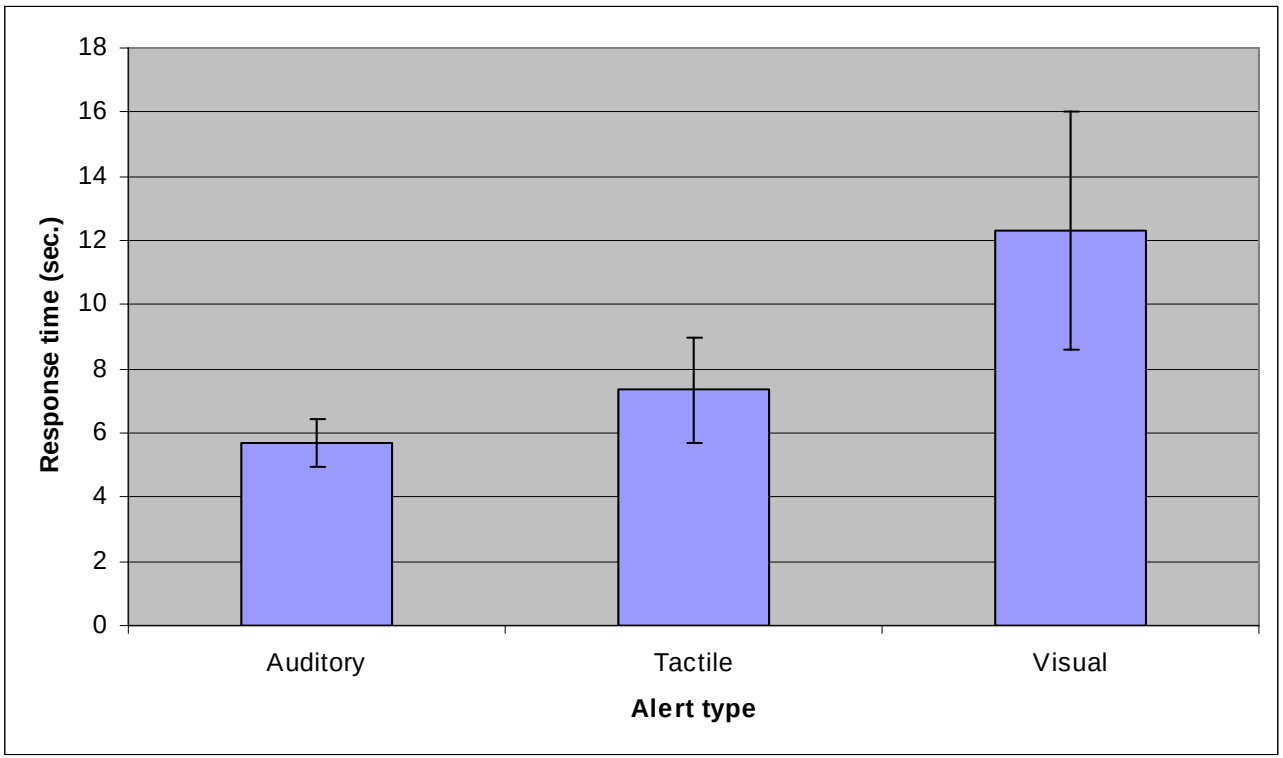
- Effects of vehicle vibration on detection of tactile cues.
  - Summer 06
- Effects of alert urgency on decision making and performance
  - Spring 06

