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**Development and Use of Mark Sense Record Cards
For Recording Medical Data on Pilots
Subjected to Acceleration Stress**

CAPTAIN HARALD A. SMEDAL, USN, MC and C. DEWEY HAVILL

Development and Use of Mark Sense Record Cards For Recording Medical Data on Pilots Subjected to Acceleration Stress

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A TIME-HONORED system of recording medical histories and the data obtained on physical and laboratory examination has been that of writing the information on record sheets that go into a folder for each patient. In order to have information which would be more readily retrieved, a program was initiated in 1952 by the U. S. Naval School of Aviation Medicine in connection with their "Care of the Flyer" study to place this information on machine record cards. In 1958, a machine record card method was developed for recording medical data in connection with the astronaut selection program. Machine record cards were also developed by the Aero Medical Laboratory, Wright-Patterson AFB, Ohio, and the Aviation Medical Acceleration Laboratory, Naval Air Development Center, Johnsville, Pennsylvania, for use in connection with a variety of tests including acceleration stress.¹ Therefore, a variety of systems resulted in which data of a medical nature could easily be recalled.

During the NASA, Ames Research Center centrifuge studies,^{2,3} the pilot subjects were interviewed after each centrifuge run, or series of runs, and subjective information was recorded in a log book by the usual history taking methods referred to above. After the methods were reviewed, it was recognized that a card system would be very useful in recording data from our pilots after they had been exposed to acceleration stress. Since the acceleration stress cards already developed did not meet our require-

ments, it was decided a different card was needed.

DESIGN

The regular machine record card with its coded information punched does not have the capability of yielding information directly from the card unless the person using the card is very familiar with the code. This disadvantage is overcome by the mark sense card method described by others.¹ On the mark sense card, the questions are written in abbreviated form. The answers are marked with an electrographic pencil in an adjacent oval-shaped space. The space used will indicate the correct answer either in the form of a specifically provided choice of answers or a Yes or No answer. An example of this card is shown in Figure 1.

An IBM card layout form for an inclined mark sense card (Fig. 2) gives maximum space for writing and printing. This form can present all the information desired for one pilot during one run or a series of runs on a single card. Through our past experience with subjective complaints during and after acceleration stress, we were able to compile a list of the most common items that occur. Visual symptoms that are of interest during the acceleration include blurring, changes in visual field, loss of vision, and pain about the eyes. Other general symptoms of interest are chest pain, headache, dizziness, nausea, abdominal pain, difficulty in breathing, and pain in the extremities. We were also interested in information as to whether or not any of these symptoms persisted after the exposure to acceleration.

Another card layout was made in order to have a history type card which could be filled once a year at the time of the annual physical

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NAME - LAST, FIRST, MIDDLE INITIAL				SERIAL NO.				CASE OR HOSP NO.				S	RANK	R-S	M	E	C	SERV.	BORN	AGE	GA	NO	YR	DATE OF EXAM
<p>1 HAS PATIENT EVER HAD ? <i>** If you do not understand a question ask the doctor or nurse **</i></p> <p>SHADED AREA - STAFF USE ONLY</p>																								
GENERAL HISTORY CARD													Significant General History			Significant Ear History								
	Measles Any Kind	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Blood Poisoning Severe Infection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Loss of Consciousness Any Cause	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lived in Foreign Countries Over 1 Year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Earaches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Chicken Pox	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Intestinal Parasites	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Severe Headaches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Tuberculosis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Draining Ears	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Mumps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Undulant (Milk) Fever	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Diabetes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rheumatism Any Kind	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Buzzing or Ringing In Ears	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Whooping Cough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Poisoning Other Than Food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Tumors of Any Kind	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Arthritis Any Kind	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Temporary Hearing Loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Influenza Any Kind	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Encephalitis (Brain Fever)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Major Operation Any Type See Card 1 - 8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hepatitis (Liver Infection)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Permanent Hearing Loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Strep Throat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Mononucleosis (Glandular Fever)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Recent Significant Weight Gains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	X-ray or Radiation Therapy For Any Purpose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Pain in Ears From Flying	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Serious Accident	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Penicillin or Other Drug Reaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Recent Weight Loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non-specific Urethritis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ever Worn Hearing Aid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Accident Prone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Immunization or Serum Reaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is Diet Necessary to Control Weight	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Frequent Colds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Unusual Hearing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
	Diphtheria	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Malaria	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Tropical Disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	On Pension or Disability Insurance Any Purpose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Other Ear Problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				

