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Title: Development and Enhancement of a Model of Performance and Decision Making Under Stress in a Real Life Setting

Institution: University of Maryland at Baltimore and
Maryland Institute for Emergency Medical Systems

Current staff with percent effort of each on project:

Colin F. Mackenzie	22%	Peter Hu	5%
William Bernhard	5%	Paul Delaney	5%
Kevin Gerold	5%	James Black	50%
Brian McAlary	5%	Robert Durocher	50%
Kenneth Dauphinee	5%		
Michael Parr	5%	Sub-contract Man-Made Systems Corp.	
Andy Trohanis	5%		
Jim Brown	5%	Richard Horst	15%
		David Mahaffey	20%

Navy 6th Quarterly Report

This quarterly report will summarize some of our analysis and the future plans for data collection, analysis and acquisition.

Analysis

The focus of the present quarter has been on using the scoring system identified in our last quarterly report (Table 1). We have tested the stressor scoring system by analyzing video tapes of patient resuscitations that have high trauma indices. The trauma index is obtained by adding three independent variables of ASA, AIS and TAG together. We have abstracted physiological data that is outside the ranges of normality. Normal ranges are shown on the bottom left of Table 1. We believe that physiological variables (heart rate, blood pressure etc.) outside the range of normality increase stress on the anesthesiologist managing the patient. To tell this hypothesis we are comparing the stressors scores during abnormal physiological data with those obtained in the same patients and with the same trauma resuscitation team when the vital signs were stabilized.

In addition to establishing whether abnormal physiological data is associated with high stressor scores the comparisons between scores made before and after successful resuscitation will enable us to better characterize what is and what is not stressful we will also be comparing team communications before and after completion of resuscitation. We hypothesize that there will be different communication behaviors during abnormal physiological data than when the trauma patient is stabilized. We have identified 11 different types of communications behaviors (Table 2).

First pass analysis of video tapes of the nine patients with the highest trauma indices are completed. Additionally first pass analysis is completed on eight other video tapes. A total of 46 video tapes have been collected. First pass analysis consists of a data analyst and anesthesiologist who participated in the taped case viewing the tape, entering notes about critical milestones in patient care, observed staff activities, and key verbalization. We have done a 3 pass analyses of one particularly interesting case in which a series of unusual circumstances caused high stress; in this case, the patient's condition deteriorated unexpectedly while he was being treated in the Admitting Area, the surgeons were late in arriving, the team leader did a poor job of taking charge once he did arrive, and there were a number of communication omissions and commissions that caused confusion for the anesthesiology team; we are using this case to further refine our data collection and analysis procedures and to train our data analysts and anesthesiology subject matter experts; it is the first case in which we are doing a detailed comparison between the decision trees that we believe should have been used and the team's actual performance, and we are considering writing this up as a case study. Some of the stressor scores from this case are shown in Fig. 1.

We have begun to broaden our project activities from a focus on data collection and the methodology of video analysis to now also include more interpretation of the data in terms of cognitive decision making and first attempts at relating our data to information processing models; we have revisited the decision trees that were generated prior to project initiation,

updated some of them, and started to qualitatively relate the sequence of events in selected video taped cases to the predictions of these trees; in addition, we have met with and received advice from our ONR contract monitors and our consultant, Dr. Gaba, and attempted to interpret the case study mentioned above in terms of various decision making concepts and "models" in the cognitive science literature.

Data Collection

We have decided to be more specific in video tapes that we wish to analyze in detail. We plan to obtain video tapes of resuscitation that requires tracheal intubation, and analyze management as determined by our decision tree for emergency management of the difficult airway. We wish to know whether anesthesiologists follow this recommended decision tree or whether they deviate from it in the heat of the moment or because they have devised a more rapid means of achieving tracheal intubation. Factors such as experience, fatigue, team interactions and stressors may affect this rapid decision making process.

Six anesthesiologists have reached asymptotic performance on SYNWORK the multi tasking fatigue assessment software we have been using. We plan to assess the effects of fatigue on SYNWORK performance by recording scores at 7 P.M., 4 A.M. and 7 A.M. of a 12 hour on call shift among these 6 anesthesiologists.

Additionally to quantitate the efficacy of SYNWORK in detecting decrements in performance we will be comparing SYNWORK scores before and after a known depressor of performance.

We have obtained additional microphones for refining the sound recording system in Shock Trauma; we have obtained the components (hardware and software) and have up a second data analysis workstation; this one is located in Shock Trauma, in the Anesthesiology Resource Room; this workstation should make it easier to get rapid turnaround analysis support from participants in the video taping; the Resource Room workstation will be networked to the workstation in the lab, so that data files can be transferred automatically.

ONR Visit

On October 8th Doctors Susan Chipman and Terry Allard spent the afternoon visiting, viewing video tapes and discussing this ONR project. The following summary briefly describes the outcome of the visit as viewed by Dr. Mackenzie and Dr. Chipman.

