Effects of Visual, Auditory, and Tactile Cues on Army Platoon Leader Decision Making: Experimental Approach

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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

Background

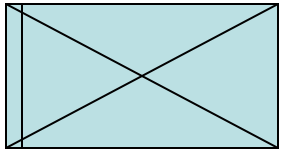
- Task network model of platoon leader workload indicates overload while:
  - Monitoring remote operations
  - Scanning battlefield
  - Receiving and comprehending digital messages
- Literature states that alerts may be effective aids for information management
  - Visual
  - Auditory
  - Tactile

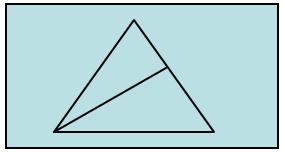
Objectives

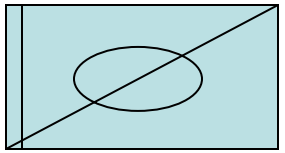
1. Develop research platform to enable data collection.
2. Develop scenarios.
3. Conduct preliminary research to investigate the effects of alerts on decision making.

Platform Requirements

- 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







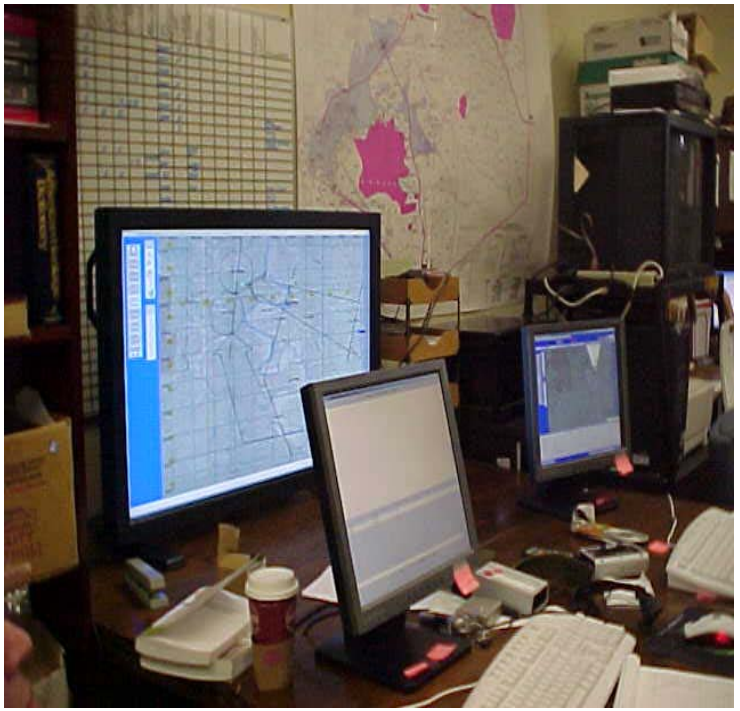
Platform Description

- 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

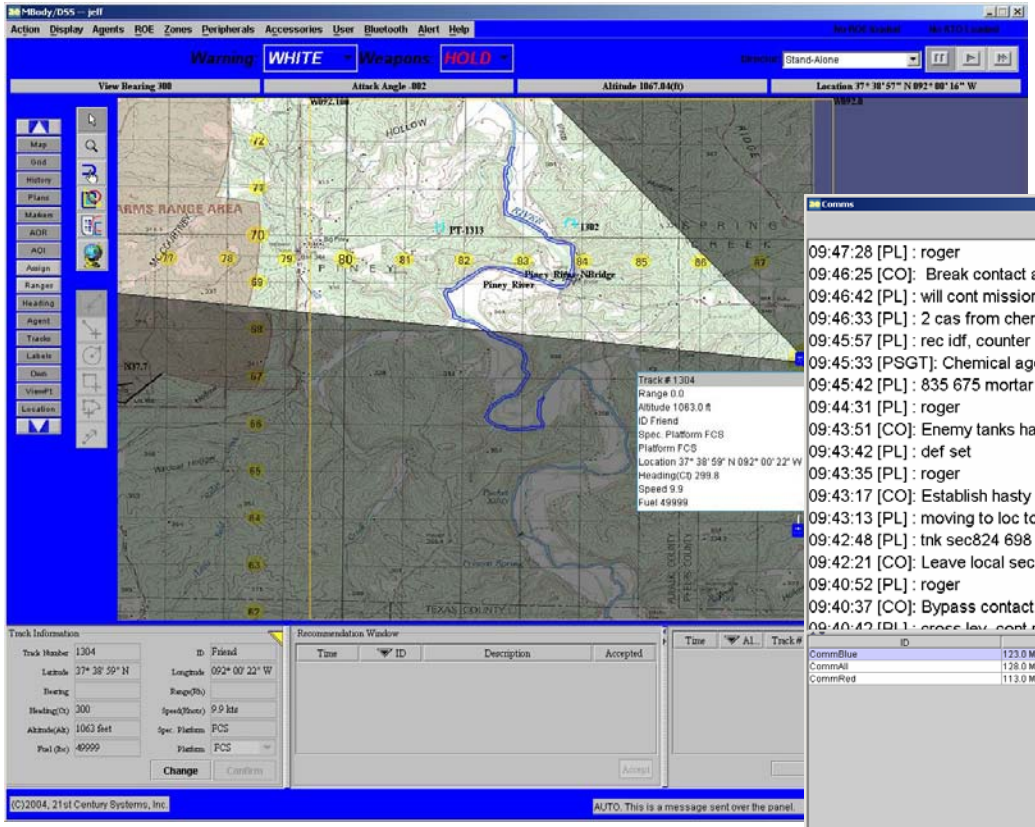
AEDGE = Agent Enabled Decision Group Environment

Platform Description (cont'd)

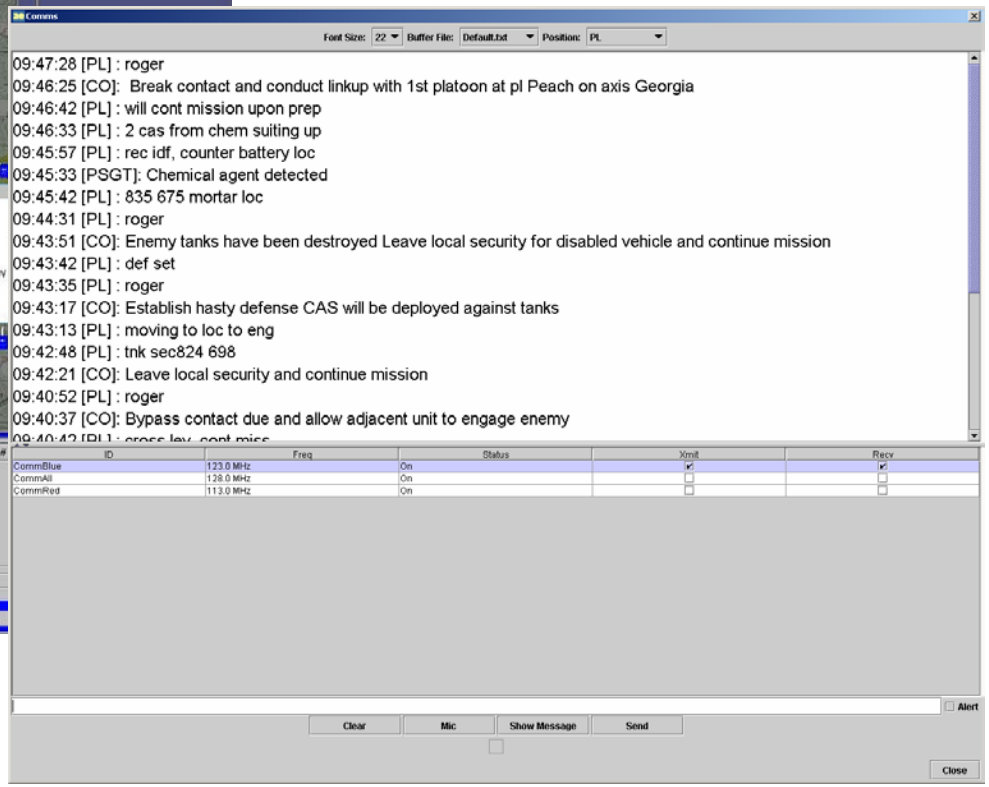
- Configuration
  - 2 interconnected workstations (client, server)
  - 2 – 17 inch flat panel displays (map & UAV views)
  - 1 – 48 inch wide screen display (map display)



