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THE EFFECT OF BREATHING ELEVATED CO_2 GAS MIXTURES ON TRACKING PERFORMANCE, BLOOD PRESSURE, AND SUBJECTIVE TOLERANCE AT 1GZ

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The voluntary informed consent of the subjects used in this research was obtained as required by Air Force Regulation 169-3.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

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The addition of small concentrations (5-10%) of carbon dioxide (CO_2) to the breathing gas has been identified as a possible technique to increase Gz tolerance for pilots. Eight subjects participated in an experiment to examine tracking performance, physiological parameters, and subjective tolerance when breathing the four following gas mixtures: air; 100% O_2; 2.5% CO_2 and 97.5% O_2; and 3.5% CO_2 and 96.5% O_2. Tracking performance was not significantly different when breathing any of these four gas mixtures. Learning, which continued to occur throughout the experiment, was inhibited when the subjects were breathing the 3.5% CO_2 mixture. When using either of the CO_2 mixtures there was a significant increase in relative respiratory volume and a modest increase in systolic (11 mm Hg) and diastolic (6 mm Hg) blood pressure. One subject, when breathing 3.5% CO_2, aborted the run after 12 minutes because of air hunger. Keywords:

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PREFACE

The addition of small amounts of carbon dioxide to the breathing gas mixture has been identified as a technique of increasing human tolerance to Gz acceleration. This study was conducted to determine if tracking performance would be adversely effected by breathing such gas mixtures.

The report describes a joint in-house and contractor experiment conducted at the Acceleration Effects Branch, Biodynamics and Bioengineering Division, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio. The effort was conducted under workunit 72313501 with support from contract F33615-81-C-0500.

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1. INTRODUCTION

Breathing gas mixtures with an elevated concentration of carbon dioxide (CO_2) has been advocated as a possible method of providing increased Gz tolerance for pilots. Increasing levels of CO_2, however, may have an adverse effect on tracking performance which would preclude its use. Carbon dioxide comprises 0.0314% of the normal atmosphere. In the human the average PCO_2 in arterial blood is 40 mm Hg and 46 mm Hg in venous blood. Inspired gas contains (760 mm Hg x .0314 = 24 mm Hg) a PCO_2 of 24 mm Hg while expired gas is about 40 mm Hg. The chemoreceptors within the body react to decreasing PCO_2 levels (and increasing pH) by reducing respiratory functions. Conversely, elevated levels of PCO_2 result in a stimulation of respiration and an increase in blood pressure. Investigators (1,2,3) have demonstrated that breathing gas mixtures with 5 to 7% CO_2 will increase tolerance to +Gz acceleration by up to 0.88 Gz. The mechanism by which this Gz tolerance increase occurs appears to be an elevation of blood pressure (5 mm Hg systolic and 12 mm Hg diastolic when breathing 5% CO_2) and a 50% increase in peripheral vascular resistance (4). These reflex reactions may be thought of simply as an internal anti-G suit. Anderson (5) found that the retinal ischemic tolerance interval was increased by the addition of small amounts of CO_2. More recently, Jennings et al. (6) conducted an experiment on the AAMRL Dynamic Environment Simulator (DES) and reported a 0.5 Gz relaxed tolerance increase for subjects breathing 5% CO_2. They also reported that many subjects felt hypoxic, fatigued, or lethargic and concluded that the adverse effects of breathing 5% CO_2 should preclude it from operational use. The experiment reported herein was

designed to examine if performance is affected by breathing small (less than 5%) amounts of CO_2.

II. METHODS

SUBJECTS

Fight subjects, seven male and one female, ranging in age from 22 to 30 years (mean age 25 years) participated in this study. After giving informed consent each subject completed three days of training runs followed by two days of data collection runs. These subjects are also members of the Sustained Acceleration Panel and participate in centrifuge experiments conducted on the DES. Six of the subjects had participated in the experiment by Jennings et al. (3) previously conducted on the DES. These eight subjects are all non-rated active duty USAF members. Three have private flying experience.

TEST SETUP

The experimental setup consisted of an ACES II aircraft seat, a two-axis side-arm force stick, and rudder pedals. A computer generated compensatory tracking task was displayed on a 12" CRT. For the two days of data collection runs the subjects wore a mask (MBU-5/P) and breathed from a low pressure A-6 cylinder with a demand regulator. Four gas mixtures were used. They were air; 100% O_2; 2.5% CO_2 and 97.5% O_2; and 3.5% CO_2 and 96.5% O_2. The gases were randomized across subjects with each subject breathing each mixture once. Blood pressure was recorded

using a Critikon, Inc. Model 1055-00006 automated blood pressure monitoring system. A cuff, placed on the left arm, was inflated by the system every 3 to 4 minutes throughout the experiment. The physiological parameters recorded were systolic, diastolic, and mean pressures and heart rate. Respiration was measured with a pneumotach, a strap and bellows (connected to a pressure transducer) placed around the subject's chest. Respiratory rate and relative volume changes were recorded with this system onto a two-channel strip chart recorder.

TRACKING TASK

The scene presented on the CRT to the subject included a circular gunsight reticle fixed in the center of the CRT, a representation of the horizon, a pitch ladder, and the aft view of a maneuvering target aircraft. Three different sum of sines forcing functions were used to displace the target aircraft in the pitch, roll, and yaw axes, respectively. The subjects' task was to center the target, wings level, within the gunsight. Each tracking task was of 30 seconds duration followed by a 10 sec rest period. Each of the forcing functions in the pitch, roll, and yaw axes was composed of seven sine waves of different frequencies with initial phase angles chosen by a random number generator. The approximate bandwidth of each task was 0.7 Hz which is about the frequency where tracking becomes too difficult to perform. A score was displayed to the subject following each task. The score was the composite root mean square error (ERMS) reflecting how well the subject minimized the error between the target aircraft and gunsight in pitch, roll, and yaw. These parameters were all recorded on magnetic tape and

could be analyzed for each individual axis as well as the combined score. The force on the stick required for a full scale deflection was 14 pounds for roll and 17 pounds in pitch. In the yaw axis the rudder pedals required a breakout force of 10 pounds and 30 pounds for full scale input. This performance task was originally developed in cooperation with AFWAL for use with the AFTI/F-16 pilots and has been used in other experiments (6,7) conducted within AAMRL.

PROCEDURES

Each subject participated in 3 days of training and 2 days of data collection. The training days allowed the subject to become progressively familiar with the three-axis tracking task. On the first training day each subject tracked 10 single-axis pitch only tasks, 10 in yaw, and 10 in roll. Next the subjects tracked 10 tasks in all of the two-axis combinations followed by 10 of the three-axis tasks. More time was devoted to the multi-axis tasks on the second and third training days. At the end of the third day of training the scores of the three-axis task were examined to see if the subjects were reaching a steady state value. If the subjects were not showing substantial improvement (less than 5% change in error score), they were assumed to be trained. The number of tracking trials for both the training and data runs is presented in Table XII. During the training phase the subjects did not wear a mask nor were any physiological measurements recorded. During the two days of data runs the subject first sat quietly in the seat for about 5 minutes while baseline physiological measurements were recorded. The mask was then donned and the subject breathed one of the four gas

mixtures for 5 minutes to acclimate to that mixture. The performance tasks were then started which included 4 warmup runs and the 30 three-axis tasks which were scored. Following the last task the subject removed the mask and sat quietly for 5 minutes of post-run baseline measurements. The subject then left the room for about 10 minutes and a different gas mixture was setup. A second performance test was then conducted which was identical to the first including baseline, acclimation, tracking and post-run baseline. Comments made by the subjects were also recorded.

III. RESULTS AND ANALYSIS

The primary purpose of the analysis was to determine differences between the gases in terms of tracking performance. The secondary purpose was to determine the effect of the gases on the measured physiological parameters of systolic, diastolic, and mean blood pressure, heart rate, respiratory rate, and relative respiratory volume. The tertiary purpose was to determine which of the gas mixtures used were subjectively tolerable for an operationally relevant period of time.

To analyze the tracking scores an analysis of covariance (ANOCOV) was performed with subject, gas, day (first or second), order (first or second run within a day), and time as the factors. Day and order were needed as factors since actual data and not a percent change from baseline was used.

To analyze the physiological data the percent change from baseline (mask off and breathing room air) to the values during the tracking tasks was used in either an analysis of variance (ANOVA) with subject and gas as the factors, or an ANOCOV with subject, gas, and time as the factors depending on whether time had an effect.

One subject (830011) was not used in any of the analyses since he stopped his 3.5% CO_2 run after 9 tracking tasks and did not have a 100% O_2 run. Another subject (830025) was not used for the analysis of respiratory rate and volume since he had no data for the 100% O_2 and 2.5% CO_2 runs.

TRACKING

The tracking score is expressed as the root mean square of the error (ERMS) between the target aircraft and the gunsight. Better performance results in less error and a lower tracking score number. There was no significant difference in tracking score (ERMS) between the gases (P=.4998). However, there was significant interaction between the gases and time (p=.0126). This indicates that differences between the gases change with time. Separate ANOVAs were then performed on the mean scores of all seven subjects for the first 10 tasks and the last 10 tasks; no significant difference was found between the gases (P=.9239 and P=.5813 respectively). The mean tracking scores for the gases are presented in Table I and Figure 3.

TABLE I - Tracking Scores

	Gas			
	Air	100% O_2	2.5% CO_2	3.5% CO_2
Score - 30 Tasks	698	695	693	704
Score - First 10 Tasks	721	711	708	701
Score - Last 10 Tasks	677	679	673	717

mean tracking scores n=7

A separate ANOCOV on each gas found the following slopes with their significance:

TABLE II - Tracking Scores Slope

Gas	Slope (score/min)	P-Value
Air	-3.6	.0001
100% O_2	-2.7	.0011
2.5% CO_2	-1.8	.0261
3.5% CO_2	0.7	.4314

The negative slope of all gases except 3.5% CO_2 showed that an improvement in performance during the 30 tracking tasks occurred. This is evidence that learning was continuing during the data runs. There was a significant difference in tracking score in day (P=.0001) and order (P=.0001).

The mean tracking scores were as follows:

TABLE III - Scores by Day and Order

	DAY	
	First	Second
Score	728	668
	ORDER	
	First	Second
Score	724	672

The most interesting performance result was from the subject (830011) who did not complete the run during the 3.5% gas exposure. Figure 4 illustrates his three-axis scores prior to terminating the run. Also plotted is his baseline on the third training day. It is obvious from this plot that he was performing at his best level prior to the time that he voluntarily aborted the run. This indicates that the physiological stress did not impair his performance but did cause him to abort. In other words, the 3.5% CO_2 gas did not appear to impair performance up to the actual point where the subject terminated the run.

PHYSIOLOGICAL PARAMETERS

Baseline measurements (mask off and breathing room air) are compared with the 20 minute period of performance testing. ANOVAs and ANOCOVs were performed to determine if significant changes occurred between the baseline and tracking periods. Time was found to have a

significant effect and was used in analyzing systolic pressure, diastolic pressure, and mean arterial pressure.

Systolic Pressure

There was no significant difference in percent change between the gases (P=.5516). There was a significant linear relationship between percent change and time (P=.0010) which resulted in an approximate increase of 3.7% over the 30 tracking tasks (20 min).

TABLE IV - Systolic Blood Pressure

	GAS			
	Air	100% O_2	2.5% CO_2	3.5% CO_2
Percent Increase from baseline	7.5%	3.5%	6.8%	7.4%
Baseline (mm Hg)	121 ± 10	126 ± 9	127 ± 10	127 ± 7
Tracking (mm Hg)	125	135	136	137

mean values for the 20 minute period required to track the 30 performances tasks. n=7

Diastolic Pressure

There was no significant difference in percent change between the gases (P=.0511). However, there was significant interaction between the gases and time (P=.0440). This indicates that the differences between the gases change with time. An ANOCOV on each gas separately found the following slopes with their significance:

TABLE V - Diastolic Slope

GAS	SLOPE (%/min)	P-VALUE
Air	-.02	.9020
100% O_2	.28	.0443
2.5% CO_2	.67	.0006
3.5% CO_2	.34	.0566

Separate ANOVAs were then performed on subject means for the first 7 min of tracking and the last 7 min of tracking and found no significant difference between the gases (P=.3439 and P=.0592 respectively). Most subjects, when breathing air, had a slight drop in diastolic pressure during the middle portion of the tracking period.

TABLE VI - Diastolic Blood Pressure

	GAS			
	Air	100% O_2	2.5% CO_2	3.5% CO_2
Percent Increase from baseline	3.7%	5.7%	13.3%	14.9%
Percent Increase First 7 Minutes	5.2%	2.6%	8.2%	11.6%
Percent Increase Last 7 Minutes	5.5%	7.5%	18.8%	17.4%
Baseline (mm Hg)	74 ± 9	73 ± 7	72 ± 3	71 ± 10
Tracking (mm Hg)	76	77	82	82

Mean Arterial Pressure

There was no significant difference in percent change between the gases (P=.1222). However, there was significant interaction between gas and time (P=.0433). The slopes were as follows:

TABLE VII - Arterial Pressure Slope

GAS	SLOPE (%/min)	P-VALUE
Air	.06	.5649
100% O_2	.23	.0146
2.5% CO_2	.48	.0001
3.5% CO_2	.25	.0202

Separate ANOVAs were performed on subject means for the first 7 min of tracking and the last 7 min of tracking and found no significant difference between the gases (P=.2478 and P=.0708 respectively).

TABLE VIII - Mean Arterial Blood Pressure

	GAS			
	Air	100% O_2	2.5% CO_2	3.5% CO_2
Percent Increase from Baseline	5.3%	4.6%	10.2%	11.2%
Percent Increase First 7 Minutes	5.3%	1.9%	6.3%	8.6%
Percent Increase Last 7 Minutes	6.5%	5.7%	13.7%	12.8%
Baseline (mm Hg)	90 ± 8	90 ± 9	90 ± 5	90 ± 8
Tracking (mm Hg)	94	95	99	100

Heart Rate

There was no significant difference in percent change between the gases (P=.0909).

TABLE IX - Heart Rate

	GAS			
	AIR	2.5% CO_2	100% O_2	3.5% CO_2
Percent Increase from Baseline	15.9%	16.9%	8.3%	12.2%
Baseline (bpm)	63 ± 15	63 ± 15	67 ± 16	68 ± 14
Tracking (bpm)	73	74	73	76

mean beats per minute (bpm) n=7

Repiratory Rate

There was no significant difference in percent change between the gases (P=.7891).