↑
STAFF MARK HERE
IF COMMENTS ARE MADE
ON BACK OF CARD

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Fig. 1. General medical history mark sense record card (Lovelace Foundation).

MARK SENSE RECORD CARDS—SMEDAL AND HAVILL

OCTOBER, 1962

IBM SUPPLIES DIVISION

IBM CARD LAYOUT FORM - INCLINED MARK SENSE

FORM X74-6259-1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
																C0	C0	C0	C0	C0	C0																																																										
																C1	C1	C1	C1	C1	C1																																																										
																C2	C2	C2	C2	C2	C2																																																										
																C3	C3	C3	C3	C3	C3																																																										
																C4	C4	C4	C4	C4	C4																																																										
																C5	C5	C5	C5	C5	C5																																																										
																C6	C6	C6	C6	C6	C6																																																										
																C7	C7	C7	C7	C7	C7																																																										
																C8	C8	C8	C8	C8	C8																																																										
																C9	C9	C9	C9	C9	C9																																																										

TYPE SPACING																																																																															
18-TO-180 PRINTERS																																																																															
PRINTING POSITIONS																																																																															
60-PRINTING INTERPRETERS																																																																															
40-TO-400 PRINTERS & INT.																																																																															
COLUMN GUIDE FOR MARK SENSING																																																																															
18-PRINTING POSITIONS																																																																															

COMPLETE THESE SECTIONS FOR ALL LAYOUTS

BRANCH OFFICE NAME _____ TRANSMITTAL NO. _____

CUSTOMER NAME _____ CUSTOMER NO. _____

CUSTOMER REFERENCE AND DATE _____ PROFS REQUIRED? YES NO

MAIL PROOFS TO _____

LAYOUT PREPARED BY _____ DATE _____

AUTHORITY _____ DATE _____

COMPLETE THESE SECTIONS WHEN APPLICABLE

CORNERS TO BE CUT

NONE UPPER LOWER

INTERPRETATION

NONE 45 PER. INT. 60 MEDICAL 557 BILL FEED END PRINTING STRIP SPEC.

REQUIREMENTS

SCORING PRENUMBERING STOR PAD CONTINUOUS BOOK TUMBLE

FOR MARK SENSING CARDS, INDICATE STYLE

Do not indicate using or printing. Not recommended for cards requiring printing or printing between H. & S. pos.

4 4 4

POINTERS FOR SHORT CARD LAYOUTS

1) DETERMINE SHORT CARD COLUMN NUMBERS BY REFERRING TO GUIDE AND COLUMNS PRINTED BELOW. USABLE COLUMN RANGE IS ESTABLISHED BY THE CAPACITY LOCATION ON EACH SIDE OF GUIDE, E. G., ON A 31-COLUMN CARD, USABLE COLUMNS ARE 15-65.

2) CUT OUT THE STRIP OF COLUMN NUMBERS.

3) PASTE THE STRIP ON THE LAYOUT FORM IN DESIRED LOCATION FOR THE SHORT CARD.

4) RULE ENDS OF SHORT CARD 2 1/2 COLUMNS BEYOND THE STRIP OF COLUMN NUMBERS.

5) DETERMINE MARK SENSE POSITIONS, IF ANY, BY ASSOCIATING STRIP NUMBERS WITH CARD LAYOUT POSITIONS, E. G., ON A 31-COLUMN CARD, M. S. POSITIONS 4-22 ARE USABLE.

SHORT CARD COLUMN GUIDE

CARD CAPACITY (COLUMNS)

CUT-OUTS FOR PASTING

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

1489

Fig. 2.