Platform Description (cont'd)



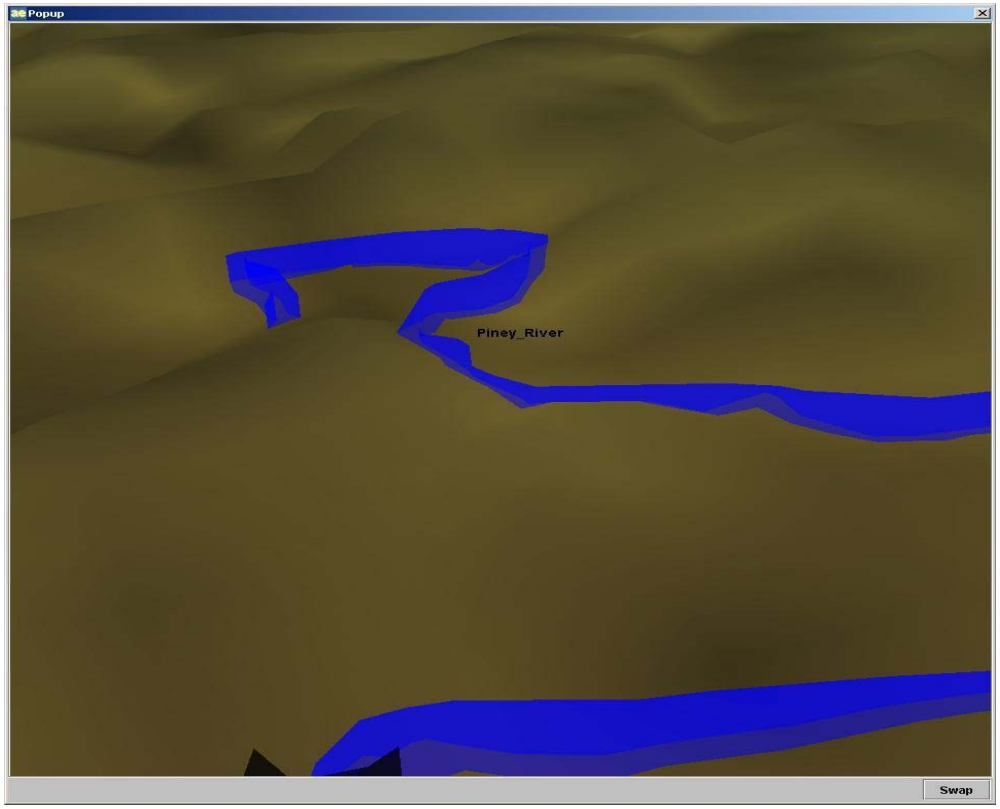
2-D map display



Communications display

Platform Description (cont'd)

UAV 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

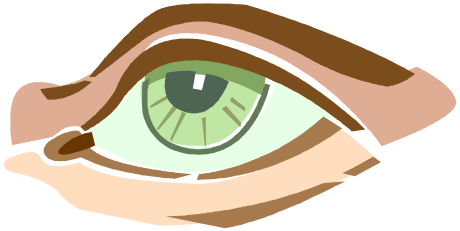
- 5 crew positions included in each scenario
  - Platoon leader
  - Company commander
  - Squad leader
  - Platoon sergeant
  - Robotics NCO
- Scripts created
  - Ensured consistency
  - Timing of alerts

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

Preliminary Research

- Focus
  - To examine the effects of alerts on the decision making of a platoon leader during a mounted attack mission.