The interests of ONR includes:

1) Characterization of what differentiates the situations perceived as stressful from those that are not
2) Comparison of normative decision trees to real-life decision making
3) Whether short-cut pattern recognition processes are occurring and their identification
4) Team communication among a large team and comparison with that found in air crews.
5) Cognitive modelling of the trauma team
6) Quantifying workload and stress levels related to workload

We agreed that many of the above issues are stand alone research projects, but we have an opportunity to address at least some of these items in detail. Dr. Chipman put us in contact with investigators at NASA-Ames who seems very interested in further collaboration. We plan to meet with these investigators who have expertise on air crew performance when they next visit Washington.

We certainly found the visit helpful and would hope that another visit would be possible in about 9 months to review progress. Doctors Chipman and Allard also attended our monthly LOTAS meeting.

Administration

Personnel

James Black a GRA employed under this grant has not been able to fulfill the 20 hour/week commitment on video analysis and has resigned effective October 9th. On November 9th we will be employing a replacement GRA Ms. Denise Ovelgone. She has expertise in computer graphics and has previously worked on video analysis for the U.S. Army. She is a student taking a masters in computer graphics at Towson State University. In the interim (Oct. 9 - Nov. 9th) we have employed Dave Mahaffey of Man-Made Systems at a greater number of hours to make up the deficiency in video analysis resulting from Mr. Black's departure. In addition we have employed Mr. Durocher as a GRA working on video analysis. He is funded by money previously assigned to Dr. Shin in agreement with our revised budget submitted in a letter dated July 30, 1992.

Budget

As discussed during the visit of Doctors Chipman and Allard we have experienced considerable problems with interference with the equipment for video acquisition. We are also spending far more time than originally anticipated on video analysis. To deal with the problem of equipment interference (unplugging VCR and computer, turning of toggle switches on the front of the VCR despite covers to prevent this and notices posted requesting that the equipment not be touched) and to assist timely video analysis we wish to use some of the money presently directed towards funding the physician-investigators in Shock Trauma to fund undergraduate and/or graduate research assistants. These students would facilitate video data acquisition by ensuring all the equipment was functioning in all 4 locations. They would also be able to start the video analysis after completion of the video taping because they would be stationed in Shock Trauma and work hours during Friday, Saturday and Sunday evening when most trauma patient admissions occur. No additional funds would be expended to achieve this. The budget re-allocation would enable funding for up to 3 students. Funding for an additional video analysis station to be located in Shock Trauma has been obtained from the Department of Anesthesiology at UMAB and partly from equipment funding carried over from the Year 1 budget (outlined in the July 30, 1992 budget revision letter).

A letter outlining our plans will be sent to ONR for consideration when we have established who the students employed under this budget re-allocation will be. ONRquart.er6

TABLE 1

REFERENCE SHEET FOR SUBJECTIVE RATINGS OF STRESS

STRESS DUE TO:

1) NOISE = Extraneous (clinically unimportant) Chatter
   = Equipment Noise/Radio Noise
   = Uninformative or Nuisance Alarms

2) TEAM INTERACTIONS BY OR AMONG NON-ANESTHESIA PERSONNEL

   e.g. = effectiveness of communication among or by non-anesthesia trauma team
   = team compatibility or efficiency of teamwork
   = communication with other members of trauma team in critical event

3) TEAM INTERACTIONS BY OR AMONG ANESTHESIA PERSONNEL

   e.g = effectiveness of communication among or by entire anesthesia team
   = team compatibility or efficiency of teamwork
   = communication with other members of team in critical event

4) TIME CONSTRAINTS = CRITICAL FOR PATIENT THAT INTERVENTION CARRIED OUT QUICKLY BY ANESTHESIA TEAM

5) TASK WORKLOAD = NUMBER AND COMPLEXITY OF TASKS BEING CARRIED OUT BY ENTIRE ANESTHESIA TEAM

6) DIAGNOSTIC UNCERTAINTY

   e.g. = Lacking lab values or examination (e.g. physical or x-ray)
   = Lacking monitoring
   = Lacking knowledge of site of injury
   = Lacking knowledge of extent of injury
   = Lacking knowledge of cause of critical event

SUMMARY/DEBRIEFING

- OVERALL PERFORMANCE - WAS RESUSCITATION ADEQUATE - WAS ANESTHESIA SKILLED
- DID THE ANESTHESIA TEAM FOLLOW THE DECISION TREES FOR MANAGEMENT OF ABNORMAL PHYSIOLOGICAL VARIABLES? (SEE BELOW)
- REVIEW POST TRAUMA QUESTIONNAIRE COMPLETED BY ANESTHESIA PERSONNEL

LIMITS DEFINING ABNORMAL PHYSIOLOGICAL DATA SCORING OF STRESSORS

(Relate to all patients that require anesthesia involvement)

	Low	High
Heart Rate (/min)	< 60	> 100
Blood pressure (mm Hg)	SBP < 90	DBP > 100
SaO_2(%)	< 90% (PaO_2 < 60)	-
$ETCO_2$ (mm Hg)	< 20	> 40
TEMP(°C)	< 35	> 39
Mean PA Pressure (mm Hg)	< 8	> 30
PCWP or PA diastolic (mm Hg)	< 5	> 24

