INFORMATION PRESENTATION
Human Research Program - Space Human Factors & Habitation
Space Human Factors Engineering Project

PURPOSE
The goal of the Information Presentation Directed Research Project (DRP) is to address design questions related to the presentation of information to the crew on flight vehicles, surface landers and habitats, and during extravehicular activities (EVA). Designers of displays and controls for exploration missions must be prepared to select the text formats, label styles, alarms, electronic procedure designs, and cursor control devices that provide for optimal crew performance on exploration tasks. The major areas of work, and some of the information presentation DRP are: 1) Controls, 2) Displays, 3) Procedures, and 4) Eva Operations.

CONTROLS – Cursor Control
The unique environmental conditions encountered by crewmembers on space missions (vibration, varied g-levels, vacuum requiring pressurized suits) impose special design requirements for crew interaction with information presented on computer displays. Cursor control devices (CCDs) must be specially designed to function under the variable, harsh conditions of space.

Partnership with Stakeholders: The cursor control device work described below has fed and supplemented concurrent work on Orion cursor control device development. Results of these studies have aided Orion device down selection, and software development for the effort to be using the Orion cursor control device evaluations.

Text battery (Diagrams – partly complete; revisions in work)
One of the first goals of the IP project was to develop a computerized text battery that could be used to evaluate a number of different types of cursor control devices. The text battery provides a standardized methodology for measurement, and will be of use to NASA researchers interested in evaluating cursor control devices.

Gloved cursor control device evaluation
Four devices were evaluated using the Text Battery, with and without EVAs gloves: an aircraft trackball, a single-button trackball, a Logitech trackball, and a trackball mouse. Requirements for reliability with a gloved hand were developed based on the results.

CURSOR MOVEMENT STUDY
In addition to investigating cursor control device hardware, the behavior of the cursor on the computer screen is an area of investigation. As the cursor is used in the interaction, performance is more precise, discrete, greatly improved. User studies will examine advantages and disadvantages of types of cursor movement under different environmental conditions: vibration, microgravity. These studies will provide recommendations for cursor movement under different environmental conditions.

DISPLAYS - Label orientation
Display designers sometimes have to use vertical text when real estate is limited. The goal of this study was to investigate the impact of different styles of vertically oriented text using short words, acronyms, and abbreviations.

Text Orientation

- Label wrapping
- Label alignment

Results
1) Wrapped labels are responded to more slowly than unwrapped labels.
2) There was a small advantage for data-aligned labels.
3) Inconclusive results on differences between vertical orientation, but marquee was subjectively rated the worst.

Next steps and Impact
Additional studies need to be done to further evaluate vertical text styles, incorporating more complex displays, additional practice, and time pressure.

Next Steps and Impact
Results from these studies will form display standards for the Orion Display Format Standards document, as well as other Constellation documentation (HSIR, HIDH).

DISPLAYS - Label alignment
Vehicle displays are often made up of many columns of labeled data values. Design direction on alignment of these columns of data is significant in the display. The goal of this study was to determine which type of label alignment is optimal under different environmental conditions.

Condition & Number of Malfunctions to Work

Results

Class 1 (fire/smoke)
Only one of the sounds tested from the existing set were rated the best.

Next Steps and Impact
Crew participants are currently being run in the study. A validation study will be done to confirm the results before recommendations are made. Results will be submitted to Orion and Constellation standards documents.

DISPLAYS - Auditory alarms
The goal of this study was to investigate the design of auditory alarms for critical classes using suitability ratings.

Stimuli
Within each task there was one hidden reference representing the existing alarm on current space vehicles for each condition. Five alternative alarms based on results from a previous study on alarms by the same authors. Only one of the sounds tested from the existing set were rated the best.

Next Steps and Impact
Crew participants are currently being run in the study. A validation study will be done to confirm the results before recommendations are made. Results will be submitted to Orion and Constellation standards documents.

EVA OPERATIONS
Working in constrained, bubble environments presents great challenges in terms of displays, controls, and suit informatics, especially in the harsh lunar environment. This is a new suite for FY09.

Next steps will be completed in the areas of:
- Auditory display
- Visual feedback and the-mover control during lunar operations
- and visual and auditory displays

PROCEDES
- An Electronic Procedure Viewer (EPV) is one of the most operationally critical interfaces for next-generation crewed space vehicles, particularly for exoatmospheric fault isolation and recovery operations.
- The recently completed human-in-the-loop evaluation of two fault management concepts, one (BESI) where the EPV is functionally integrated with an advanced Caution and Warning (C&W) System, and another (ELSIE) with no functional connections between the EPV and the C&W System.

- ELSIE Fault Management Display at the outset of procedures
- Participant input fault diagnoses by interpreting information from C&W fault messages (over left section of display) and colored differential indications in system summary display (back-up reference points), and list of system faults in C&W System.
- Fault management display shows the point where participant has diagnosed fault and is waiting to work procedures through the EPV.
- Blue (‘Current Status’) line is one of many cues to help operator navigate through the steps in the procedure checklist.

- BESI Fault Management Display at the outset of Procedure Navigation.
- Advanced Caution and Warning System interfaces include ‘Root Cause Cues’ where automated fault isolation diagnoses is provided.
- Magnetic tape high level system component associated with automated display.
- Display consists of system diagrams suggesting likelihood of automated diagnoses of individual faults.
- Fault management display shows the point where participant has acknowledged the automated diagnosis, which has automatically updated the appropriate checklist in the EPV.
- Number of steps reduced compared to ELSIE due to automated checks for sensor failures.

AUTHORS
K.L. Heldt1 (PI), A. Sandor1, S.J. Thompson2, R.S. McCan1, M.K. Kuster1, B.H. Rapoport1, B.D. Adelstein2, B.R. Bautuz2, L.S. Stone1 (Lockheed Martin (2160 NASA Parkway Houston, Texas 77051, Infinity building) NASA Ames Research Center)

1NASA Ames Research Center
2NASA Johnson Space Center

WORKSHOPS – PIIUS (Crew Support System)”
Crew Support System
Case: EVA OPERATIONS

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