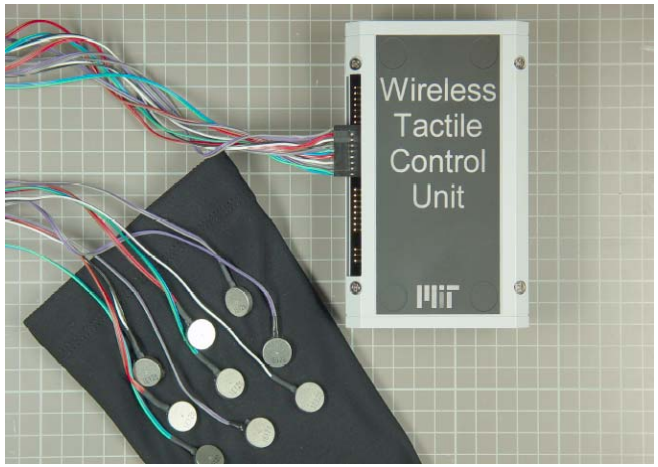
- Participants
  - 12 infantry officers (11A), recent graduates of Infantry Captains Career Course (ICCC).

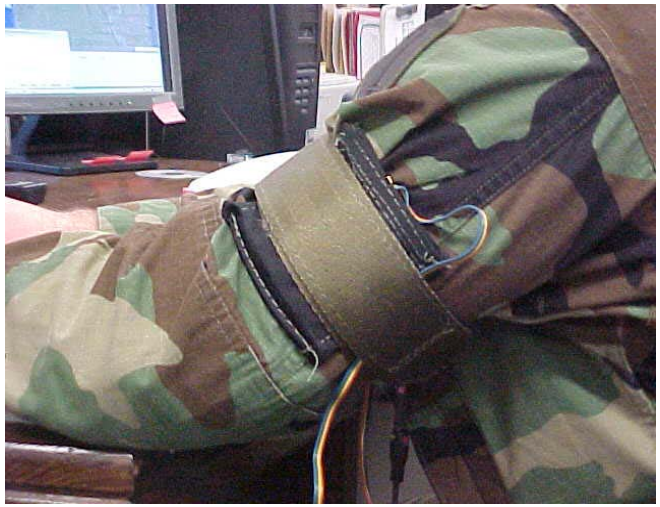


Preliminary Research

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

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

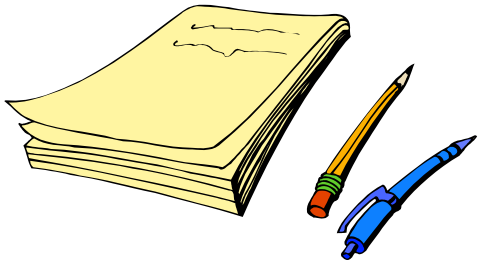




Preliminary Research

- Questionnaires
  - Alert rating
    - Likert scale
  - Alert ranking
    - Scale 1 - 3

Getting attention
Helpful



- Experimental design
  - One way within-subjects
    - IV = Alert type (visual, auditory, tactile)
    - DV = Response time, Ratings, Rankings

