INFORMATION PRESENTATION

Human Research Program - Space Human Factors & Habitability
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 extra-vehicular 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, or subtasks, within the Information Presentation DRP are: 1) Controls, 2) Displays, 3) Procedures, and 4) EVA Operations.

AUTHORS

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CONTROLS – Cursor Control

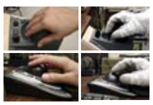
The unique environmental conditions encountered by crewmembers on space missions (vibration, varied g-levels, vacuum requiring pressurized suits) translate into special design requirements for crew interaction with information presented on computer displays. Cursor control devices (CCDs) must be specially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

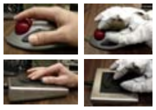
Partnership with Stakeholders: The cursor control device work described below has fed and supplemented concurrent work on Orion cursor control device definition. Results of these studies have aided Orion device down selection, and software developed for this effort is being used for Orion cursor control device evaluations.

Test battery
(Status – beta complete; revisions in work)
One of the first goals of the IP 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 CCD pointing and dragging time and accuracy. Many of the tasks are based on ISO-XXXX.

Example task displays including simple target acquisition of various sized targets, text selection, dragging, and interaction with standard interface components.

Gloved cursor control device evaluation
Four devices were evaluated using the Test Battery, with and without EVA gloves: an aircraft trackball, a Kensington trackball, a Logitech trackball, and a Hulapoint 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 JSC. Additional conclusions were developed to feed forward into 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 well. Later studies will examine advantages and disadvantages of type of cursor movement under different environmental conditions: vibration, microgravity. These studies will yield recommendations for cursor movement under different environmental conditions.

SHFE RISK TARGETED: Poor human factors design

DISPLAYS - Label orientation

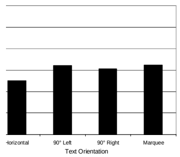
Display designers sometimes have to use vertical text when real estate is limited. The goal of this study was to examine the impact of different styles of vertically oriented text using short words, acronyms, and abbreviations.

Results
Text orientation:
1)Participants could read the horizontally oriented text faster than the rotated and marquee text. This confirms that horizontal alignment is the preferred type for display of labels.
2) Inconclusive results on differences between vertical orientation, but marquee was subjectively rated the worst.

Scan Patterns:
It appears that when participants are engaged in visual search of a text item they follow a specific pattern moving from left (top to bottom) to right (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.

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



igure 1. Response Time by Orientation Type

TARGETED: Poor human factors design

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 conflicts in the literature. The goal of this study was to experimentally compare different types of alignment.

Results
1) Wrapped labels are responded to more slowly than unwrapped labels.
2) There was a small advantage for data-aligned labels.

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

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

Left-aligne

gned

Wrapped

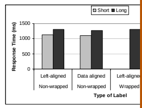


Figure 1. Response time as a functio label (length, alignment and wrappin

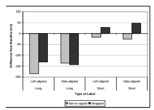


Figure 2. Response time difference as a function of abel length, alignment, and wrapping.

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DISPLAYS - Aud

The goal of this study was to i optimal semantic mapping of s classes using suitability ratings

Stimuli
Within each trial there was on reference representing the exi used on current space vehicle condition, and five alternative on results from a previous stu by the same authors.

Results
Only one of the sounds tested set were rated the best.

Next Steps and Impact
Crew participants are currentl study. A validation study will b the results before recommend Results will be submitted to O Constellation standards docu

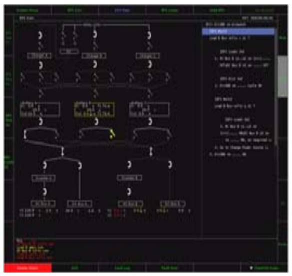
Class 1 (fire/smoke)
Class 1 (depressurization
Class 2 (warning)
Class 3 (caution)

Figure. Screenshot of the software used for the study.

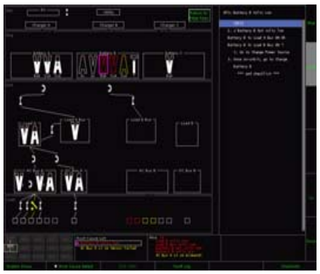
SHFE RISK TARGETED: Poor human factors design

PROCEDURES

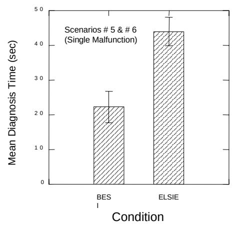
- An **Electronic Procedure Viewer** (EPV) is one of the most operationally critical interfaces for next-generation crewed space vehicles, particularly for real-time fault isolation and recovery operations.
- We recently completed a human-in-the-loop evaluation of two fault management concepts, one (BESI)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

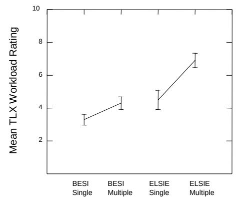


- ELSIE Fault management Display at the outset of procedure navigation.
- Participants made fault diagnosis by integrating information from C&W fault messages (lower left section of display); color-coded off-nominal indications on system summary display (upper left section of display), and list of system 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
- Blue ("current focus") line is one of many cues to help operator navigate through the steps in the procedure checklist



- BESSIE Fault Management Display at the outset of Procedure Navigation
- Advanced Caution and Warning System interfaces include "Root Cause List" where automated malfunction diagnosis is provided
- Magenta box highlights system component associated with automated diagnosis
- Original list of C&W messages available for verification of automated diagnosis (if desired)
- 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
- Number of steps reduced compared to ELSIE due to automated checks for sensor failures





Condition & Number of Malfunctions to Work

EVA OPERA

Working in a pressurized, suite displays, controls, and suit infor This is a new subtask for FY08.

oses great challenges in terms of ly in the harsh lunar environment.

Work will be completed in the a
- suit display design
- tactile feedback and fine-mot
- near-eye and auditory display

gloved operations

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