TABLE X - Repiratory Rate

	GAS			
	AIR	100% O_2	2.5% CO_2	3.5% CO_2
Percent Increase from Baseline	16.4%	6.7%	12.2%	13.2%
Baseline (bpm)	16 ± 2	16 ± 3	18 ± 3	18 ± 2
Tracking (bpm)	19	17	20	20

mean breaths per minute (bpm) n=7

Relative Respiratory Volume

There was a significant difference in percent change between the gases (P=.0102). However, due to significant interaction with subject (P=.0001), this difference represents an average across subjects.

TABLE XI - Relative Respiratory Volume

	GAS			
	AIR	100% O_2	2.5% CO_2	3.5% CO_2
Percent Increase over Baseline	54%	79%	134%	181%

Means connected by the same line were not significantly different (P greater than .01).

IV. DISCUSSION

Performance

For this performance measure no significant difference was noted in the tracking proficiency of the subjects while breathing any of the four gas mixtures. The three-axis task is considered difficult as nearly continuous inputs to the stick and rudders are required to track the target aircraft. As shown in Table III the subjects continued to learn throughout the experiment. The exception was when subjects were breathing 3.5% CO_2 and performance declined during the 30 tasks (Table I). In

this condition learning of the task was inhibited while breathing 3.5% CO_2. The best performance for the first 10 tasks (7 minutes of tracking) and the worst performance for the last 10 tasks were both when the subjects were breathing 3.5% CO_2. This task has been used in previous studies to measure performance decrements in various acceleration environments (6,7). It is possible that the CO_2 breathing gases were not enough of a stressor to elicit performance changes that were within the sensitivity range of this task.

Subject Comments

Comments were obtained from seven of the eight subjects. The following is a collection of those comments. When breathing the air mixture six subjects reported no problem and one subject reported an increase in his breathing rate. While being exposed to 100% O_2 one subject found it hard to breath and sometimes hard to see the CRT. Another subject complained of being short of breath; the remaining five subjects reported no problems with 100% O_2. During the exposure to 2.5% CO_2, one subject experienced labored breathing and stated that he would not want to fly using this gas. Another subject reported that during this exposure it was slightly more difficult to breathe than breathing ambient air. The remaining five reported no problems. Using 3.5% CO_2, one subject aborted after being on the gas for 12 minutes while another subject reported being short of breath. The remaining five subjects reported no problems.

During the preliminary buildup and checkout for this experiment, two subjects breathed a 4.87% CO_2 (balance O_2) gas mixture for the 20 minutes required to track the 30 tasks. Both had noticeable increases in respiratory rate and tidal volume and felt they were near a voluntary abort level because of air hunger. This finding, not reported in earlier work (1,2), has important operational implications.

Physiological Data

Modest increases in heart rate, blood pressure, and respiratory rate occurred as the subjects performed the tracking task. These increases are to be expected as the task requires a high level of mental concentration and a fair amount of muscular activity input into the stick and rudders. The only physiological parameter change of statistical significance was the increase in relative respiratory volume (Table XI). The increase in diastolic pressure approached significance (p=.0511). Of operational relevance are the differences between the normal breathing gas (air) and the two experimental gases (2.5 and 3.5% CO_2). The mean change for all subjects was an increase of 11 mm Hg and 6 mm Hg in systolic and diastolic pressure respectively when breathing either of the CO_2 mixtures. For each increase in Gz acceleration level a corresponding decrease in head level blood pressure of about 23 mm Hg results. It may therefore be speculated that these CO_2 concentrations could provide about 0.5Gz of increased tolerance. This hypothesis would need to be verified by centrifuge testing. Jennings et al. (3) reported a 0.6Gz tolerance increase with subjects breathing 5% CO_2. Because of adverse side effects (feeling of air hunger) they recommended against

its operational use. To date no pharmacological agent has been identified that would increase Gz tolerance, have no adverse side effects, and still be operationally acceptable.

IV. CONCLUSIONS

The responses of the subjects in terms of physiological response and tracking performance to these CO_2 concentrations were very subject specific. While one subject was unable to complete the run with 3.5% CO_2 because of shortness of breath, five others reported no problems. When breathing the CO_2 mixtures there was a significant increase in relative respiratory volume and a modest increase in systolic (11 mm Hg) and diastolic (6 mm Hg) blood pressure. This blood pressure increase suggests the potential of increased Gz tolerance (estimated 0.5Gz) when breathing these CO_2 mixtures. Although the subjects were trained for 3 days with nearly 200 trials, they continued to learn throughout the experiment. Learning was inhibited when the subjects were breathing the 3.5% CO_2 mixture. The results from this study suggest that 2.5% CO_2 is the mixture of choice as a candidate breathing gas to increase Gz tolerance while being both subjectively acceptable and not adversely affecting performance.

It is recommended that additional studies be conducted at 1Gz to better quantify the magnitude and time history of physiological and performance reactions to breathing small amounts of CO_2. From these results it would be possible to formulate a schedule of time required to pre-breathe various CO_2 concentrations to enhance Gz tolerance. Testing on the centrifuge could then validate the data.

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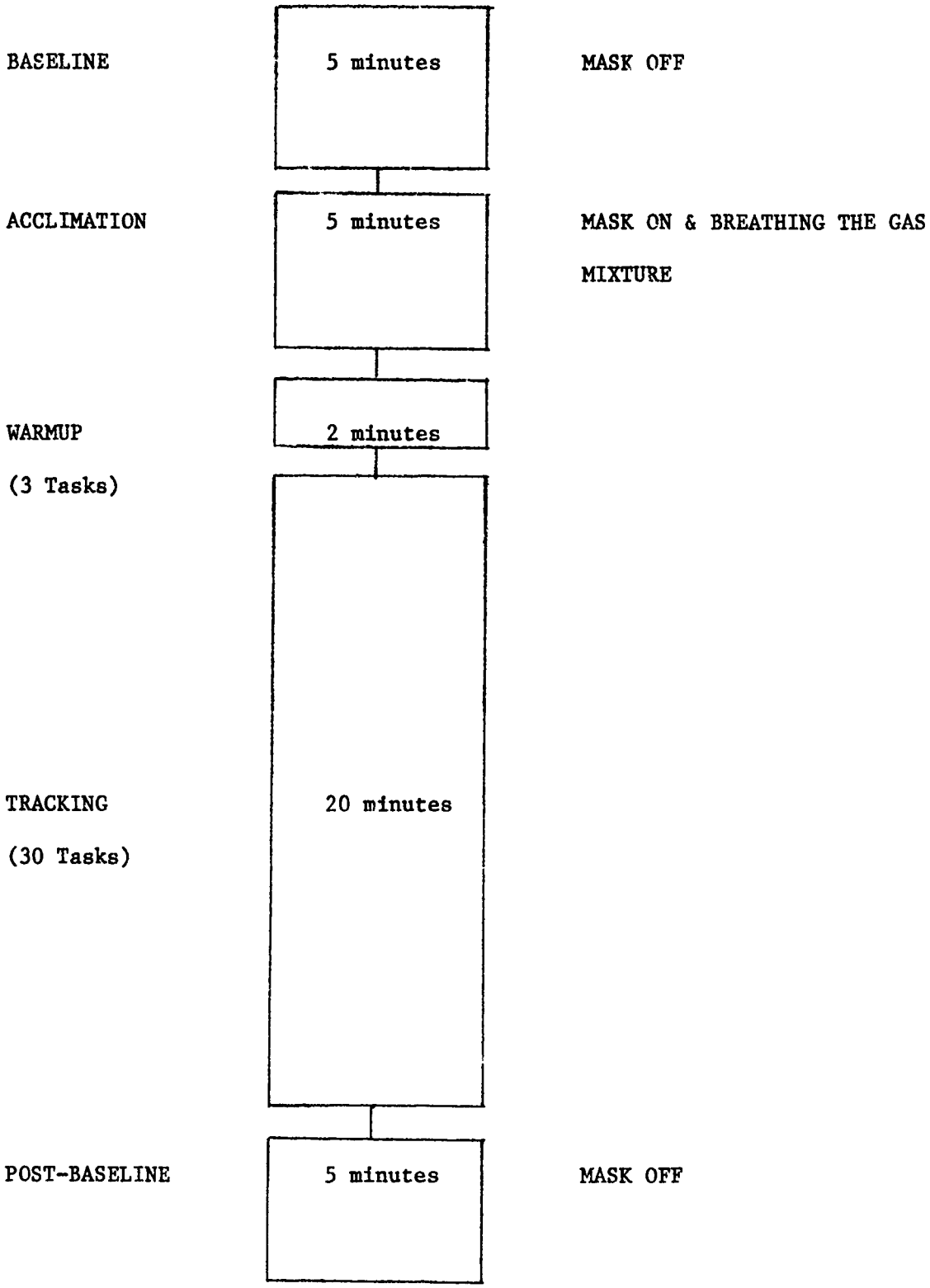

FIGURE 1. Experimental Procedures

TABLE XII. Number of Tracking Tasks

	Training Days			Data Day 1		Data Day 2		Total
	1	2	3	1st	2nd	1st	2nd	
Pitch	10	5	5	1	1	1	1	24
Yaw	10	5	5	1	1	1	1	24
Roll	10	5	5	1	1	1	1	24
Pitch & Yaw	10	10	5	0	0	0	0	25
Roll & Yaw	10	10	5	0	0	0	0	25
Pitch & Roll	10	10	5	0	0	0	0	25
Pitch, Roll & Yaw	10	20	30	31	31	31	31	184
TOTAL	70	65	60	34	34	34	34	331

TABLE XIII. Subject Means

FOR TRACKING SCORES, DATA IS MEAN OF ALL 30 TASKS

FOR THE PHYSIOLOGICAL PARAMETERS, DATA IS MEAN PERCENT CHANGE FROM PRE BASELINE TO THE MEAN OF THE 8 MEASUREMENTS TAKEN DURING THE 30 TASKS

SUBJECT	GAS	MEAN TRACKING SCORE	% CHANGE SYSTOLIC PRESSURE	% CHANGE DIASTOLIC PRESSURE	% CHANGE MEAN ARTERIAL PRESSURE	% CHANGE HEART RATE	% CHANGE RESPIRATORY RATE	% CHANGE RESPIRATORY VOLUME
830008	AIR	755	25	3	13	13	-4	138
830008	100% 02	735	1	2	2	24	3	119
830008	2.5% C02	749	7	14	10	16	2	181
830008	3.5% C02	985	12	34	23	19	17	250
830011	AIR	622	3	13	8	25	1	94
830011	SECOND AIR	605	10	13	12	21	-2	38
830011	2.5% C02	641	7	-0	3	3	1	86
830011	3.5% C02	610	.	.	.	.	5	45
830013	AIR	654	7	1	3	24	39	175
830013	100% 02	600	4	-0	2	11	68	116
830013	2.5% C02	622	17	16	16	30	37	181
830013	3.5% C02	674	11	9	10	24	45	275
830021	AIR	787	-4	-4	-4	9	1	11
830021	100% 02	735	-4	-3	-4	-14	3	38
830021	2.5% C02	694	9	17	13	10	1	125
830021	3.5% C02	684	7	2	4	5	25	89
830025	AIR	713	5	6	5	22	3	38
830025	100% 02	848	3	10	7	15	.	.
830025	2.5% C02	722	8	11	10	23	.	.
830025	3.5% C02	650	3	5	4	6	-2	144
850001	AIR	619	6	6	6	13	45	-27
850001	100% 02	645	15	17	16	15	-19	83
850001	2.5% C02	582	5	24	14	11	13	196
850001	3.5% C02	638	13	20	16	18	-11	290
850005	AIR	632	6	13	10	13	22	7
850005	100% 02	610	-1	5	2	-2	-3	94
850005	2.5% C02	601	-4	-8	-6	13	7	-20
850005	3.5% C02	593	-2	12	5	-2	11	50
850013	AIR	720	6	0	3	18	-5	21
850013	100% 02	748	7	10	8	9	-10	25
850013	2.5% C02	827	6	20	13	15	13	138
850013	3.5% C02	727	7	23	15	16	-7	134