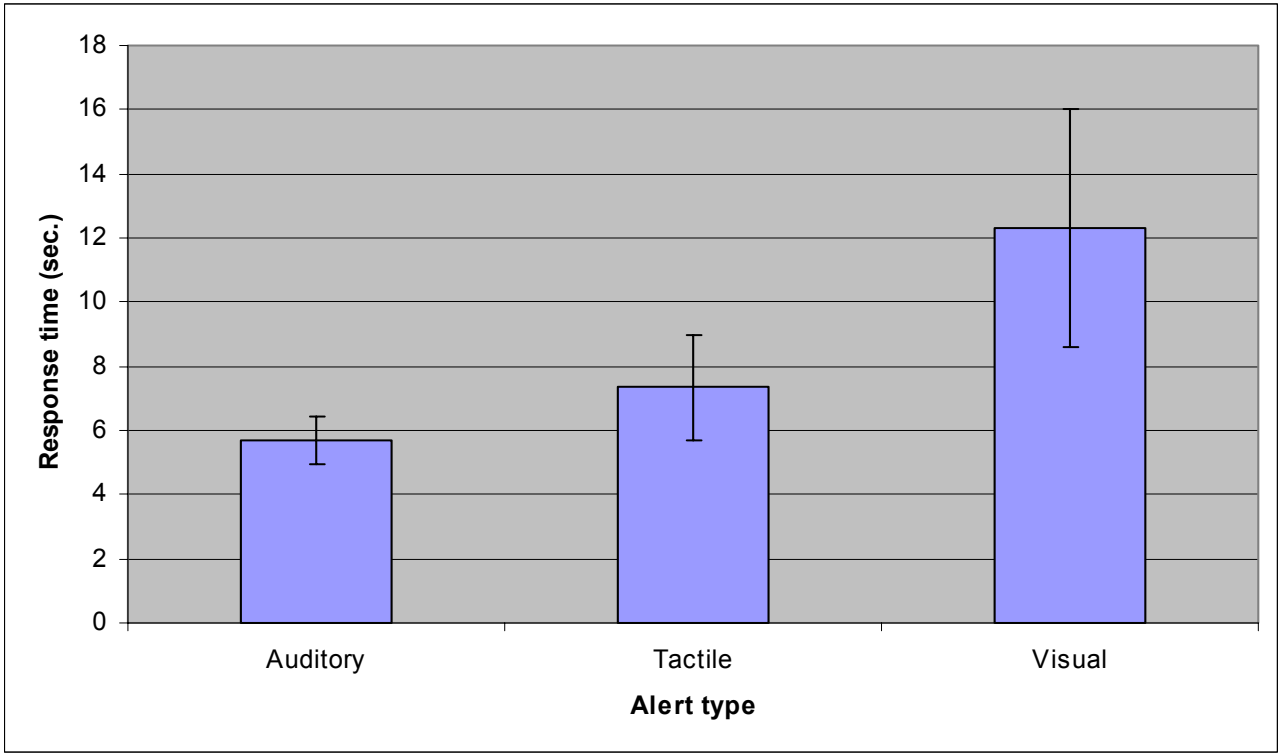
Video Highlights

Preliminary Research

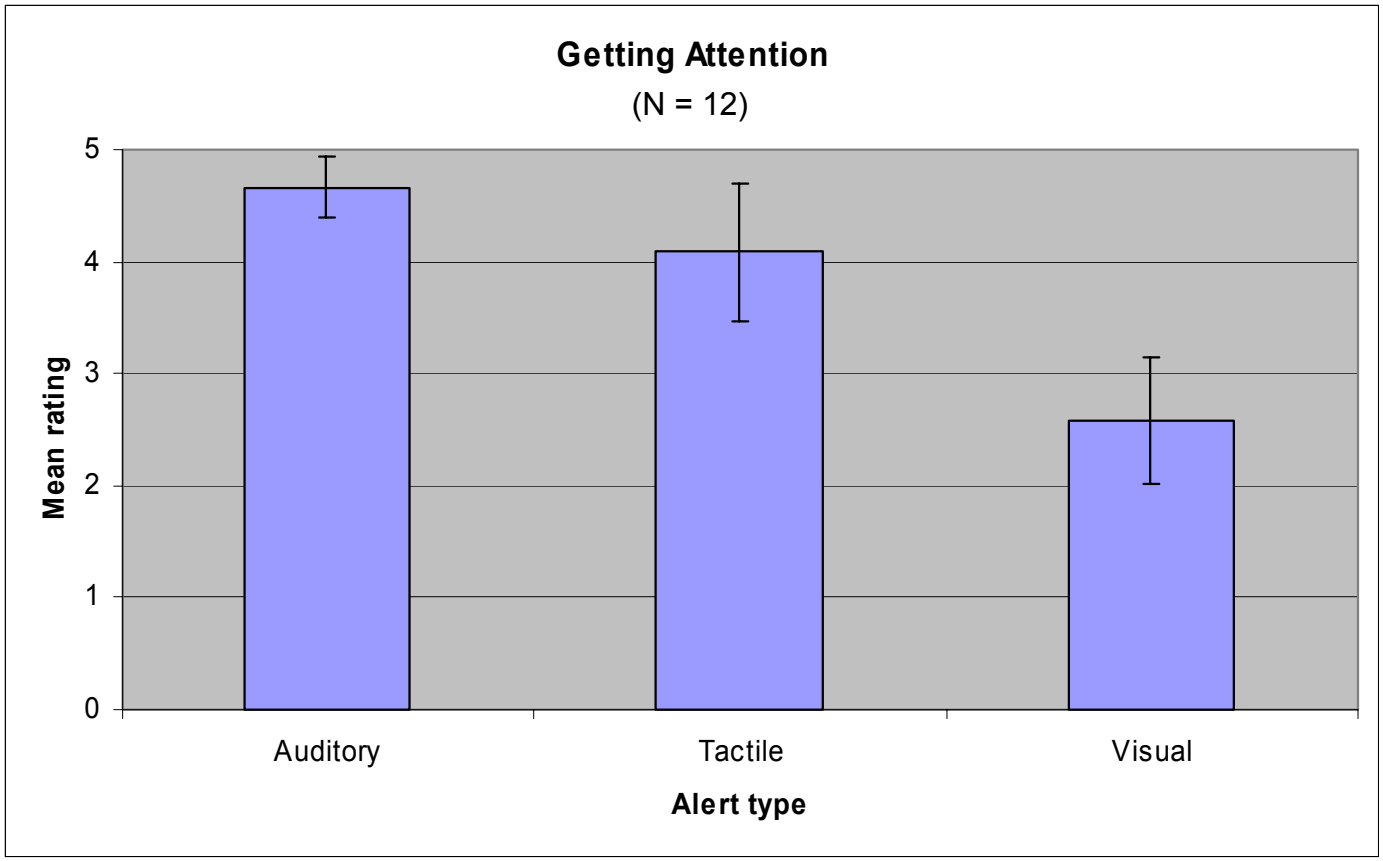
- Results
  - Response time → ANOVA → • Main effect of alert (p = .0003)
  - Alert ratings → ANOVA → Getting attention •Main effect of alert ($p < .0001$)
  - Alert rankings → Frequency → Visual alert • worst choice for getting attention and least helpful

