Speech-Enhanced and Context Dependent Alerts: Future Implications for Spacecraft Design Abstract

In the future, NASA missions will involve many different space vehicles, habitats, and surface assets working together to provide safe and productive living and working environments for crew. Because these systems will be provided by multiple commercial companies working with NASA, it will be very different from missions of the past, bringing new challenges. One of the challenges is related to whether NASA should move beyond simple tone annunciation alerting systems, to more advanced systems that include speech. The other is related to determining the level of consistency required of safety-critical alert systems across spacecraft. Two studies were completed to address these important issues. The first study investigated the advantages and disadvantages of a tone+speech alert relative to the traditional tone-only alert. Results indicate that speech-enhanced alerts initially take longer to silence (the default action to which NASA personnel are trained), due to the need to listen to the entire message, but ultimately provided for faster understanding of the alert situation. Speech-enhanced alerts were also preferred by a large majority of crew-like study participants. An unexpected finding from this first study was that participants took longer to respond to tone-only alerts when they were mixed with speech-enhanced alerts. Participants waited to hear the speech message even for alerts they were trained to know did not contain speech components. This performance error is believed to be due to negative transfer of training. A second study focused on task and alert performance using a common set of tones across two contexts ("vehicles") versus performance with a different set of tones for each context ("vehicle"). Participants were able to manage two different alert sets successfully; results indicate that discriminability of the two alert sets played a major role in their success. Implications for the design of spacecraft alerts are discussed and future areas of research are identified.