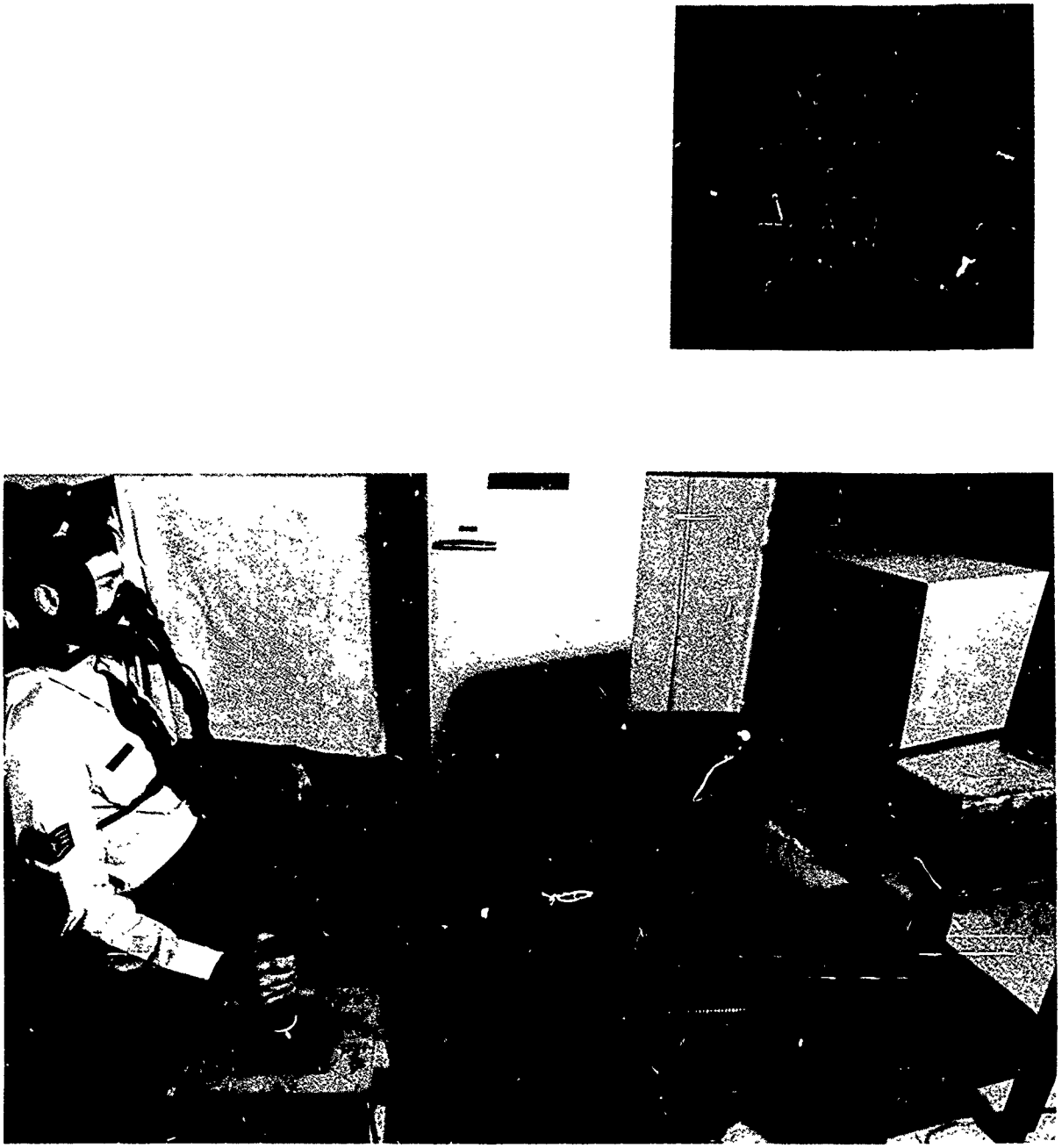

FIGURE 2. Photo of Test Setup & Tracking Task

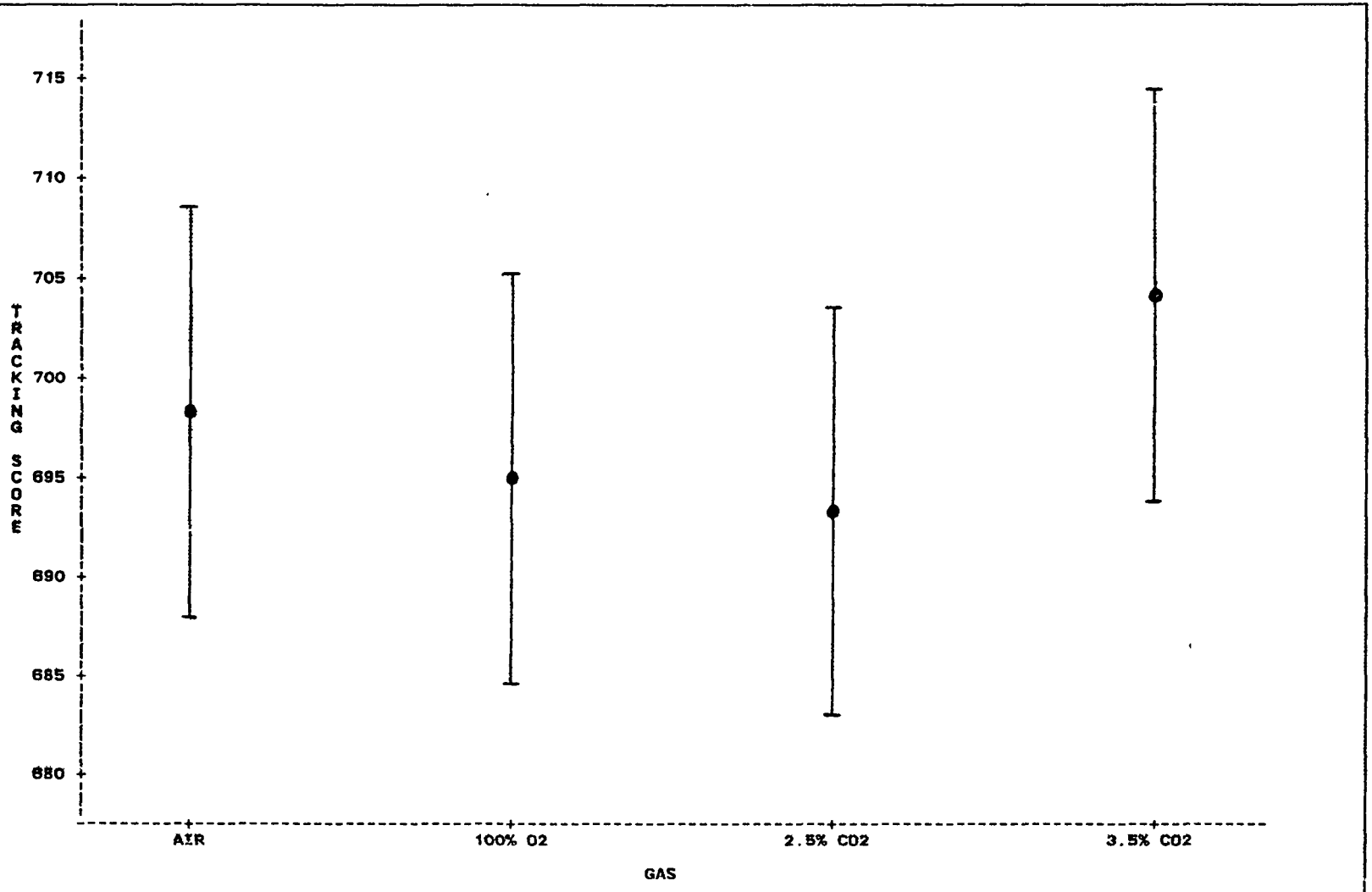

FIG. 3. MEAN TRACKING SCORES (WITH APPROXIMATE 95% CONFIDENCE INTERVALS, N=7).

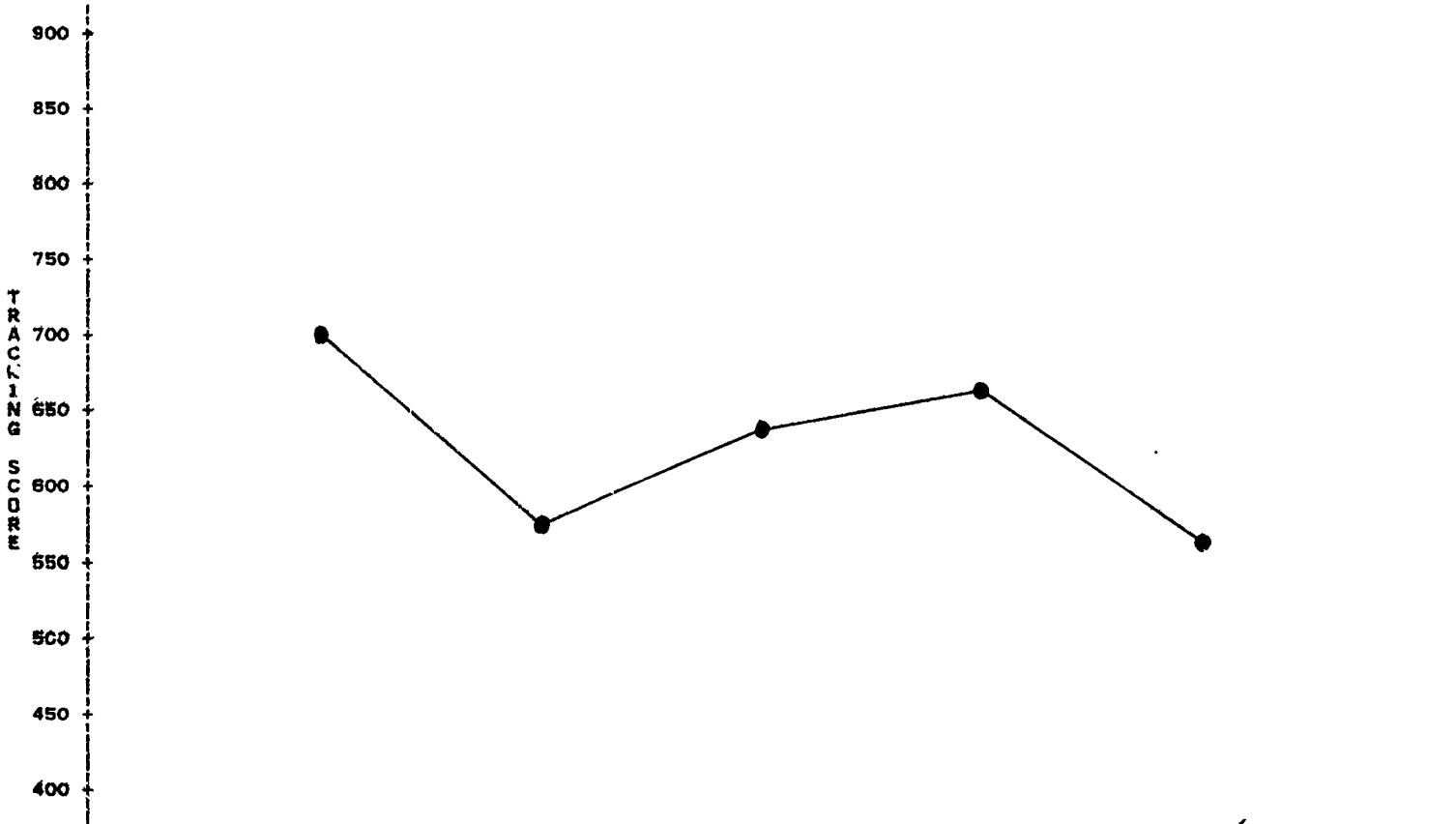

FIG. 4. TRACKING SCORES OF SUBJECT 830011 UP TO THE TIME OF ABORT WHEN BREATHING 3.5% CO2.

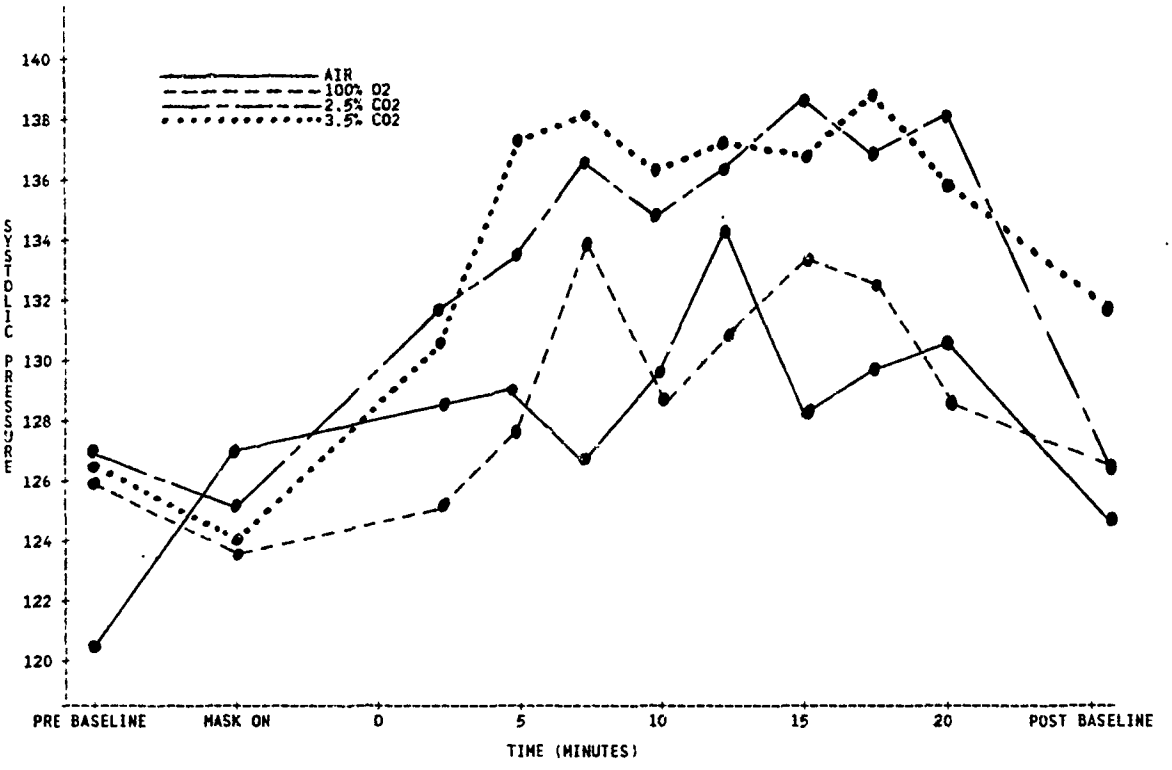

FIG. 5. MEAN SYSTOLIC BLOOD PRESSURE (MM HG,, N=7.

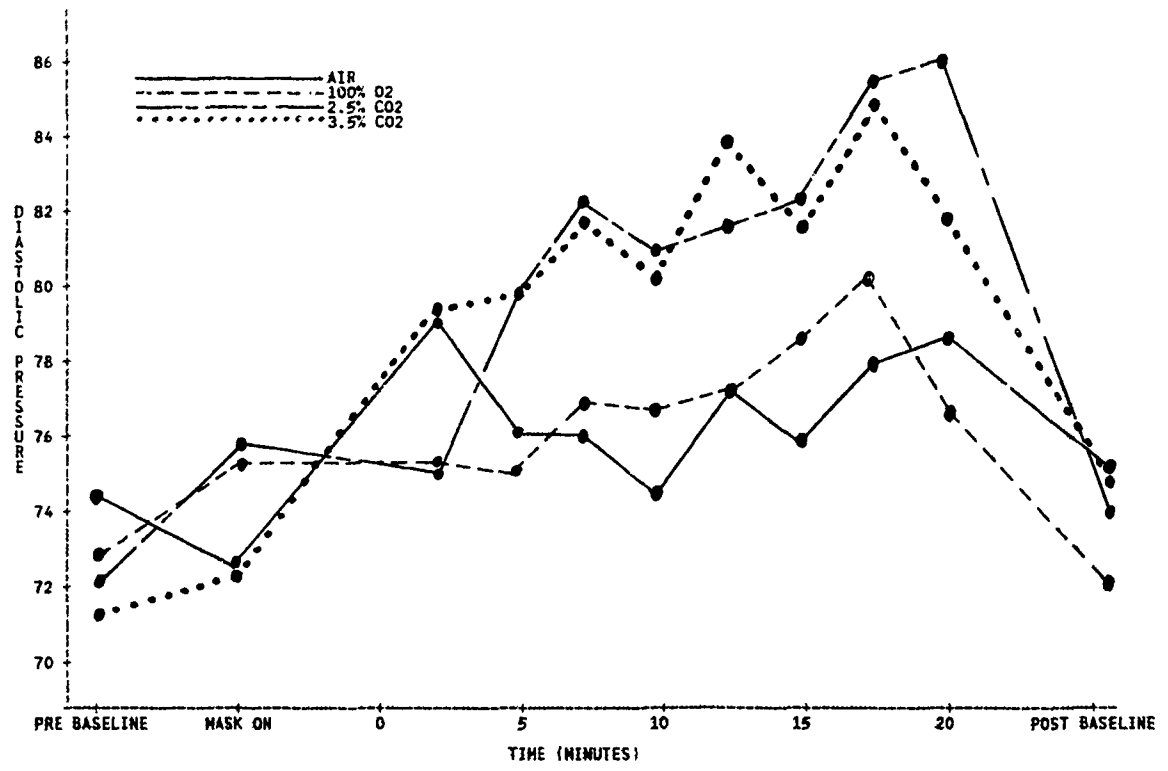

FIG. 6. MEAN DIASTOLIC BLOOD PRESSURE (MM HG), N=7.

