Fiscal Year:	FY 2009	**Task Last Updated:**	FY 06/21/2010
PI Name:	Holden, Kritina Ph.D.		
Project Title:	Information Presentation		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
Human Research Program Risks:	(1) **HSIA**:Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Houston	**State:**	TX
Zip Code:	77058-3607	**Congressional District:**	22
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	10/02/2006	**End Date:**	09/30/2010
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:			
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COI Name (Institution):	McCann, Robert (NASA Ames Research Center)		
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	Display and control user interfaces are the critical vehicle elements supporting crew performance for many, if not most, mission operations. Correctly defining, refining, and validating the requirements for the proper display and use of information for systems monitoring and vehicle control is critical for optimizing operational performance and minimizing operational risk. The goal of this Information Presentation Directed Research Project (DRP) is to address design questions related to the presentation of information to the crew. This includes not only the issues of information formatting, style, and layout, but also methods of interacting with the information, use of information under the extreme environments encountered in space travel, and refinement of human factors techniques, such as modeling, that will supplement traditional design techniques, and help ensure that optimal information design is accomplished in the most cost efficient manner. This DRP will result in the development of guidelines, requirements, and validation techniques for advanced information display solutions currently contemplated for the various spacecraft systems being designed and developed under the Constellation program.		

Task Description:	The major areas of work, or subtasks, within this DRP are: 1) Displays, 2) Controls, 3) Electronic Procedures and Fault Management, and 4) Human Performance Modeling. The Displays subtask addresses label formatting, text color, auditory alarms, and navigation across and within display units. The effects of vibration on reading and speech communication are also investigated. The Controls subtask concentrates on cursor control functionality, design, and use under vibration and microgravity. The Electronic Procedures and Fault Management subtask focuses on information architecture issues for nominal and off-nominal electronic procedures, and their integration with advanced caution and warning systems. The Modeling subtask focuses on human performance modeling of user interfaces in the space environment. The focus within each major subtask has been carefully selected to address either 1) a near-term identified need within ongoing Orion development work, or 2) a longer-term Exploration need that is sufficiently complex to warrant initiation of research. It is envisioned that activities within these subtasks will evolve and be modified for out-years, as additional research needs are identified.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Research on Displays involves label design, auditory alarms, and readability under vibration. Standards and guidelines resulting from this research can be applied to software labels and auditory alarms in any domain. Results from readability under vibration studies may be relevant to race car drivers, pilots or other operators in vibration environments. Research results on Controls, such as cursor control devices (CCD), can be applied in any setting using CCDs, and the CCD Test Battery developed can be used in many types of research involving CCD use or motor control related topics. Electronic Procedures and Fault Management study results apply in any domain having procedure-driven tasks that involve alerting, such as plant control rooms, air traffic control, and piloting. Modeling results can offer insights into human interaction with real-time control systems, whether these are spacecraft, aircraft, or other types of real-time task displays.
Task Progress:	Label Design In FY09, the series of studies from FY08 was followed up with a study on label/ value visual distinction. Of the design features investigated (colon, bolding, space), no significant effects were found. Results from these and prior studies have led to several label guidelines/recommendations on orientation, alignment, and label/value distinction. These recommendations have been or will be documented in several NASA standards and requirements documents. Readability under Vibration The results of vibration research in FY08 and FY09 suggested that different forms of symbology were differentially sensitive to vibration effects, with larger, more graphical symbols (such as those found on a primary flight display) more resistant to vibration than alphanumeric symbology. On the basis of this and other considerations, a study (jointly funded by Orion and HRP) investigated the performance impacts of a realistic Orion vibration profile during Thrust Oscillation on a task measuring operator capability to process and integrate information from candidate primary flight display (graphical) symbology. The results of the study were provided to the Orion Project Office, as well as the astronaut office, and formed the basis of a crew-consensus report that broke out crew requirements for maximum vibration during Orion ascents into two components: a maximum vibration level for peaks or bursts set at 0.70 (zero-to-peak), and a sustained vibration level at 0.31 Root Mean Square (RMS). Effect of vibration on speech intelligibility Initial work was begun in FY09 to look at speech communication under vibration. In this study, the effect of 0.5 and 0.7 g whole body vibration was evaluated on speech production of words (Diagnostic Rhyme Test word list). Initial observations indicate that, while discrimination of consonants in a two-alternative forced choice paradigm may be only moderately affected, an absolute word identification test will yield low scores. Software and hardware were developed for future testing of speech intelligibility using the Diagnostic Rhyme Test (DRT). Alarms In FY09, a third study in a series was completed to investigate alarms currently in use within NASA space programs, along with some new, candidate alarm tones. Eleven non-crew and 3 crew subjects were asked to rate six candidate alarms in comparison to the current alarm for each of the following categories of alert: Emergency (fire/smoke), Emergency (depressurization), Warning, and Caution. Ratings were also obtained for perceived urgency of the alarm, overall satisfaction with the alarm, and the perceived value of a speech component. The results firmed up a recommended alarm set and indicated that the use of a speech component is preferred by both crew and non-crew. Cursor Control Device In FY09, an additional cursor control device evaluation was completed in order to collect data on some new device types, and add to the growing database of cursor control device data. Devices tested included the leading candidate prototype for Orion, as well as some other concepts that had been considered for CxP use. The testing used discrete modes of cursor movement, and participants wore space gloves. Devices tested included the Kensington trackball, a smaller castle-type switch, an F-18 aircraft-derived device, and a rocker switch (Orion candidate). Results showed that the smaller castle-type switch and rocker switch had some of the fastest movement times and lowest frequency of errors. In addition, subjective ratings found the rocker to be most preferred. This study provides important objective performance data to the Orion program, confirming that the rocker switch is a good design. Cursor Control Device Test Battery In FY09, the Cursor Control Device Test Battery was further improved by adding a study set-up screen that allows study conductors to set the parameters and the order of the tasks for a study. Usability testing was also conducted on the test battery to improve the user experience with the application. Electronic Procedures and Fault Management During FY09, the eye movement data collected as part of the FY07 fault management study were re-analyzed at a more granular level to subdivide originally specified “regions of interest” into more specific “areas of interest” down to the

	level of specific display symbols. Temporal sequences of fixations to these areas of interest are currently being compared to predictions derived from the application of N-SEEV, a computational model of visual attention that assigns specific weightings to individual display elements on the basis of bottom-up factors (perceptual dimensions such as brightness, contrast, etc.) and top-down factors (derived from dynamic assessments of the task relevance of that particular display element at that specific point in time), and then makes predictions for fixation sequencing based on Luce's choice rule Human Performance Modeling Data analyses of the FY07 Advanced Caution and Warning System (ACAWS) study in support of model development was continued in FY09. Individual fixations from study participants are being analyzed for intent, based on real-time viewing of fixations in conjunction with videotape viewing of the participants.
Bibliography Type:	Description: (Last Updated: 10/29/2023)
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