Multimodal Evaluation of Resource Allocation in a Comprehension Task
Multimodal Evaluation of Resource Allocation in a Communication Monitoring Task

Adam Sitz¹
Advisors: Susan T. Davis, Ph.D¹ & Victor S. Finomore, Ph.D².
University of Dayton¹; Air Force Research Laboratory²

BACKGROUND

• In order to successfully carry out their mission, Command and Control (C2) operators must monitor large volumes of communication data.
• A better understanding of information processing is needed in order to develop a multimodal interface which optimizes C2 performance.
• Mental Resource has been defined as mental effort used to carry out information processing.
• Research has shown that cognitive performance on tasks can be improved through the combined use of different presentation modalities (Wickens, 2008).
• Based on these findings, Wickens proposed Multiple Resource Theory which states there are separate fixed-capacity pools of resources that are characterized along multiple dimensions, one being information modality.

Present Research:
The present experiment evaluated participant performance in the context of a communication monitoring task comprised of two components, comprehension and detection. Each task component was presented in one of two modalities, audio or text, such that, all four possible combinations of task component and modality were examined.

Hypothesis:
It was predicted that conditions featuring incongruent (non-matching) presentation modalities would show superior performance over congruent (matching) modalities because of the lack of interference in information processing (See Figure 1).

METHOD

Participants:
This study used 16 participants (7 men and 9 women, ranging in age from 18-31). All participants possessed prior experience with communication monitoring.

Materials:
An Air Force developed computerized communication management suite called Multi-Modal Communication (Figure 2) was used in this study. An audio headset with microphone was also utilized.

Procedure:
• Seated at a computer workstation, participants were instructed to complete the communication monitoring task with no bias given for either component.
• The comprehension component required participants to listen/read two news articles and then answer a number of questions testing content comprehension.
• The detection component required that participants respond to critical signal phrases (e.g. “Eagle 1 Hostile North Lead Group 43 Miles”) as they were presented in a continuously updated stream of neutral signal phrases (e.g. “Viper 2 Contact North Trail Group 50 Miles”).
• Each condition lasted 5 minutes.

RESULTS

• A within-subjects ANOVA found a statistically significant main effect for presentation modality, F(3, 45) = 12.71, p < .05.
• A post hoc test with Bonferroni correction found that participant performance scores were significantly lowest in the Radio/Radio condition.
• Performance scores were highest in the Radio/Chat condition which was not significantly different from the Chat/Radio condition.
• Performance in the Chat/Chat condition did not show any significant difference from the Chat/Radio condition.

CONCLUSION

• Participant performance was shown to be greater in the incongruent conditions with the exception of the Chat/Chat condition.
• Participant performance in the Chat/Chat condition did not demonstrate any interference effects, as was shown in the Radio/Radio condition, possibly due to the nonperishable nature of text information presented in the Chat modality.
• These data support the development of a multimodal interface which leverages the benefits of presenting communication data based on the principles of Multiple Resource Theory and the inherent nature of test based communication.

REFERENCES