APPENDIX

The appendix contains all data for all subjects and conditions. In Tables 1A thru 8A the blood pressure values are expressed in mm Hg, heart rate in beats per minute, and respiratory rate in breaths per minute. The following experimental design was used:

	DAY				
	1		2		
SUBJECT	1	2	1	2	
1	A	B	D	C	
2	B	C	A	D	
3	C	D	B	A	
4	D	A	C	B	CONDITIONS
5	B	D	C	A	
6	D	B	A	C	
7	A	C	D	B	
8	C	A	B	D	

A = 100% O_2

B = 97.48% O_2; 2.52% CO_2

C = 96.47% O_2; 3.53% CO_2

D = Air

TABLE 1A - DATA FOR SUBJECT 830008

SUBJECT=830008 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	112	74	87	42	20	2
PRE BASELINE	-18.0	.	.	.	.	21	2
MASK ON	-11.0	.	.	.	.	.	.
MASK ON	-8.0	.	.	.	.	16	3
TRACKING	2.0	131	79	96	.	20	5
TRACKING	4.5	139	73	95	45	19	5
TRACKING	7.0	145	76	99	48	19	5
TRACKING	9.5	143	78	100	49	20	5
TRACKING	12.0	142	67	92	47	20	5
TRACKING	14.5	140	80	100	49	21	4
TRACKING	17.0	142	80	101	47	20	5
TRACKING	19.5	.	.	.	.	19	4
POST BASELINE	26.0	134	83	100	40	19	3
POST BASELINE	29.0	146	75	99	40	18	3

SUBJECT=830008 GAS=100% O2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	139	76	97	40	20	2
PRE BASELINE	-18.0	125	82	96	58	19	2
MASK ON	-11.0	.	.	.	.	15	2
MASK ON	-8.0	134	89	104	40	17	2
TRACKING	2.0	118	73	88	.	19	4
TRACKING	4.5	130	80	97	64	22	4
TRACKING	7.0	140	79	99	62	22	5
TRACKING	9.5	125	88	100	68	18	4
TRACKING	12.0	139	71	94	58	19	5
TRACKING	14.5	137	88	104	57	21	4
TRACKING	17.0	147	86	106	55	19	4
TRACKING	19.5	131	80	97	62	21	5
POST BASELINE	26.0	138	76	97	41	18	2
POST BASELINE	29.0	123	69	87	42	18	2

SUBJECT=830008 GAS=2.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	136	78	97	43	22	2
PRE BASELINE	-18.0	129	74	92	44	21	2
MASK ON	-11.0	134	85	101	42	19	3
MASK ON	-8.0	.	.	.	.	18	3
TRACKING	2.0	134	79	97	44	22	5
TRACKING	4.5	148	75	99	55	22	5
TRACKING	7.0	136	88	104	56	19	5
TRACKING	9.5	142	85	104	50	21	7
TRACKING	12.0	145	93	110	53	24	7
TRACKING	14.5	139	93	108	49	23	5
TRACKING	17.0	147	91	110	45	24	5
TRACKING	19.5	.	.	.	.	20	6
POST BASELINE	26.0	115	81	92	41	20	2
POST BASELINE	29.0	135	78	97	43	21	2

SUBJECT=830008 GAS=3.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	128	65	86	54	21	2
PRE BASELINE	-18.0	129	66	87	54	21	2
MASK ON	-11.0	131	57	82	53	14	4
MASK ON	-8.0	106	75	85	46	18	5
TRACKING	2.0	129	81	97	67	23	6
TRACKING	4.5	145	81	102	67	26	7
TRACKING	7.0	146	88	107	65	26	7
TRACKING	9.5	143	87	106	62	24	7
TRACKING	12.0	145	98	114	70	24	7
TRACKING	14.5	150	84	106	61	25	7
TRACKING	17.0	147	97	114	62	25	8
TRACKING	19.5	147	86	106	60	24	7
POST BASELINE	26.0	147	69	95	41	21	4
POST BASELINE	29.0	137	70	92	40	18	4

TABLE 2A - DATA FOR SUBJECT 830011

SUBJECT=830011 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	121	68	86	61	.	.
PRE BASELINE	-18.0	120	65	83	56	19	2
MASK ON	-11.0	125	76	92	62	16	3
MASK ON	-8.0	126	62	83	60	17	3
TRACKING	2.0	125	80	95	76	21	4
TRACKING	4.5	113	76	88	78	19	4
TRACKING	7.0	132	79	97	78	18	4
TRACKING	9.5	129	76	94	71	20	4
TRACKING	12.0	128	77	94	68	19	4
TRACKING	14.5	117	61	80	78	20	4
TRACKING	17.0	129	76	94	71	19	3
TRACKING	19.5	123	76	92	66	17	4
POST BASELINE	26.0	.	.	.	.	.	.
POST BASELINE	29.0	126	74	91	71	17	3

SUBJECT=830011 GAS=SECOND AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	110	65	80	67	20	5
PRE BASELINE	-18.0	114	67	83	64	20	5
MASK ON	-11.0	128	66	87	69	15	6
MASK ON	-8.0	111	69	83	67	18	6
TRACKING	2.0	128	70	89	70	19	8
TRACKING	4.5	125	87	100	82	19	8
TRACKING	7.0	124	73	90	79	19	8
TRACKING	9.5	114	62	79	80	20	7
TRACKING	12.0	117	77	90	88	20	6
TRACKING	14.5	131	78	96	77	21	6
TRACKING	17.0	.	.	.	.	21	6
TRACKING	19.5	.	.	.	.	18	6
POST BASELINE	26.0	120	74	89	84	21	3
POST BASELINE	29.0	102	74	83	73	21	4

SUBJECT=830011 GAS=2.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	115	71	86	62	.	.
PRE BASELINE	-18.0	.	.	.	69	20	2
MASK ON	-11.0	.	.	.	60	17	5
MASK ON	-8.0	126	54	78	55	15	5
TRACKING	2.0	.	.	.	.	20	4
TRACKING	4.5	118	63	81	71	19	3
TRACKING	7.0	126	75	92	66	20	4
TRACKING	9.5	122	70	87	66	22	3
TRACKING	12.0	128	74	92	66	21	4
TRACKING	14.5	127	72	90	63	20	3
TRACKING	17.0	.	.	.	70	.	.
TRACKING	19.5	115	70	85	69	20	5
POST BASELINE	26.0	.	.	.	.	21	2
POST BASELINE	29.0	121	71	88	60	20	2

SUBJECT=830011 GAS=3.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	116	65	82	69	21	6
PRE BASELINE	-18.0	111	75	87	77	21	5
MASK ON	-11.0	117	51	73	76	.	.
MASK ON	-8.0	131	82	98	72	20	9
TRACKING	2.0	.	.	.	.	22	8
TRACKING	4.5	.	.	.	.	.	.
TRACKING	7.0	.	.	.	.	.	.
TRACKING	9.5	.	.	.	.	.	.
TRACKING	12.0	.	.	.	.	.	.
TRACKING	14.5	.	.	.	.	.	.
TRACKING	17.0	.	.	.	.	.	.
TRACKING	19.5	.	.	.	.	.	.
POST BASELINE	26.0	.	.	.	.	.	.
POST BASELINE	29.0	.	.	.	.	.	.

TABLE 3A - DATA FOR SUBJECT 830013

SUBJECT=830013 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	118	76	90	66	16	4
PRE BASELINE	-18.0	123	80	94	73	14	4
MASK ON	-11.0	125	78	94	66	12	5
MASK ON	-8.0	123	73	90	71	11	7
TRACKING	2.0	134	81	99	84	21	12
TRACKING	4.5	133	79	97	82	19	11
TRACKING	7.0	117	78	91	84	20	10
TRACKING	9.5	127	76	93	84	21	10
TRACKING	12.0	132	78	96	87	22	11
TRACKING	14.5	134	74	94	91	22	11
TRACKING	17.0	130	81	97	91	21	12
TRACKING	19.5	121	82	95	84	21	11
POST BASELINE	26.0	132	83	99	73	17	5
POST BASELINE	29.0	115	79	91	70	12	4

SUBJECT=830013 GAS=100% O2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	132	78	96	73	11	4
PRE BASELINE	-18.0	122	79	93	71	13	4
MASK ON	-11.0	120	76	91	63	12	4
MASK ON	-8.0	123	75	91	69	15	5
TRACKING	2.0	122	79	93	79	21	8
TRACKING	4.5	126	81	96	76	21	8
TRACKING	7.0	137	76	96	91	21	10
TRACKING	9.5	130	72	91	81	20	10
TRACKING	12.0	133	79	97	79	19	8
TRACKING	14.5	137	78	98	79	20	8
TRACKING	17.0	133	80	98	77	18	8
TRACKING	19.5	137	81	100	80	21	9
POST BASELINE	26.0	132	72	92	67	18	4
POST BASELINE	29.0	120	72	88	73	18	3

SUBJECT=830013 GAS=2.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	127	73	91	65	14	4
PRE BASELINE	-18.0	124	76	92	73	16	4
MASK ON	-11.0	134	79	97	69	11	6
MASK ON	-8.0	124	77	93	71	12	7
TRACKING	2.0	138	73	95	92	20	10
TRACKING	4.5	144	72	96	92	21	10
TRACKING	7.0	155	96	116	98	20	11
TRACKING	9.5	149	91	110	87	21	12
TRACKING	12.0	150	85	107	90	22	11
TRACKING	14.5	151	90	110	95	21	13
TRACKING	17.0	150	93	112	81	20	12
TRACKING	19.5	138	90	106	83	20	11
POST BASELINE	26.0	134	77	96	81	19	5
POST BASELINE	29.0	137	79	98	73	14	4

SUBJECT=830013 GAS=3.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	128	81	97	73	14	4
PRE BASELINE	-18.0	134	77	96	72	16	4
MASK ON	-11.0	131	80	97	71	11	5
MASK ON	-8.0	143	85	104	70	11	6
TRACKING	2.0	143	93	110	91	.	.
TRACKING	4.5	141	89	106	93	.	.
TRACKING	7.0	145	85	105	85	21	14
TRACKING	9.5	149	87	108	84	.	.
TRACKING	12.0	146	82	103	93	.	.
TRACKING	14.5	143	82	102	97	22	15
TRACKING	17.0	146	84	105	89	22	15
TRACKING	19.5	150	87	108	88	22	16
POST BASELINE	26.0	135	86	102	80	19	7
POST BASELINE	29.0	144	84	104	76	18	4

TABLE 4A - DATA FOR SUBJECT 830021

SUBJECT=830021 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	121	81	94	82	14	4
PRE BASELINE	-18.0	125	75	92	86	.	.
MASK ON	-11.0	129	77	94	78	11	4
MASK ON	-8.0	118	75	89	79	.	.
TRACKING	2.0	120	83	95	91	15	5
TRACKING	4.5	123	73	90	86	15	4
TRACKING	7.0	106	68	81	86	12	4
TRACKING	9.5	111	69	83	86	14	5
TRACKING	12.0	130	80	97	102	14	4
TRACKING	14.5	113	71	85	88	14	4
TRACKING	17.0	113	80	91	100	.	.
TRACKING	19.5	132	76	95	94	15	5
POST BASELINE	26.0	123	70	88	79	11	4
POST BASELINE	29.0	114	72	86	77	17	4

SUBJECT=830021 GAS=100% O2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	133	75	94	95	.	.
PRE BASELINE	-18.0	140	82	101	98	13	4
MASK ON	-11.0	124	81	95	70	.	.
MASK ON	-8.0	125	76	92	79	13	5
TRACKING	2.0	.	.	.	.	.	.
TRACKING	4.5	139	73	95	85	.	.
TRACKING	7.0	128	79	95	87	13	5
TRACKING	9.5	121	77	92	79	12	6
TRACKING	12.0	129	83	98	83	13	5
TRACKING	14.5	130	76	94	85	14	6
TRACKING	17.0	136	80	99	85	16	5
TRACKING	19.5	131	65	87	78	12	6
POST BASELINE	26.0	130	81	97	76	11	3
POST BASELINE	29.0	136	83	101	74	.	.