MARK SENSE RECORD CARDS—SMEDAL AND HAVILL.

NAME

SERIES CARD

AGE

DATE

SIMULATOR LOCATION

TYPE OF SIMULATOR	TYPE OF ACCELERATION ANGULAR LINEAR VIBRATORY IMPACT	SIMULATOR TIME COVERED BY THIS CARD	TYPE OF ACCELERATION I O D	DID YOU HAVE ANY OF THE FOLLOWING SYMPTOMS DURING OR SUBSEQUENT TO THE SIMULATOR TIME COVERED BY THIS CARD											COMMENTS
				SYMPTOMS DURING, OR SUBSEQUENT TO SIMULATOR OPERATION											
1	MOST IMPORTANT COMPONENT	C0C0C0C0	C0C0C0C0	SYMPTOMS DURING SIMULATOR OPERATION			DURING SIMULATOR OPERATION	SUBSEQUENT TO SIMULATOR OPERATION		INTERMITTENT SUBSEQUENT SYMPTOMS (COMMENT ON YES ANSWERS)	YES				
2	SECOND	C1C1C1C1	C1C1C1C1					LESS THAN 8 HRS	MORE THAN 8 HRS						
3	THIRD	C2C2C2C2	C2C2C2C2												
4	FOURTH	C3C3C3C3	C3C3C3C3												
5	IS THIS CARD FOR A SINGLE RUN OR ONE SERIES OF RUNS	C4C4C4C4	C4C4C4C4					BLURRED VISION	YES NO			HEADACHE	YES NO	NO YES YES	YES NO
6		C5C5C5C5	C5C5C5C5					CHANGES IN VISUAL FIELD	YES NO			PAIN IN OR ABOUT THE EYES	YES NO	NO YES YES	YES NO
		C6C6C6C6	C6C6C6C6	LOSS OF VISION	YES NO	DIZZINESS	YES NO	NO YES YES	YES NO						
		C7C7C7C7	C7C7C7C7	CHEST PAIN	YES NO	NAUSEA	YES NO	NO YES YES	YES NO						
		C8C8C8C8	C8C8C8C8	DIFFICULTY IN BREATHING	YES NO	ABDOMINAL PAIN	YES NO	NO YES YES	YES NO						
		C9C9C9C9	C9C9C9C9	LOSS OF CONSCIOUSNESS	YES NO	PAIN IN THE EXTREMITIES	YES NO	NO YES YES	YES NO						
	OTHER (COMMENT?)			OTHER (COMMENT IF YES)	YES NO		YES NO	NO YES YES	YES NO						

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

IBM LB4013

Fig. 3. Ames mark sense record card (series card).