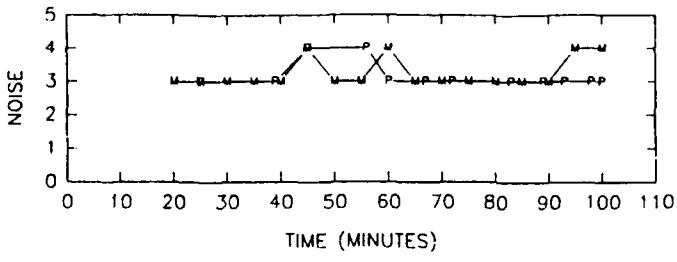
1 = a lot less(stress) than usual
2 = a little less than usual
3 = typical or usual amount (for trauma anesthesia)
4 = a little more than usual
5 = a lot more than usual

TABLE 2

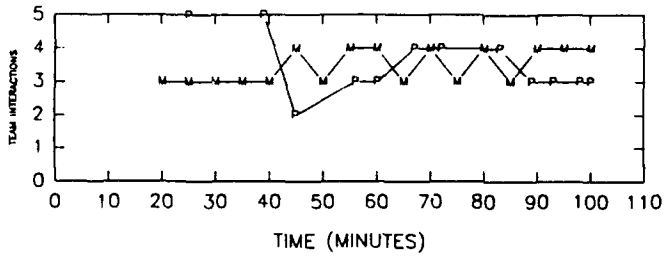
Communication Behaviors

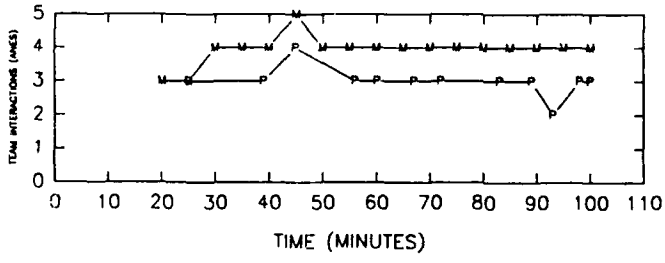
CP	Communicate with patient (meaningful communication between staff member and patient)
CO	Communicate with oneself (utterances that are seemingly "absent-minded;" i.e., not directed at teammates)
CQ	Ask a task-relevant question or ask for assistance
CA	Provide an answer or other direct response to an inquiry or request for assistance
CI	Provide task-relevant information unsolicited
CS	Communicate a strategy, plan or schema
CD	Communicate a directive, give instructions, or delegate tasks, but not in a strategic sense
CR	Other task-relevant communication
CN	Non-task relevant communication (but directed at a teammate or at the patient)
CU	Unintelligible verbalization
CZ	Silence (i.e., no verbalization)

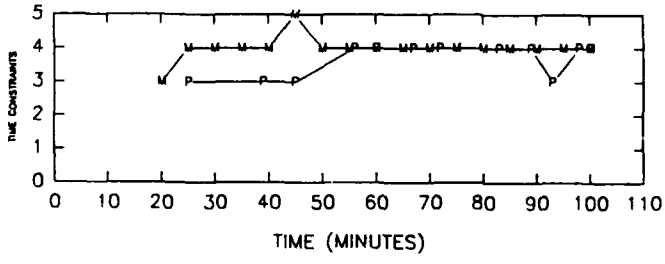
We have also contacted Judith Orasanu at NASA-Ames to get her publications and those of Fouchette on communication analysis and aircrew communications. The list above may be revised to incorporate additional ideas.

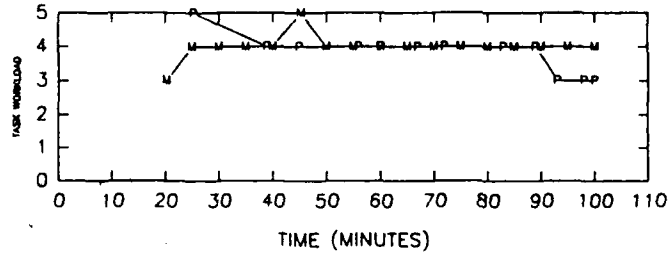


P = PATEY
M = MACKENZIE









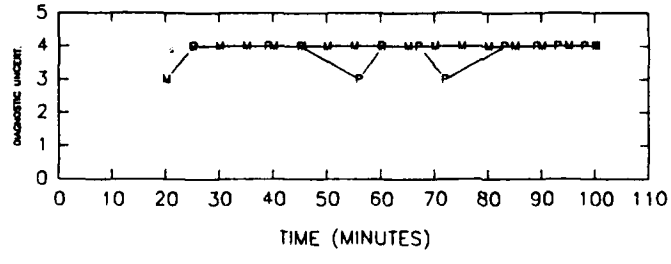


Fig. 1: Six stressors are scored by 2 subject matter experts who viewed the tape independently. Dr. Patey participated in the management of this patient. The scoring system used is shown in Table 1 which also lists the stressors.