SUBJECT=830021 GAS=2.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	123	70	88	90	19	3
PRE BASELINE	-18.0	133	74	94	87	18	2
MASK ON	-11.0	125	73	90	85	11	4
MASK ON	-8.0	133	78	96	86	16	3
TRACKING	2.0	138	79	99	93	19	7
TRACKING	4.5	141	84	103	92	19	5
TRACKING	7.0	138	83	101	98	19	4
TRACKING	9.5	136	80	99	98	18	4
TRACKING	12.0	139	83	102	99	19	5
TRACKING	14.5	150	89	109	97	18	8
TRACKING	17.0	134	89	104	98	19	6
TRACKING	19.5	140	85	103	102	18	6
POST BASELINE	26.0	138	83	101	97	18	3
POST BASELINE	29.0	131	78	96	88	18	2

SUBJECT=830021 GAS=3.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	125	85	98	100	15	4
PRE BASELINE	-18.0	134	84	101	94	18	3
MASK ON	-11.0	129	84	99	91	12	3
MASK ON	-8.0	132	87	102	91	15	4
TRACKING	2.0	127	89	102	95	20	5
TRACKING	4.5	148	79	102	100	23	8
TRACKING	7.0	142	86	105	108	20	8
TRACKING	9.5	140	78	99	94	18	6
TRACKING	12.0	136	91	106	103	22	6
TRACKING	14.5	145	86	106	100	21	6
TRACKING	17.0	135	96	109	106	22	7
TRACKING	19.5	138	83	101	105	19	7
POST BASELINE	26.0	132	79	97	103	19	4
POST BASELINE	29.0	138	80	99	98	15	3

TABLE 5A - DATA FOR SUBJECT 830025

SUBJECT=830025 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	125	72	90	62	20	5
PRE BASELINE	-18.0	120	78	93	60	22	5
MASK ON	-11.0	131	74	93	68	22	7
MASK ON	-8.0	.	.	.	.	21	8
TRACKING	2.0	127	84	98	80	21	8
TRACKING	4.5	132	82	99	70	21	6
TRACKING	7.0	127	78	94	72	21	7
TRACKING	9.5	132	82	99	79	22	7
TRACKING	12.0	135	80	98	75	21	7
TRACKING	14.5	129	76	94	71	22	7
TRACKING	17.0	129	78	95	70	23	6
TRACKING	19.5	136	79	98	77	22	7
POST BASELINE	26.0	129	73	92	61	16	3
POST BASELINE	29.0	120	77	91	64	17	4

SUBJECT=830025 GAS=100% O2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	131	73	92	66	.	.
PRE BASELINE	-18.0	120	73	89	61	.	.
MASK ON	-11.0	131	80	97	62	.	.
MASK ON	-8.0	.	.	.	.	.	.
TRACKING	2.0	130	80	97	66	.	.
TRACKING	4.5	128	78	95	71	.	.
TRACKING	7.0	139	82	101	73	.	.
TRACKING	9.5	138	79	99	72	.	.
TRACKING	12.0	124	78	93	76	.	.
TRACKING	14.5	124	80	95	75	.	.
TRACKING	17.0	128	82	97	73	.	.
TRACKING	19.5	127	81	96	76	.	.
POST BASELINE	26.0	130	66	87	64	.	.
POST BASELINE	29.0	121	73	89	66	.	.

SUBJECT=830025 GAS=2.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	120	60	80	55	.	.
PRE BASELINE	-18.0	120	82	95	61	.	.
MASK ON	-11.0	116	70	85	56	.	.
MASK ON	-8.0	136	75	95	61	.	.
TRACKING	2.0	127	78	94	69	.	.
TRACKING	4.5	122	84	97	62	.	.
TRACKING	7.0	123	80	94	75	.	.
TRACKING	9.5	131	78	96	69	.	.
TRACKING	12.0	133	80	98	74	.	.
TRACKING	14.5	129	75	93	72	.	.
TRACKING	17.0	133	77	96	75	.	.
TRACKING	19.5	136	79	98	73	.	.
POST BASELINE	26.0	114	67	83	64	.	.
POST BASELINE	29.0	112	72	85	61	.	.

SUBJECT=830025 GAS=3.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	128	73	91	65	24	6
PRE BASELINE	-18.0	.	.	.	.	.	.
MASK ON	-11.0	126	68	87	67	17	9
MASK ON	-8.0	125	74	91	62	22	14
TRACKING	2.0	131	76	94	69	22	14
TRACKING	4.5	135	80	98	73	22	15
TRACKING	7.0	129	79	96	71	24	15
TRACKING	9.5	131	76	94	66	24	15
TRACKING	12.0	135	81	99	72	24	15
TRACKING	14.5	132	75	94	70	24	15
TRACKING	17.0	140	82	101	68	24	14
TRACKING	19.5	126	65	85	69	24	14
POST BASELINE	25.0	124	77	93	61	24	6
POST BASELINE	29.0	122	76	91	60	19	6

TABLE 6A - DATA FOR SUBJECT 850001

SUBJECT=850001 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	141	86	104	76	.	.
PRE BASELINE	-18.0	140	86	104	76	14	7
MASK ON	-11.0	140	77	98	72	9	7
MASK ON	-8.0	135	75	95	75	9	8
TRACKING	2.0	.	.	.	.	21	6
TRACKING	4.5	142	85	104	89	21	6
TRACKING	7.0	142	97	112	84	21	5
TRACKING	9.5	154	91	112	84	.	5
TRACKING	12.0	159	99	119	91	19	5
TRACKING	14.5	141	90	107	84	21	5
TRACKING	17.0	153	86	108	83	19	4
TRACKING	19.5	155	91	112	85	20	5
POST BASELINE	26.0	.	.	.	.	.	.
POST BASELINE	29.0	.	.	.	.	.	.

SUBJECT=850001 GAS=100% O2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	133	76	95	74	18	3
PRE BASELINE	-18.0	131	74	93	73	.	.
MASK ON	-11.0	139	82	101	71	11	6
MASK ON	-8.0	138	79	99	73	12	5
TRACKING	2.0	150	81	104	78	15	6
TRACKING	4.5	148	83	105	85	15	6
TRACKING	7.0	157	82	107	88	13	5
TRACKING	9.5	147	91	110	88	15	6
TRACKING	12.0	151	87	108	84	.	.
TRACKING	14.5	158	93	115	86	.	.
TRACKING	17.0	151	93	112	84	15	5
TRACKING	19.5	151	93	112	82	14	5
POST BASELINE	26.0	134	76	95	71	.	.
POST BASELINE	29.0	137	78	98	75	18	3

SUBJECT=850001 GAS=2.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	155	76	102	73	19	3
PRE BASELINE	-18.0	138	71	93	68	18	3
MASK ON	-11.0	136	79	98	66	14	6
MASK ON	-8.0	.	.	.	.	15	6
TRACKING	2.0	145	83	104	79	21	8
TRACKING	4.5	147	94	112	76	21	9
TRACKING	7.0	158	90	113	79	20	9
TRACKING	9.5	148	85	106	75	21	10
TRACKING	12.0	151	91	111	82	21	10
TRACKING	14.5	156	93	114	80	21	9
TRACKING	17.0	160	90	113	79	21	8
TRACKING	19.5	164	102	123	77	21	8
POST BASELINE	26.0	.	.	.	.	.	.
POST BASELINE	29.0	139	75	96	73	21	3

SUBJECT=850001 GAS=3.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	132	78	96	68	19	3
PRE BASELINE	-18.0	137	75	96	73	21	2
MASK ON	-11.0	132	81	98	77	10	9
MASK ON	-8.0	136	87	103	67	11	9
TRACKING	2.0	142	86	105	72	18	8
TRACKING	4.5	148	83	105	78	17	9
TRACKING	7.0	146	91	109	87	17	9
TRACKING	9.5	159	95	116	83	18	10
TRACKING	12.0	164	84	111	81	18	11
TRACKING	14.5	143	100	114	88	18	11
TRACKING	17.0	161	92	115	88	18	10
TRACKING	19.5	148	101	117	87	18	10
POST BASELINE	26.0	148	89	109	78	18	3
POST BASELINE	29.0	138	79	99	72	21	2

TABLE 7A - DATA FOR SUBJECT 850005

SUBJECT=850005 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	114	59	77	53	15	3
PRE BASELINE	-18.0	110	57	75	47	17	4
MASK ON	-11.0	119	65	83	48	20	4
MASK ON	-8.0	121	59	80	47	19	6
TRACKING	2.0	.	.	.	.	19	5
TRACKING	4.5	115	71	86	53	20	5
TRACKING	7.0	120	66	84	54	20	5
TRACKING	9.5	121	60	80	58	19	3
TRACKING	12.0	125	63	84	55	19	3
TRACKING	14.5	120	62	81	58	19	3
TRACKING	17.0	121	69	86	56	20	3
TRACKING	19.5	112	69	83	62	20	3
POST BASELINE	26.0	.	.	.	.	.	.
POST BASELINE	29.0	.	.	.	.	.	.

SUBJECT=850005 GAS=100% 02

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	117	58	78	57	.	.
PRE BASELINE	-18.0	119	62	81	59	19	2
MASK ON	-11.0	109	58	75	52	18	5
MASK ON	-8.0	103	66	78	51	20	5
TRACKING	2.0	123	63	83	55	18	4
TRACKING	4.5	113	61	78	54	19	4
TRACKING	7.0	117	67	84	56	18	5
TRACKING	9.5	115	63	80	59	18	4
TRACKING	12.0	119	67	84	58	19	4
TRACKING	14.5	122	59	80	59	19	4
TRACKING	17.0	112	65	81	55	18	3
TRACKING	19.5	115	59	78	59	18	3
POST BASELINE	26.0	126	81	96	60	.	.
POST BASELINE	29.0	109	56	74	57	.	.

SUBJECT=850005 GAS=2.5% C02

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	120	70	87	49	18	3
PRE BASELINE	-18.0	117	71	86	49	20	2
MASK ON	-11.0	104	72	83	52	20	3
MASK ON	-8.0	110	67	81	46	20	2
TRACKING	2.0	.	.	.	.	20	2
TRACKING	4.5	116	64	81	55	22	2
TRACKING	7.0	115	65	82	54	20	2
TRACKING	9.5	114	63	80	55	20	2
TRACKING	12.0	107	64	78	57	20	2
TRACKING	14.5	119	61	80	56	20	2
TRACKING	17.0	106	64	78	55	21	2
TRACKING	19.5	118	71	87	57	20	2
POST BASELINE	26.0	118	61	80	56	.	.
POST BASELINE	29.0	104	73	83	53	20	3

SUBJECT=850005 GAS=3.5% C02

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	.	.	.	.	19	3
PRE BASELINE	-18.0	119	59	79	56	19	3
MASK ON	-11.0	116	50	72	61	16	4
MASK ON	-8.0	104	51	69	51	18	5
TRACKING	2.0	114	57	76	50	20	5
TRACKING	4.5	117	67	84	50	20	4
TRACKING	7.0	123	68	86	50	20	4
TRACKING	9.5	112	61	78	53	22	4
TRACKING	12.0	116	75	89	60	22	5
TRACKING	14.5	119	64	82	58	22	4
TRACKING	17.0	114	65	81	58	21	5
TRACKING	19.5	117	71	86	57	21	5
POST BASELINE	26.0	117	61	80	54	.	.
POST BASELINE	29.0	110	59	76	64	18	3

TABLE 8A - DATA FOR SUBJECT 850013

SUBJECT=850013 GAS=AIR

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	116	73	87	54	16	3
PRE BASELINE	-18.0	109	69	82	58	16	4
MASK ON	-11.0	117	69	85	51	10	6
MASK ON	-8.0	.	.	.	.	.	.
TRACKING	2.0	115	73	87	67	15	4
TRACKING	4.5	118	69	85	68	15	4
TRACKING	7.0	128	70	89	66	15	4
TRACKING	9.5	120	66	84	66	15	4
TRACKING	12.0	119	74	89	64	15	4
TRACKING	14.5	119	75	90	66	16	4
TRACKING	17.0	119	71	87	66	15	5
TRACKING	19.5	.	.	.	.	16	5
POST BASELINE	26.0	111	65	80	56	12	7
POST BASELINE	29.0	110	68	82	57	11	5

SUBJECT=850013 GAS=100% O2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	107	66	80	57	17	3
PRE BASELINE	-18.0	113	65	81	57	17	3
MASK ON	-11.0	112	56	75	57	10	6
MASK ON	-8.0	109	68	82	62	10	6
TRACKING	2.0	107	71	83	57	15	4
TRACKING	4.5	110	67	81	64	15	4
TRACKING	7.0	120	73	89	64	16	4
TRACKING	9.5	124	66	85	64	16	4
TRACKING	12.0	121	73	89	62	15	4
TRACKING	14.5	126	75	92	58	15	4
TRACKING	17.0	122	74	90	67	15	3
TRACKING	19.5	108	75	86	61	15	3
POST BASELINE	26.0	120	61	81	60	11	6
POST BASELINE	29.0	118	64	82	59	11	5

SUBJECT=850013 GAS=2.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	117	66	83	62	14	4
PRE BASELINE	-18.0	116	65	82	62	14	4
MASK ON	-11.0	114	63	80	61	.	.
MASK ON	-8.0	115	74	88	60	.	.
TRACKING	2.0	121	74	90	69	15	10
TRACKING	4.5	114	84	94	75	16	10
TRACKING	7.0	132	72	92	74	15	10
TRACKING	9.5	123	80	94	69	16	10
TRACKING	12.0	127	71	90	67	17	9
TRACKING	14.5	124	74	91	76	16	9
TRACKING	17.0	125	93	104	67	16	9
TRACKING	19.5	122	80	94	75	16	9
POST BASELINE	26.0	134	65	88	67	18	5
POST BASELINE	29.0	114	64	81	61	18	4

SUBJECT=850013 GAS=3.5% CO2

CONDITION	APPROXIMATE TIME (MINUTES)	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MEAN ARTERIAL PRESSURE	HEART RATE	RESPIRATORY RATE	RELATIVE RESPIRATORY VOLUME
PRE BASELINE	-21.0	114	64	81	64	18	4
PRE BASELINE	-18.0	118	59	79	60	17	4
MASK ON	-11.0	108	66	80	59	11	8
MASK ON	-8.0	115	66	82	72	12	9
TRACKING	2.0	128	71	90	72	16	8
TRACKING	4.5	124	77	93	71	16	9
TRACKING	7.0	134	73	93	76	17	10
TRACKING	9.5	118	76	90	75	15	10
TRACKING	12.0	117	76	90	75	16	9
TRACKING	14.5	125	77	93	66	17	10
TRACKING	17.0	127	78	94	73	17	9
TRACKING	19.5	124	77	93	67	16	10
POST BASELINE	26.0	122	71	88	59	17	6
POST BASELINE	29.0	127	65	86	66	17	4

TABLE 9A - TRACKING SCORES

SUBJECT=830008

TRACKING TASK #	100% O2	2.5% CO2	3.5% CO2	AIR
1	643	763	757	910
2	659	670	950	826
3	735	892	.	709
4	690	669	744	659
5	750	780	909	931
6	762	617	1091	802
7	686	728	1197	842
8	809	844	825	800
9	679	675	904	691
10	852	737	1083	812
11	793	760	908	763
12	877	712	1001	716
13	820	790	860	660
14	689	767	913	689
15	835	815	1338	663
16	693	692	876	743
17	774	880	799	726
18	720	881	734	761
19	815	705	1198	655
20	773	660	.	933
21	800	634	818	866
22	781	764	1067	822
23	747	762	.	595
24	692	684	.	804
25	666	823	984	734
26	699	641	1385	681
27	734	721	1056	788
28	632	946	1198	740
29	642	823	.	652
30	610	648	1039	680