Response Time

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

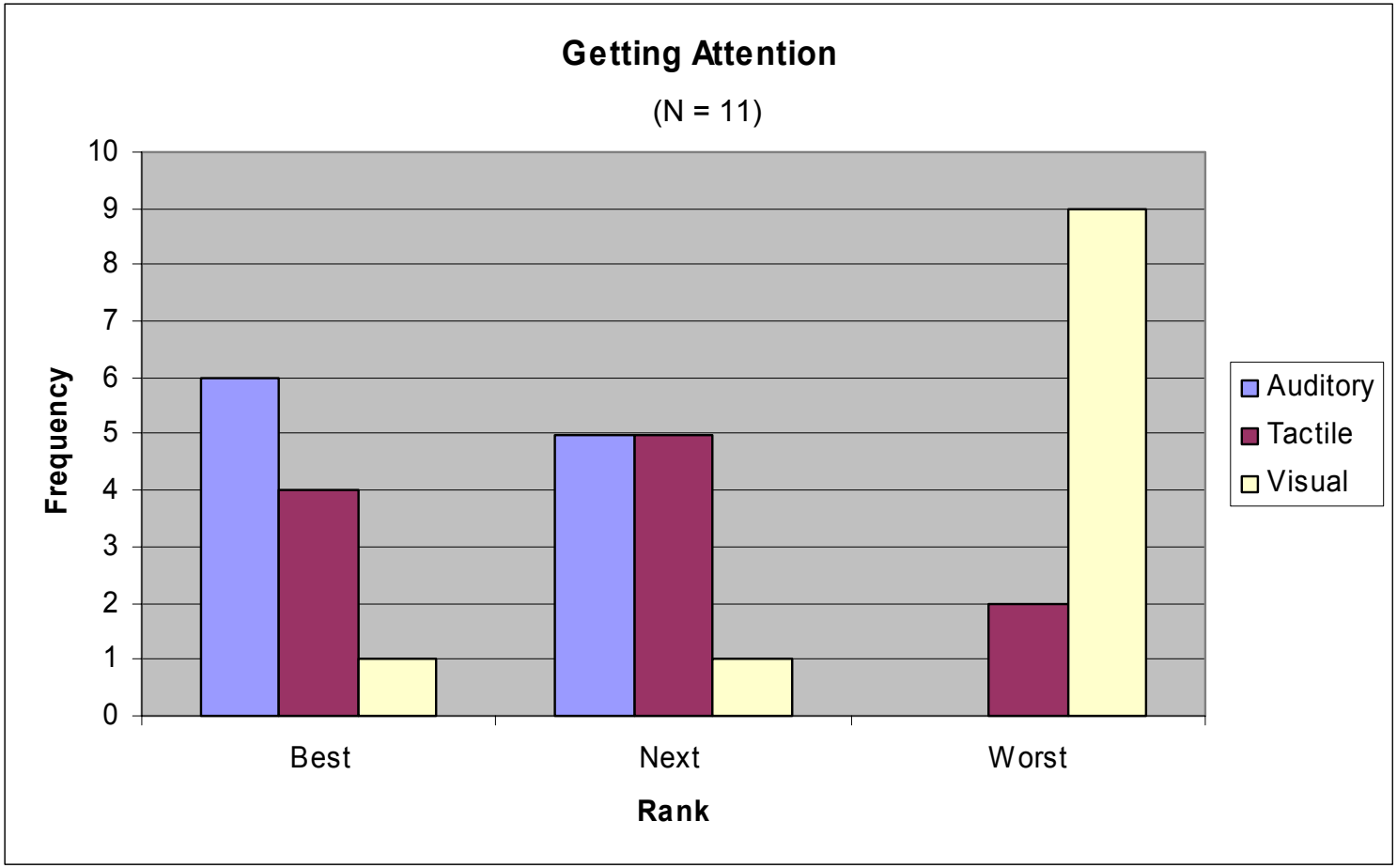


Subjective Ratings

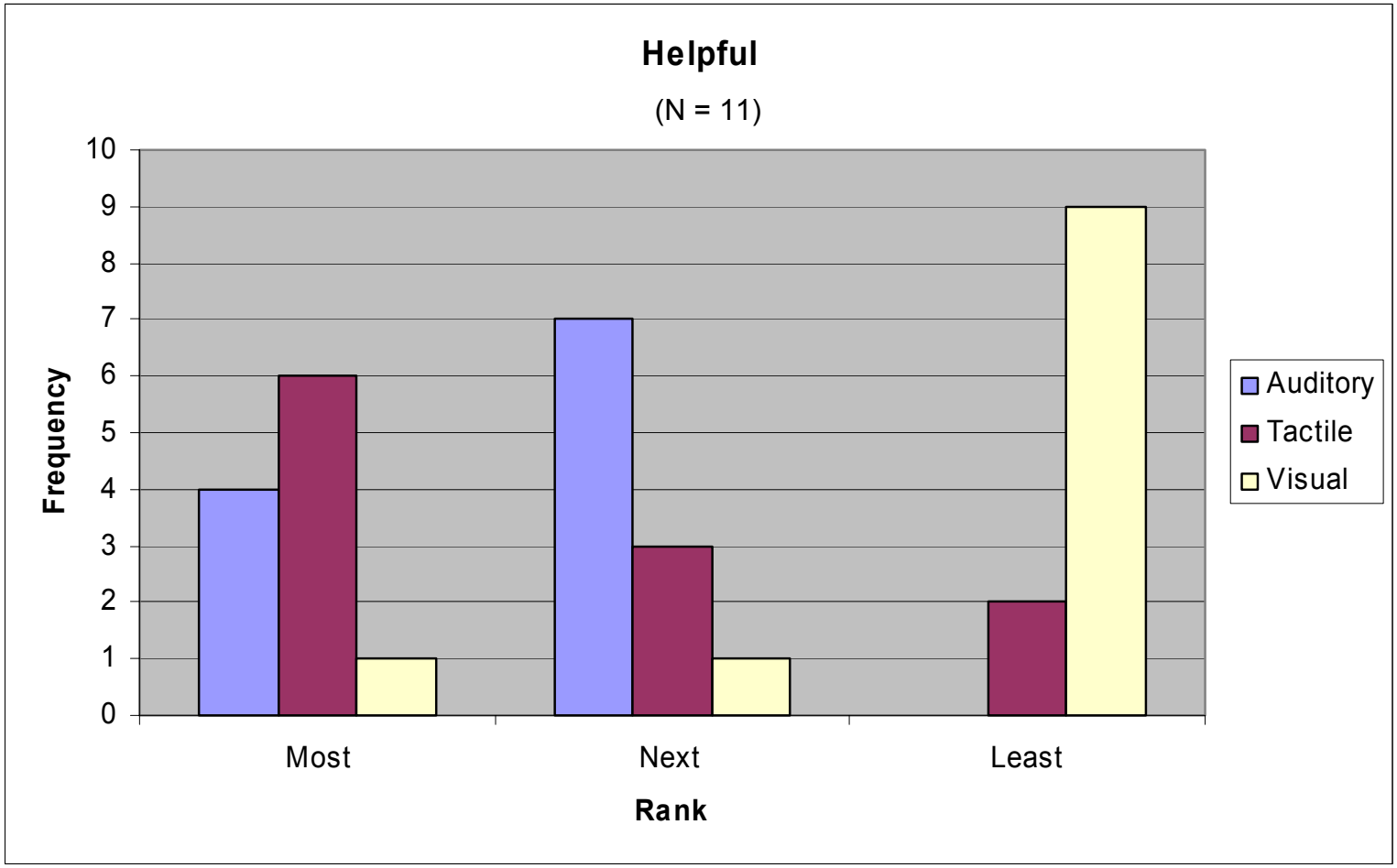


(1) Strongly Disagree	(2) Disagree	(3) Neither agree nor disagree	(4) Agree	(5) Strongly Agree

Subjective Rankings



Subjective Rankings



Conclusions

- The MBODY AEDGE® platform is a powerful tool for studying various aspects of decision making and display design.

- Auditory and tactile alerts may enable platoon leader to better manage information than visual alerts, thereby impacting decision making.
  - Limitations
    - Environmental noise
    - Vehicle vibration

Future Work

- Expand capabilities of platform to include multimodal alerts
  - Visual + Auditory
  - Visual + Tactile
- Effects of vehicle vibration on detection of tactile cues.
- Urgency of alerts