OCTOBER, 1962

NAME - LAST, FIRST, MIDDLE INITIAL			SERIAL NO.	CASE OR NOSP. NO.	S	RANK	R-S	M	E	C	SERV	BORN	AGE	DA	MO	YR	DATE OF EXAM
SPECIAL AVIATION HISTORY	MAIN TYPE OF SIMULATOR USED	TOTAL SIMULATOR TIME (HRS)	SIMULATOR TIME THIS YEAR (HRS)	TYPE OF ACCELERATION ANGULAR LINEAR VIBRATORY IMPACT		DID YOU HAVE ANY OF THE FOLLOWING SYMPTOMS DURING OR SUBSEQUENT TO YOUR SIMULATOR WORK										COMMENTS	
	1	C0C0C0C0C0C0C0C0C0C0	C0C0C0C0C0C0C0C0C0C0	MOST IMPORTANT COMPONENT		SYMPTOMS DURING SIMULATOR OPERATIONS					SYMPTOMS DURING OR SUBSEQUENT TO SIMULATOR OPERATIONS					YES	
	2	C1C1C1C1C1C1C1C1C1C1	C1C1C1C1C1C1C1C1C1C1	SECOND		DURING SIMULATOR OPERATION					SUBSEQUENT TO SIMULATOR OPERATION LESS THAN 24 HOURS MORE THAN 24 HOURS		INTERMITTENT SUBSEQUENT SYMPTOMS				
	3	C2C2C2C2C2C2C2C2C2C2	C2C2C2C2C2C2C2C2C2C2	THIRD		BLURRED VISION					HEADACHE						
	4	C3C3C3C3C3C3C3C3C3C3	C3C3C3C3C3C3C3C3C3C3	FOURTH		YES NO		YES NO		YES NO		YES NO					
	5	C4C4C4C4C4C4C4C4C4C4	C4C4C4C4C4C4C4C4C4C4			CHANGE IN VISUAL FIELD		PAIN IN OR ABOUT THE EYES		YES NO		YES NO					
	6	C5C5C5C5C5C5C5C5C5C5	C5C5C5C5C5C5C5C5C5C5			LOSS OF VISION		DIZZINESS		YES NO		YES NO					
	7	C6C6C6C6C6C6C6C6C6C6	C6C6C6C6C6C6C6C6C6C6			CHEST PAIN		NAUSEA		YES NO		YES NO					
	8	C7C7C7C7C7C7C7C7C7C7	C7C7C7C7C7C7C7C7C7C7			DIFFICULTY IN BREATHING		ABDOMINAL PAIN		YES NO		YES NO					
	9	C8C8C8C8C8C8C8C8C8C8	C8C8C8C8C8C8C8C8C8C8			LOSS OF CONSCIOUSNESS		PAIN IN THE EXTREMITIES		YES NO		YES NO					
10	C9C9C9C9C9C9C9C9C9C9	C9C9C9C9C9C9C9C9C9C9			OTHER		OTHER		YES NO		YES NO						

IBM L54014

MARK SENSE RECORD CARDS—SMEDAL AND HAVILL.

Fig. 4. Ames mark sense record card (history card).

examination of the pilot. This allows the examiner to keep a year-to-year record of the total acceleration stress encountered over the year, both as to total time as well as type of acceleration, i.e., linear, angular, impact, or vibratory. It also permits the evaluation of any sign or symptom that might be accumulative and related to repeated acceleration stress.

A final example of the two cards, one called the series card, and the other called the history card, is shown in Figure 3 and Figure 4, respectively.

RESULTS AND DISCUSSION

The series cards were used in collecting data on 22 test pilots used as subjects during a centrifuge program conducted at the Naval Air Development Center, Aviation Medical Acceleration Laboratory, Johnsville, Pennsylvania, during the months of March, April, and May of 1961. The cards proved to be readily understood and easily filled out by the pilots. A few items were found to be unsatisfactory in the first form of the sense card. For example, the simulator time columns which were three in number were found to be one too many since the time resulting from any one run or a series of runs was always less than 9 minutes, and two columns which would show the time in nine or fewer minutes plus a question were all that was required. It was also found that with a series of runs it was difficult to relate the symptoms to a specific run. The vector of the applied g often differed in each of the runs in a series and the pilot would not leave the cockpit. As a result, he was unable to fill out a card after each different run in the series. In general, however, the sense card when used for the single run was quite adequate. Modifications of these cards will be made from time to time as is found necessary.

The history cards have been forwarded to the Lovelace Foundation where they are currently

being used as a part of their large series of cards that cover test pilot type examinations.

SUMMARY

This report presents the design format of two machine record cards of the mark sense card type which have been developed for use in connection with recording medical data on test pilots who are subjected to various acceleration stresses. One is a series card used to record subjective data from pilots after a single or a series of runs on a motion simulator during which acceleration stress is encountered. The other is a history card intended for use once a year at the time of the pilot's annual physical examination. The history card is intended to provide information regarding accumulative effects of repeated acceleration stress on the pilot. The series card has been used during one centrifuge program conducted by the NASA, Ames Research Center at the Naval Air Development Center, Aviation Medical Acceleration Laboratory, Johnsville, Pennsylvania, during March, April, and May of 1961, and has proved very successful. Although the population group was small and so not ideally suited for mark sense card data acquisition, some valuable accurate subjective information was obtained, particularly in regard to vision. This information would not have been obtained by simply keeping a log.

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