SUBJECT=830011

TRACKING TASK #	SECOND AIR	2.5% CO2	3.5% CO2	AIR
1	654	538	573	672
2	650	707	638	631
3	559	591	660	638
4	565	603	568	743
5	525	636	.	648
6	620	748	.	758
7	625	642	.	627
8	585	576	.	552
9	547	639	.	695
10	638	620	.	568
11	580	539	.	648
12	503	691	.	584
13	571	756	.	557
14	633	728	.	555
15	630	682	.	516
16	648	730	.	599
17	624	714	.	651
18	758	700	.	620
19	587	607	.	610
20	542	528	.	587
21	587	700	.	613
22	551	643	.	585
23	666	636	.	663
24	581	635	.	584
25	607	714	.	678
26	625	563	.	554
27	547	559	.	635
28	559	565	.	583
29	642	620	.	626
30	594	626	.	588

TABLE 10A - TRACKING SCORES

SUBJECT=830013

TRACKING TASK #	100% O2	2.5% CO2	3.5% CO2	AIR
1	551	670	675	645
2	666	738	800	601
3	560	691	708	696
4	623	639	695	761
5	575	559	663	632
6	552	608	683	622
7	620	607	721	638
8	606	612	685	693
9	561	540	636	648
10	548	588	654	686
11	567	696	630	658
12	588	572	841	708
13	639	637	730	641
14	704	601	588	617
15	694	650	711	624
16	585	568	583	706
17	618	603	.	705
18	657	678	655	627
19	595	531	682	710
20	560	600	634	618
21	552	551	669	665
22	666	621	649	621
23	573	725	681	633
24	592	586	687	609
25	566	648	656	624
26	606	549	674	606
27	551	666	663	609
28	646	652	640	684
29	603	647	605	654
30	583	630	661	681

SUBJECT=830021

TRACKING TASK #	100% O2	2.5% CO2	3.5% CO2	AIR
1	868	708	670	892
2	816	769	706	647
3	773	769	680	865
4	783	633	666	872
5	736	676	750	887
6	734	692	639	815
7	703	647	672	1070
8	745	664	677	845
9	758	718	650	703
10	659	781	739	757
11	710	711	727	944
12	682	748	691	918
13	699	664	.	827
14	740	708	704	818
15	687	677	744	700
16	752	662	700	756
17	625	780	665	793
18	651	788	753	946
19	727	874	669	700
20	846	684	646	692
21	858	662	669	756
22	626	591	645	748
23	722	609	686	715
24	794	613	635	684
25	758	615	680	681
26	796	624	698	853
27	821	672	658	737
28	643	770	687	665
29	647	663	656	649
30	682	641	677	686

TABLE 11A - TRACKING SCORES

SUBJECT=830025

TRACKING TASK #	100% O2	2.5% CO2	3.5% CO2	AIR
1	807	691	642	697
2	969	797	727	688
3	823	794	636	829
4	1040	798	602	786
5	1145	781	549	802
6	1234	721	596	692
7	901	765	693	747
8	856	782	611	667
9	762	757	641	671
10	863	806	701	742
11	919	616	684	756
12	764	592	633	780
13	882	642	606	727
14	850	782	737	653
15	862	759	659	744
16	869	820	624	684
17	821	789	654	681
18	814	642	609	852
19	803	711	689	713
20	738	650	655	640
21	850	719	626	674
22	748	685	714	688
23	830	674	720	664
24	680	746	633	731
25	857	707	648	687
26	764	744	628	675
27	768	666	626	723
28	642	662	703	725
29	715	626	628	606
30	864	736	623	656

SUBJECT=850001

TRACKING TASK #	100% O2	2.5% CO2	3.5% CO2	AIR
1	605	560	618	692
2	656	550	687	588
3	768	575	608	755
4	603	57[illegible]	605	661
5	668	592	632	656
6	599	562	648	610
7	688	580	654	653
8	638	537	661	614
9	604	561	654	584
10	745	555	623	649
11	597	606	652	646
12	613	543	578	583
13	647	629	619	612
14	585	587	684	583
15	733	515	680	621
16	708	525	621	613
17	647	565	652	675
18	599	498	574	584
19	691	587	669	554
20	616	587	687	602
21	653	638	621	552
22	616	628	554	631
23	597	598	639	633
24	710	575	663	561
25	643	640	612	625
26	610	643	708	598
27	657	636	607	619
28	644	615	607	577
29	614	599	624	628
30	704	610	707	604

TABLE 12A - TRACKING SCORES

SUBJECT=850005

TRACKING TASK #	100% O2	2.5% CO2	3.5% CO2	AIR
1	634	621	625	669
2	675	579	646	675
3	621	656	629	642
4	604	618	577	597
5	584	591	607	688
6	553	659	607	623
7	581	656	614	689
8	598	614	581	612
9	604	549	518	728
10	686	573	607	637
11	537	555	569	618
12	582	598	554	594
13	650	622	611	624
14	586	662	630	664
15	633	553	581	594
16	602	600	602	612
17	591	611	574	658
18	615	588	571	633
19	577	611	590	600
20	564	574	587	526
21	610	582	554	619
22	617	602	602	704
23	608	585	606	607
24	622	621	647	611
25	662	640	640	623
26	618	530	570	622
27	625	549	581	611
28	600	615	558	642
29	616	544	579	607
30	583	667	572	640

SUBJECT=850013

TRACKING TASK #	100% O2	2.5% CO2	3.5% CO2	AIR
1	761	946	900	803
2	790	739	614	763
3	816	870	682	847
4	658	867	625	750
5	807	1009	684	673
6	735	831	670	628
7	718	970	730	709
8	840	804	776	615
9	723	773	699	696
10	800	943	812	639
11	782	784	738	707
12	769	745	692	723
13	727	811	660	665
14	719	754	742	688
15	713	938	746	752
16	892	905	778	764
17	636	880	752	776
18	734	1030	745	725
19	682	905	677	675
20	643	796	734	723
21	771	692	794	766
22	722	717	625	730
23	701	635	845	851
24	775	984	740	658
25	784	669	751	726
26	753	801	645	705
27	697	724	754	681
28	711	691	772	728
29	834	714	670	684
30	746	872	566	742

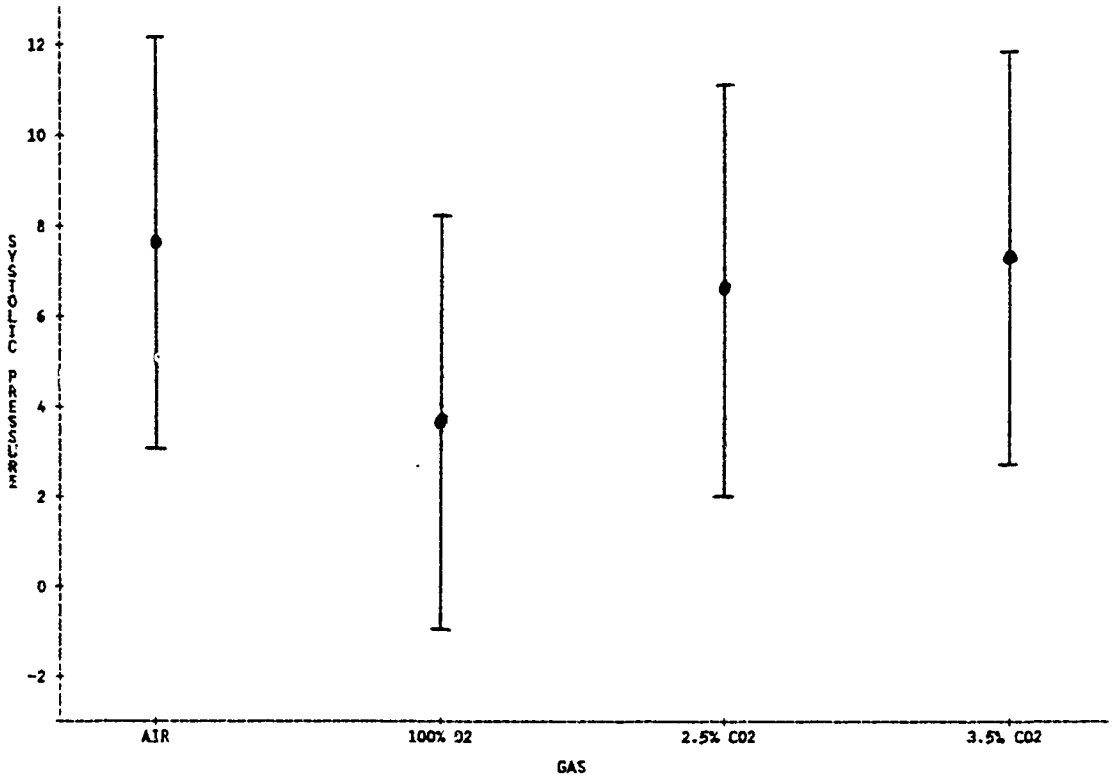

FIG. 1A. APPROXIMATE 95% CONFIDENCE INTERVALS FOR SYSTOLIC BLOOD PRESSURE MEAN PERCENT CHANGE FROM PRE BASELINE DURING 30 TASKS (N=7).

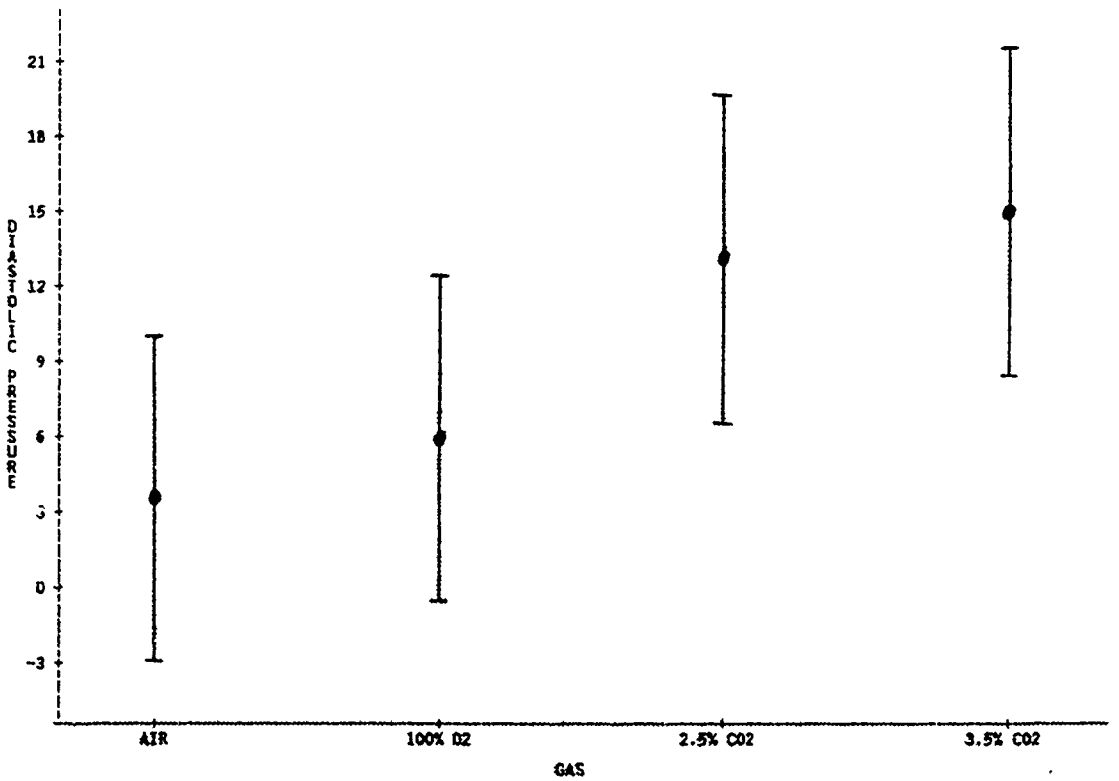

FIG. 2A. APPROXIMATE 95% CONFIDENCE INTERVALS FOR DIASTOLIC BLOOD PRESSURE MEAN PERCENT CHANGE FROM PRE BASELINE DURING 30 TASKS (N=7).

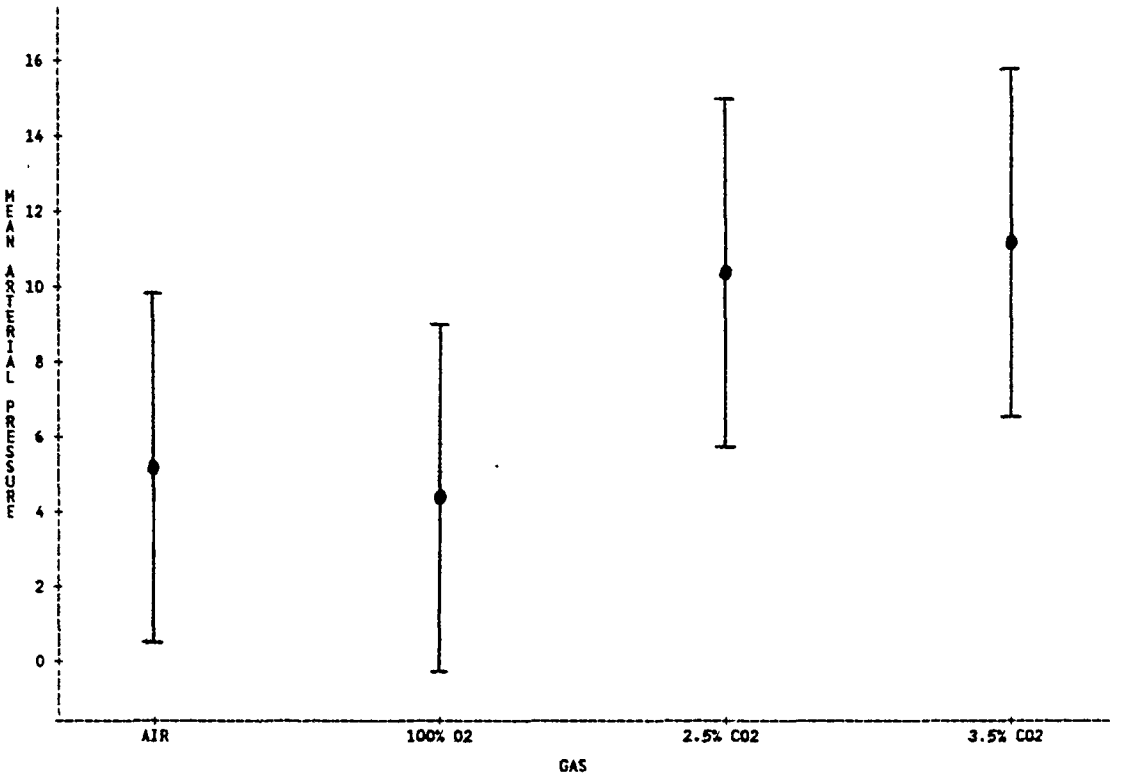

FIG. 3A. APPROXIMATE 95% CONFIDENCE INTERVALS FOR MEAN ARTERIAL PRESSURE MEAN PERCENT CHANGE FROM PRE BASELINE DURING 30 TASKS (N=7).