# Extra Slides

# Response Time

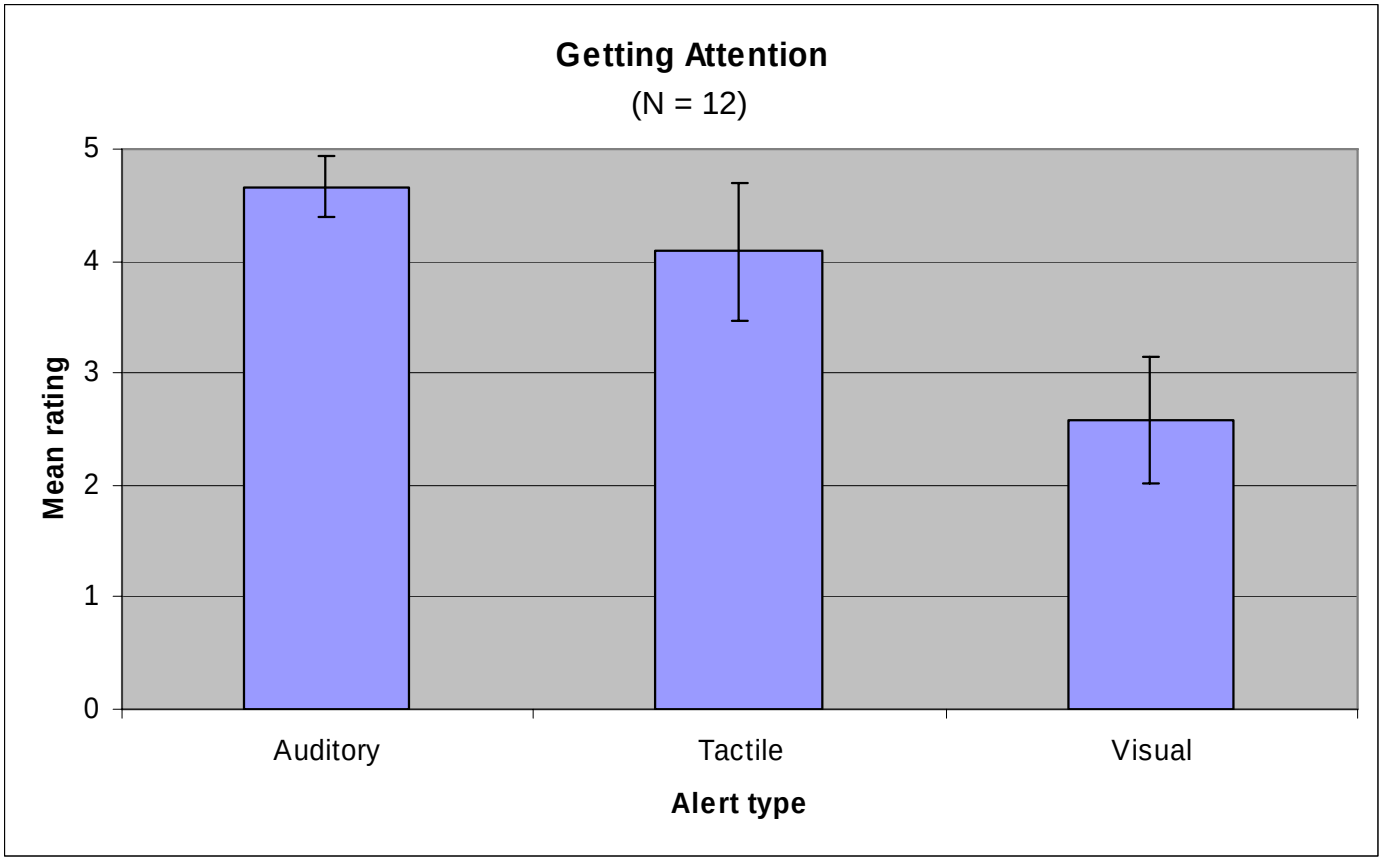


- Visual alert
  - 54% slower than auditory
  - 41% slower than tactile



# Subjective Ratings

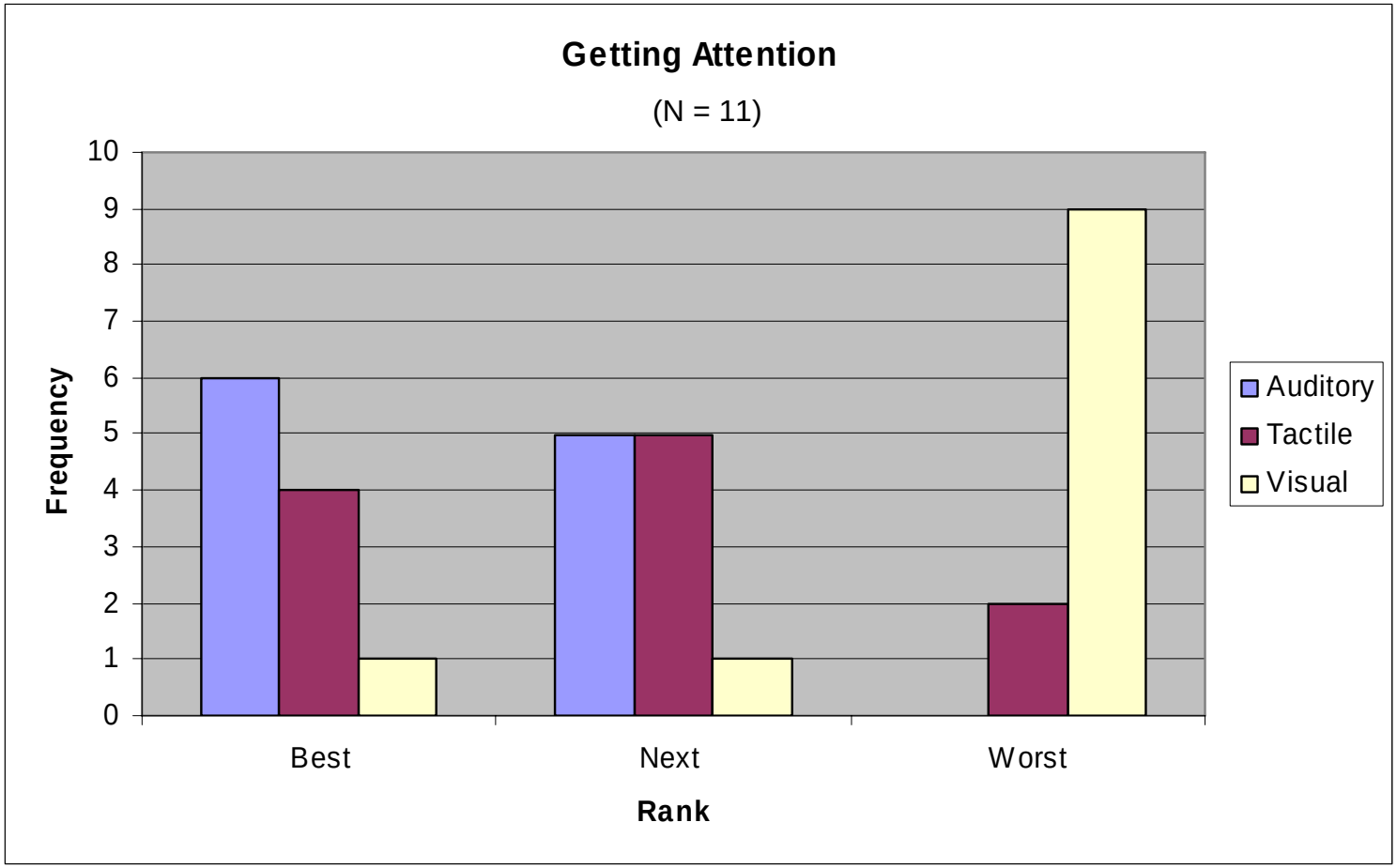





| (1) Strongly Agree | (2) Agree | (3) Neither agree nor disagree | (4) Disagree | (5) Strongly Disagree |
|---|---|---|---|---|

# Subjective Rankings





# Subjective Rankings