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

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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 (EVAs). Designers of displays and controls for exploration missions must be prepared to select the text formats, label styles, alarms, electronic procedure devices, and cursor control devices that provide for optimal crew performance on exploration tasks. The major areas of work, or subtasks, within 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) limits their ability to interface with information presented on computer displays. Cursor control devices (CCDs) must be specially designed to function under the variable, harsh conditions of space.

Test battery
(Excludes = tasks complete, revisions in work)
One of the first goals of the Information Presentation project was to develop a computerized test battery that could be used to evaluate a number of different types of cursor control devices. The test battery provides a standard methodology for measurement, and will be of use to any researcher interested in evaluating cursor control devices. A collection of 7 tasks measuring CDD pointing and dragging time and distance. Many of the tasks are based on ISO 9241-9.

Gloved cursor control device evaluation
Four devices were evaluated using the test battery, with and without EVA glove. Each test, a Krisline ball, a Logitech ball, and a Nubpoint mouse. Recommendations for usability with a gloved hand were developed based on the results.

Pressurized gloved cursor control study
A study was performed in collaboration with the Orion Cockpit Working Group using EVA gloves in a pressurized glovebox at Johnson Space Center. Recommendations were developed for the design of a cursor control device for Orion.

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 well. An upcoming study will experimentally compare task performance with a cursor in the following modes: continuous, discrete, gravity. Later studies will examine advantages and disadvantages of different types of cursor controls under more environmental conditions: vibration, microgravity. These studies will yield recommendations for cursor movement under different environmental conditions.

IMPACT
The cursor control device work described above has supplemented concurrent work on Orion cursor control device definition. Results of these studies are being used to guide design of a cursor control device for Orion. Results of these studies will yield Constellation and NASA-wide standards and requirements for cursor control devices.

DISPLAYS - Label orientation
Display designers sometimes have to use vertical text when real estate is limited. The goal of this study was to evaluate the effectiveness of different styles of vertically oriented text using short words, acronyms, and abbreviations. Results
Test orientation
1) Participants could read the horizontally oriented text faster than the rotated and marqued text. This confirms that horizontal alignment is the preferred orientation for labels.
2) Inconclusive results on differences between vertical orientation, but marqued text was subjectively rated the worst.

Scan Patterns
It appears that when users are engaged in a visual search of a text item, they follow a specific pattern, moving from left to right and top to bottom.

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

DISPLAYS - Label alignment
Vehicle displays are often made up of many columns of labeled data values. Design direction on alignment often depends on decisions of data conflict in the literature. The goal of this study was to experimentally compare different types of label alignment.

Results
1) There was a small response time advantage for data-aligned labels. 2) Wrapped labels were responded to more slowly than unwrapped labels for mixed displays (group of long and short labels).

Next Steps
Additional studies need to be done to further evaluate label alignment, incorporating more complex displays, additional practice, and time pressure.

DISPLAYS - Auditory alarms
The goal of this study was to investigate optimal semantic mapping of sounds to alarm classes using suitability ratings.
Stimuli
Within each trial, there was one sound representing the existing alarm used on current space vehicles, and five alternative alarm sounds based on results from a previous alarm study by the same authors. Results
Off-the-shelf alarm classes tested, only one of the sounds from the existing set were rated the best; new sounds were rated highest for the remaining alarms.
Status and Next Steps
Crew participants were currently being run in the study. A validation study will be done to confirm results before recommendations are made.

IMPACT
Results of these studies will yield Constellation and NASA-wide standards and requirements for alarms.

PROCEDURES – Fault Management
An Electronic Procedure Viewer (EPV) is one of the most operationally critical interfaces for next-generation crewed space vehicles, particularly for real-time fault isolation and recovery operations. A human-in-the-loop evaluation of two fault management concepts was completed – one (BESI) where the EPV is functionally integrated with an advanced Caution and Warning (CAW) System, and another less advanced concept (ELSE) with no functional connections between the EPV viewer and the CAW system.

BESI Fault Management Display
• Advanced Caution and Warning System interfaces include "Root Cause List," where automated malfunction diagnosis is provided
• Magna light highlights system component associated with automated diagnosis
• Original list of CAW messages available for verification of automated diagnosis
• Fault management display shows the point where participant has accepted and selected the automated diagnosis, which has automatically brought up the appropriate checklist in the EPV

ELSE Fault Management Display
• Participants made fault diagnosis by integrating information from CAW fault messages (lower left section of display); color-coded external indications on system summary display (upper left section of display), and list of system faults in EPV (upper right section of display).
• Fault management display shows the point where participant has diagnosed malfunction and is starting to work procedures through the EPV.
• Rule ("current focus") line is one of many cues to help operator navigate through the steps in the procedure checklist.

IMPACT
Results from these studies will yield Constellation and NASA-wide standards and requirements for fault management displays and electronic procedures.

EVA OPERATIONS
Working in a pressurized, suit-specific environment poses great challenges in terms of displays, controls, and suit information, especially in the harsh lunar environment. This is a new subtask for Fiscal Year 2008.

Work is beginning in the areas of:
- suit display design
- tactile feedback and fine-motor control during gloved operations
- near-eye and auditory displays

IMPACT
Results from these studies will yield Constellation and NASA-wide standards and requirements for alarms.