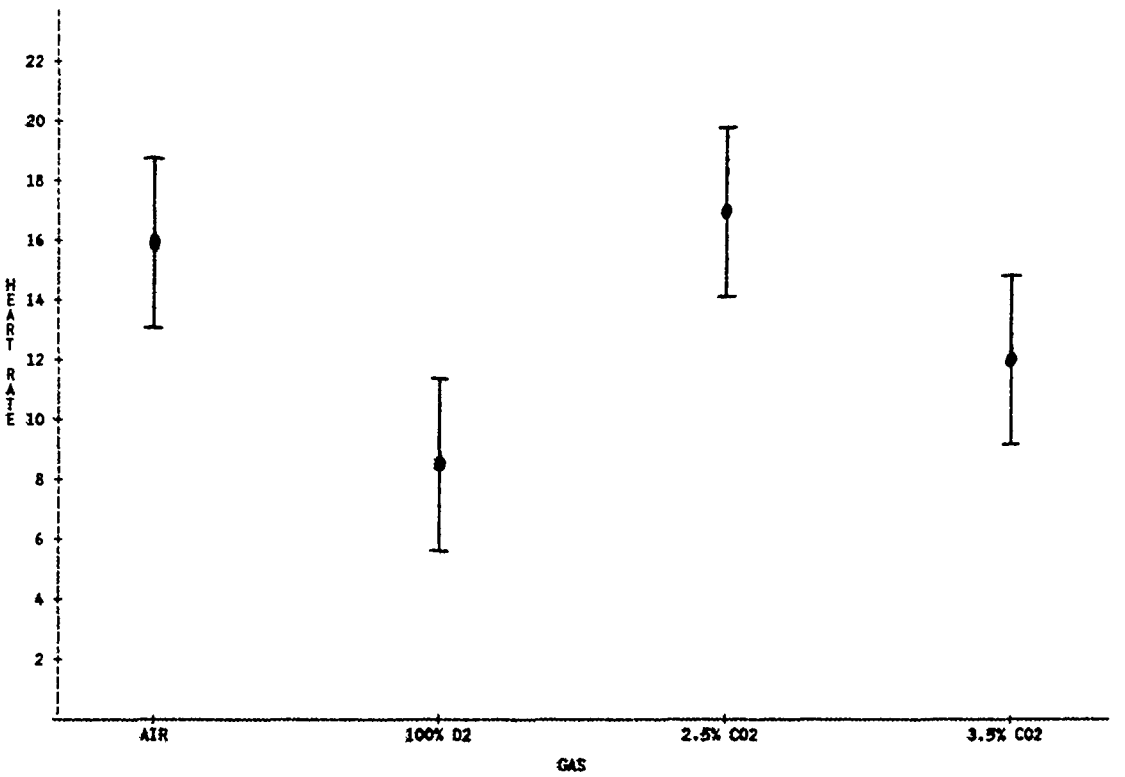

FIG. 4A. APPROXIMATE 95% CONFIDENCE INTERVALS FOR HEART RATE MEAN PERCENT CHANGE FROM PRE BASELINE DURING 30 TASKS (N=7).

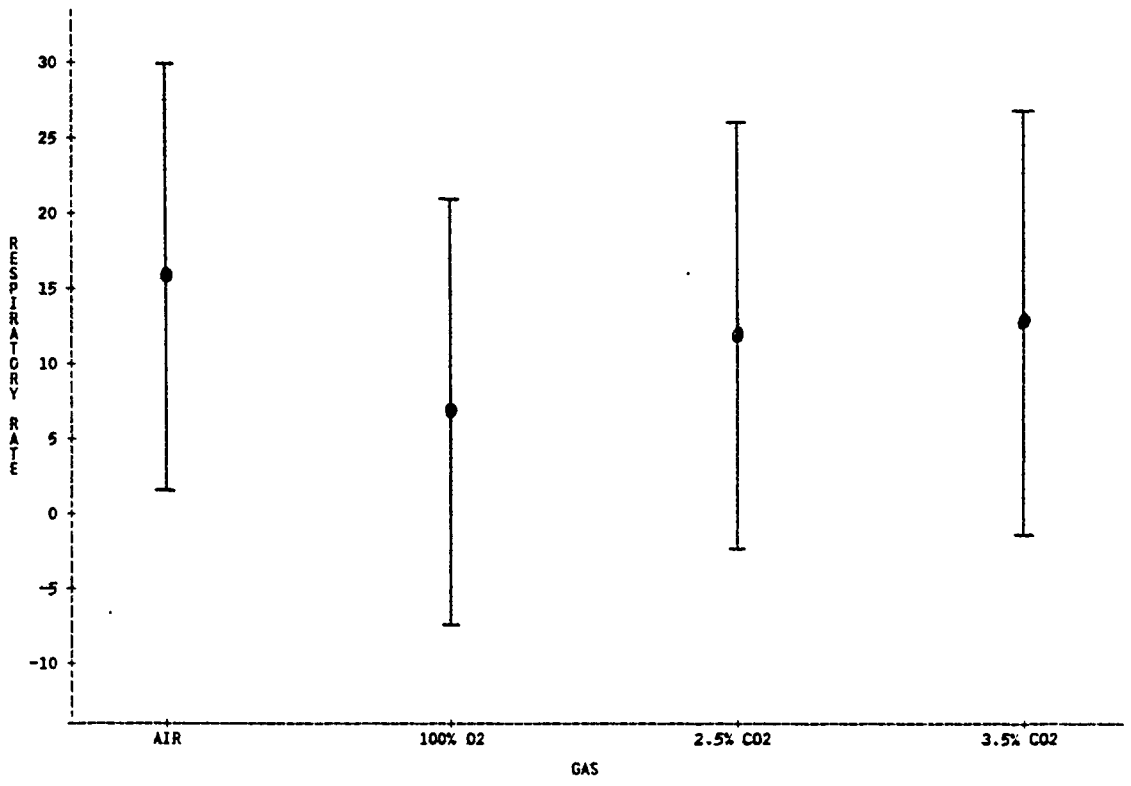

FIG. 5A. APPROXIMATE 95% CONFIDENCE INTERVALS FOR RESPIRATORY RATE MEAN PERCENT CHANGE FROM PRE BASELINE DURING 30 TASKS (N=6).

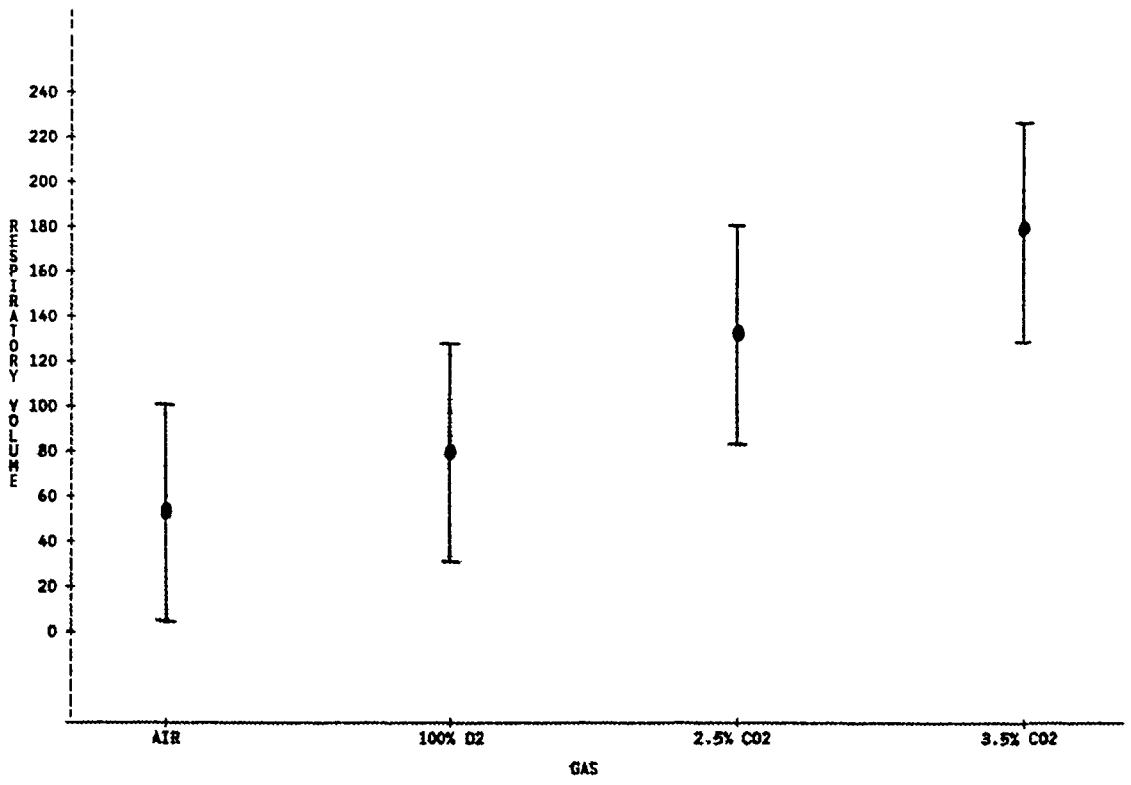

FIG. 6A. APPROXIMATE 95% CONFIDENCE INTERVALS FOR RELATIVE RESPIRATORY VOLUME MEAN PERCENT CHANGE FROM PRE BASELINE DURING 30 TASKS (N=6).

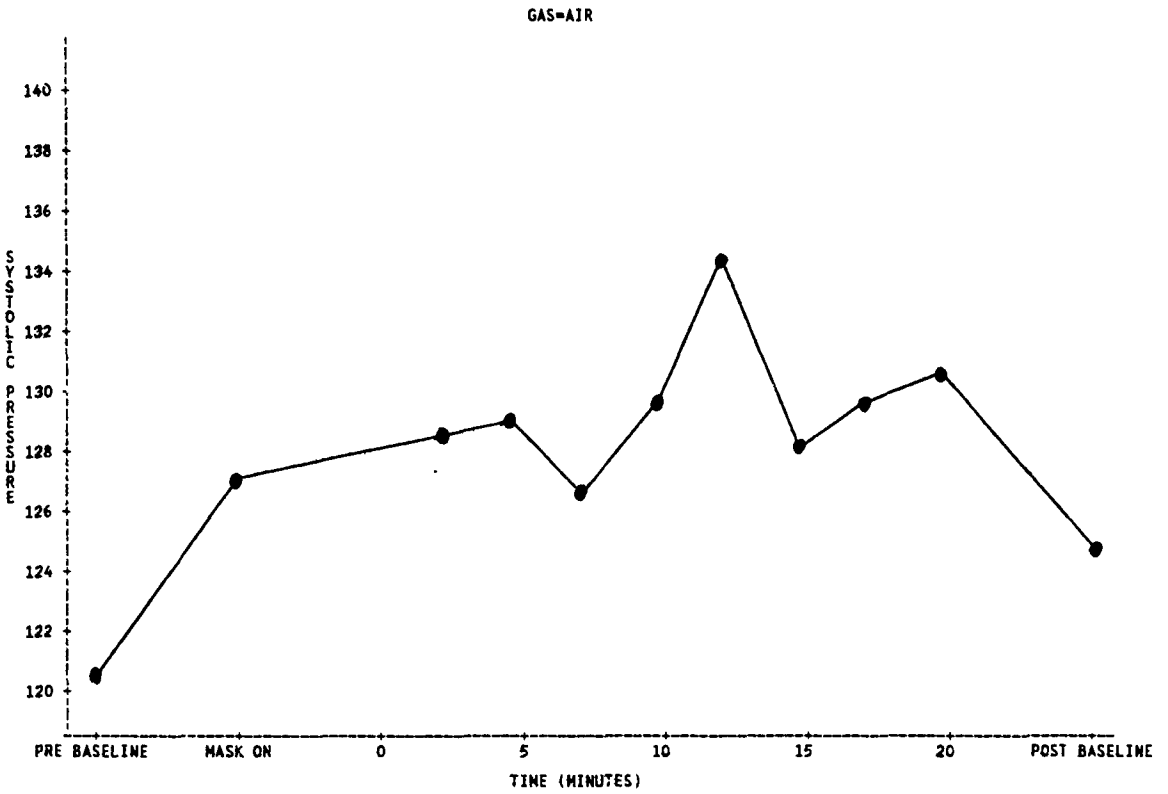

FIG. 7A. MEAN SYSTOLIC BLOOD PRESSURE WHEN BREATHING AIR (MM HG), N=7.

