Department of Defense Human Factors Engineering Technical Advisory Group

Mission Centric Human Performance Discussion Group, and Workload and Stress SubTAG Consolidated Report

Elizabeth K. Bowman

1. Mission Centric Human Performance Discussion Group, and Workload and Stress SubTAG, TAG 64
2. Prepared by Elizabeth K. Bowman, Chair of MCHP Discussion Group, ARL-CISD, 410-278-5924, ebowman@arl.army.mil, Bldg 321, Aberdeen Proving Ground, MD 21005
3. Number of members present: 30
4. Organizations represented: Army, Navy, Air Force, DHS, NASA,
5. Agenda
    a. Workload Measures and Metrics, Dr. Brian Gore, SJSU/ARC
    b. Development of NASA TLX, Lowell Staveland, SHFE, Inc.
    c. A Pilot's Perspective on UAS Workload, Mr. Mark Pestana, NASA Dryden
    d. Use of NASA TLX and Bedford in System Design and Analysis for Space Operations, Dr. Robert McCann, NASA Ames Research Center
    e. Initial Workload Assessment for the HC/MC-130J, Rahel Rudd, ASC/Wise
6. Abstract Information
    a. Workload Measures and Metrics

        Workload metrics are used by human factors engineers and system designers to determine whether proposed system designs are within tolerable human performance limits. One challenge faced by this community is selecting suitable workload measures/devices/tools to evaluate the concepts that are proposed. It is maintained that a comprehensive approach that utilizes both objective and subjective measures arrives at designs that are most optimal for the human operator. The current discussion leveraged two recently completed NASA Space Human Factors Engineering publications and provided an overview of the selection criteria and the strengths and weaknesses of five commonly used scales; the instantaneous self assessment (ISA), the NASA Task Load Index (NASA TLX), the Cooper-Harper, the Modified Cooper-Harper, and the Bedford scales. Additional challenges as they relate to NASA's requirements verification and long duration mission operations were discussed.

    b. Development of NASA TLX,

    NASA TLX is a multi-dimensional scale designed to obtain workload estimates from one or more operators while they are performing a task or immediately afterwards. TLX originally included 19 workload factors but over several years of testing was stripped down to the 6 multi-dimensional scales and weights currently used. Tests grouped into 6 categories of experimental conditions with different primary sources of loading were rated with the sets of scales and a single overall workload value. Regressions of scales

against the Overall WL value were used to refine the scales to those best predicting WL on new tests and to create a weighted averaging method. The multi-dimensional scales and weights in NASA TLX has been growing for 24 years over a wide range of measures. It has limitations in assessing the full environment affecting tasks and WL, which should be considered when choosing the TLX vs. other WL scales for operational environments. Future use in operations may necessitate using TLX in new ways or as a hybrid with other measures.

c. A Pilot's Perspective on UAS Workload,

Mr. Mark Pestana discussed issues related to piloting an unmanned aerial system (UAS) to include definitions of 'pilot' and interface design issues. He presented a background of the legacy of UAV research at NASA-Dryden. The focus of his presentation centered on the UAV pilot's lack of access to all human senses. He noted that when flying a UAV from the ground control station, they only have one sense in play (visual). For example, a UAV pilot can't: 1) hear the engine rpm fluctuating, 2) feel vibrations, accelerations or motion,3) smell the fuel leak, 4) taste the electrical fire smoke, and 5) lose vision in one eye (with a 30º field of view). He gave an example of how the UAV was used in support of the fire service in fighting wildfires in California. In this case, infrared data was "draped" on Google Earth 3-D terrain maps and location data was delivered to the Fire Incident Commander in less than 10 minutes resulting in accurate and timely fire-fighting assets applied to the fires in remote locations.

d. End Of Trial Workload Ratings And Real Time Operator Behavior: Making The Connection

In next-generation deep-space missions, astronauts are going to have to perform many more mission operations without real-time ground assistance than in today's missions. The workload associated with these additional operations will have to be carefully controlled in order to avoid overload and under-load situations that compromise crew performance. Issues were discussed related to associating workload with real-time task operator activities such as information acquisition patterns (visual fixations), with the goal of being able to assess workload empirically, in real-time, as opposed to through after-the-fact subjective ratings. Preliminary results are encouraging, showing significant correlations between operators' post-trial TLX and Bedford workload ratings and online performance measures such as total number of visual fixations and re-fixation frequency.

e. Initial Workload Assessment for the HC/MC-130J

Rahel Rudd discussed the need to consider workload issues early in the design phase of fielding new aircraft. She noted that there is a high degree of difficulty when trying to assess the cognitive workload levels with a limited number of subjects that haven't been adequately familiarized and/or trained. This research was performed with the engineering simulator at the Lockheed Martin Aero facility. Two aircrews were participated and comprised four pilots, two Combat Systems Operators, and two Loadmasters. Workload levels were rated using a Cooper-Harper scale. Results indicated that workload levels were adequate for the majority of mission phases. The items that contributed to inadequate levels were design issues, checklist immaturity and lack of training/experience.

7. Highlights of issues or concerns discussed during the meeting. There were no issues raised from an administrative note during the meeting due to the large number of presentations. After the meeting, LCDR Jeff Grub and Dr. Liz Bowman spoke about the possibility of combining the two groups. They agreed that this made sense and agreed to work toward this goal. They will work together over the next several months to develop a firm idea and a draft charter to present to the Operating Board. They agreed that the most feasible approach would be to incorporate the discussion group into the sub-TAG.

8. The results of any elections held. No elections were held.

9. SubTAG open actions existing:
    a. Title of concern/problem: Consolidation of Workload/Stress and Mission-Centric Human Performance Discussion Group
    b. Advocate or organization that raised the issue: Chairs of each group (LCDR Grubb and Dr. Bowman)
    c. Group discussion summary related to the topic: The two groups are similar enough that they should be combined to take advantage of limited resources.
    d. Actions to be taken, if necessary
        i. LCDR Grubb and Dr. Bowman will develop a draft charter for the combined group by mid-January
        ii. The revised charter will be shared with the Operating Board by early Feb 2011
        iii. The revised charter will be shared with the sub-TAG at the May meeting
    e. Target date for issue resolution: May 2011