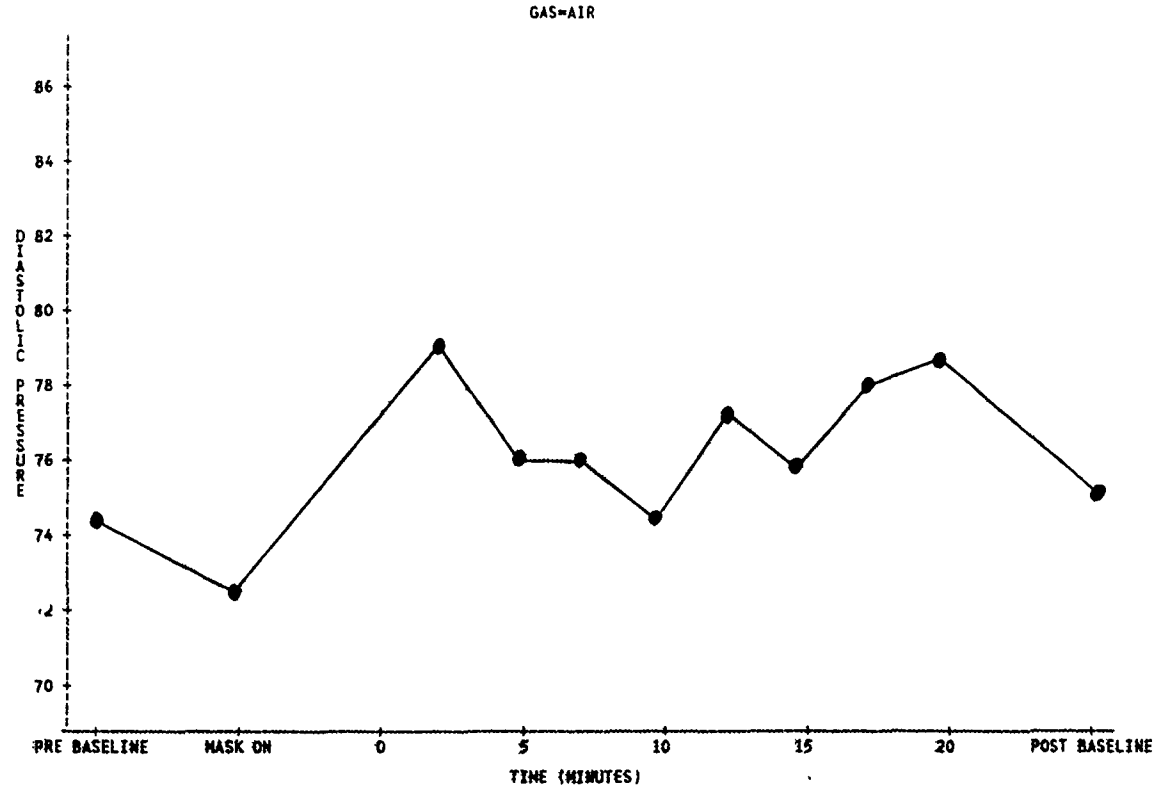

FIG. 8A. MEAN DIASTOLIC BLOOD PRESSURE WHEN BREATHING AIR (MM HG), N=7.

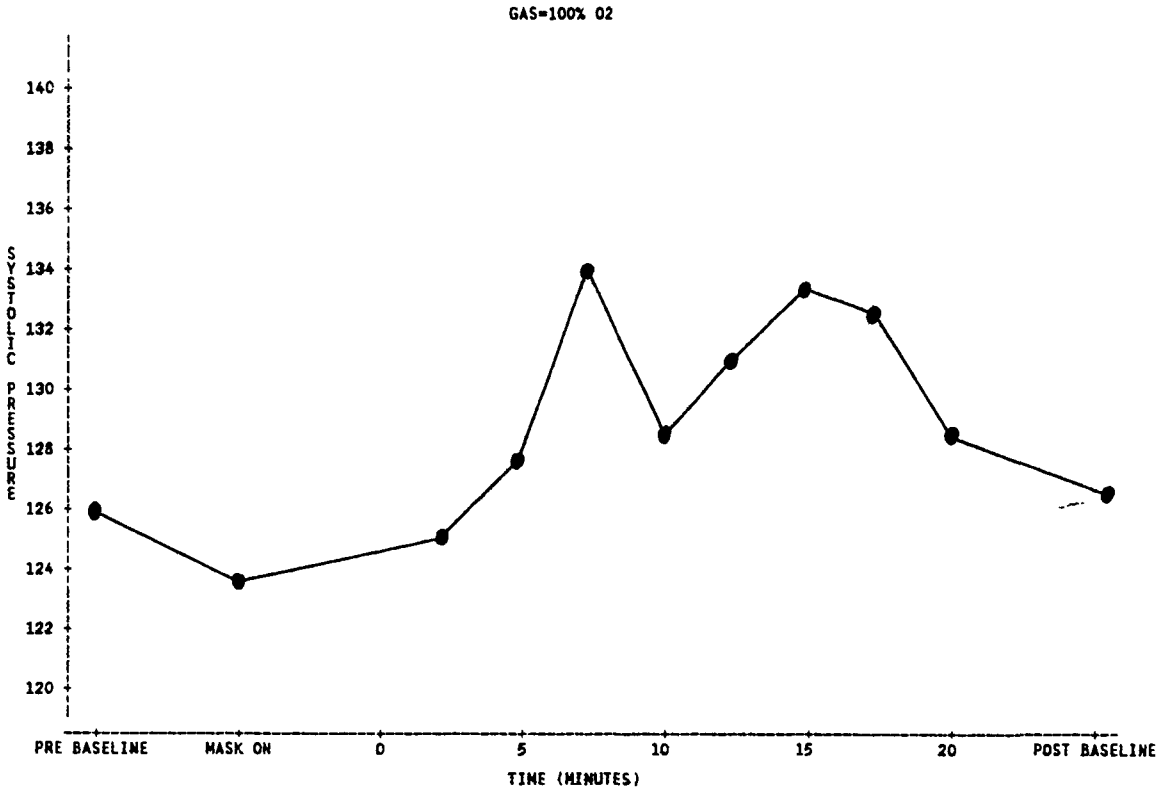

FIG. 9A. MEAN SYSTOLIC BLOOD PRESSURE WHEN BREATHING 100% 02 (MM HG), N=7.

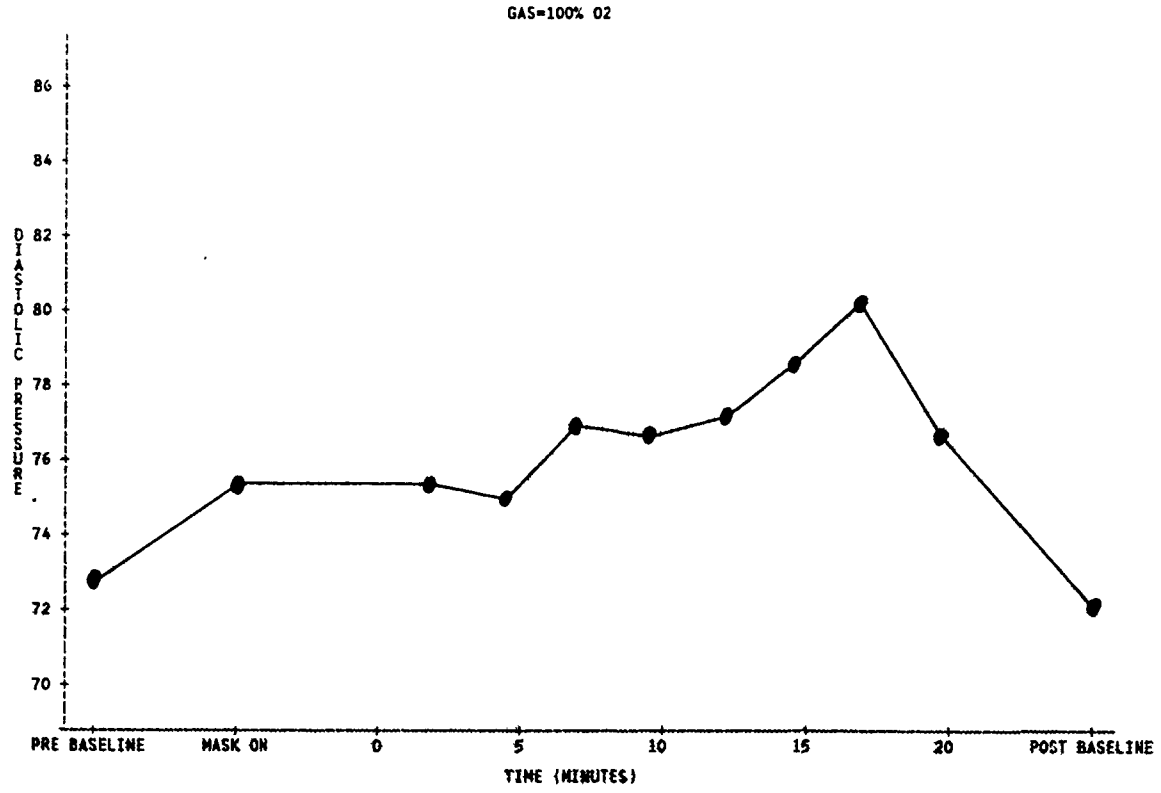

FIG. 10A. MEAN DIASTOLIC BLOOD PRESSURE WHEN BREATHING 100% 02 (MM HG), N=7.

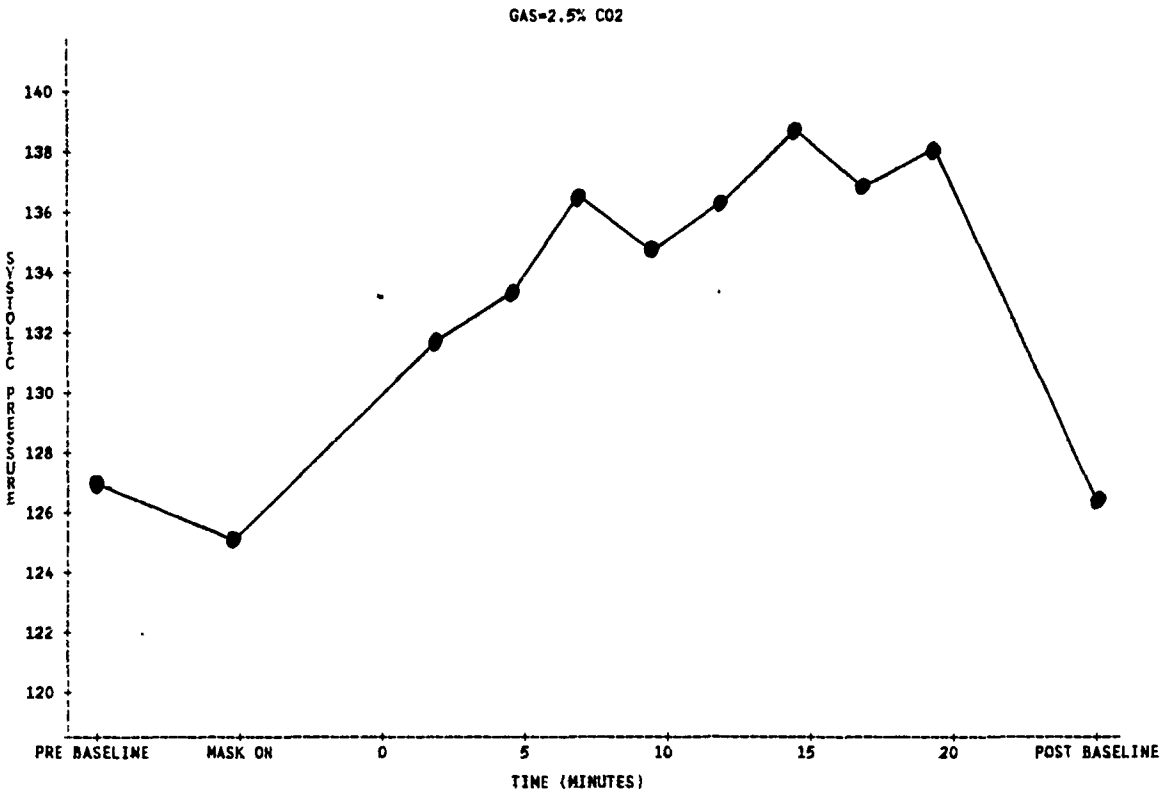

FIG. 11A. MEAN SYSTOLIC BLOOD PRESSURE WHEN BREATHING 2.5% CO2 (MM HG), N=7.

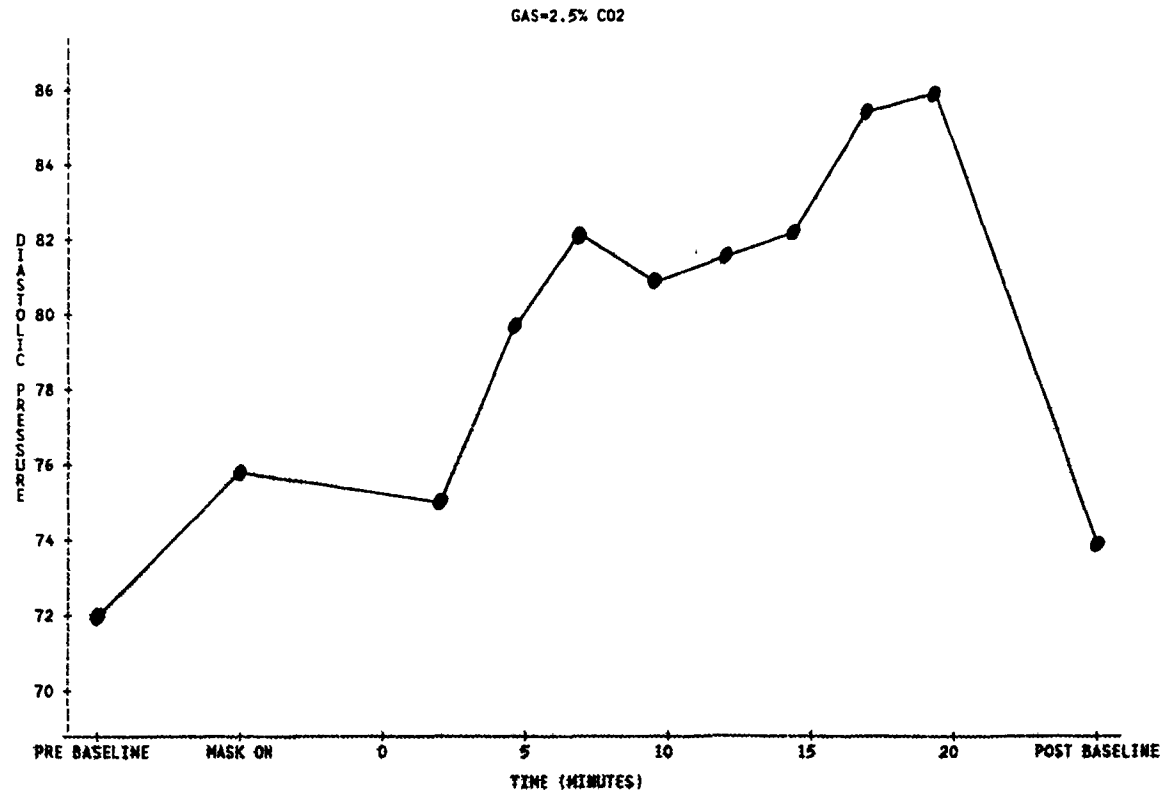

FIG. 12A. MEAN DIASTOLIC BLOOD PRESSURE WHEN BREATHING 2.5% CO2 (MM HG), N=7.

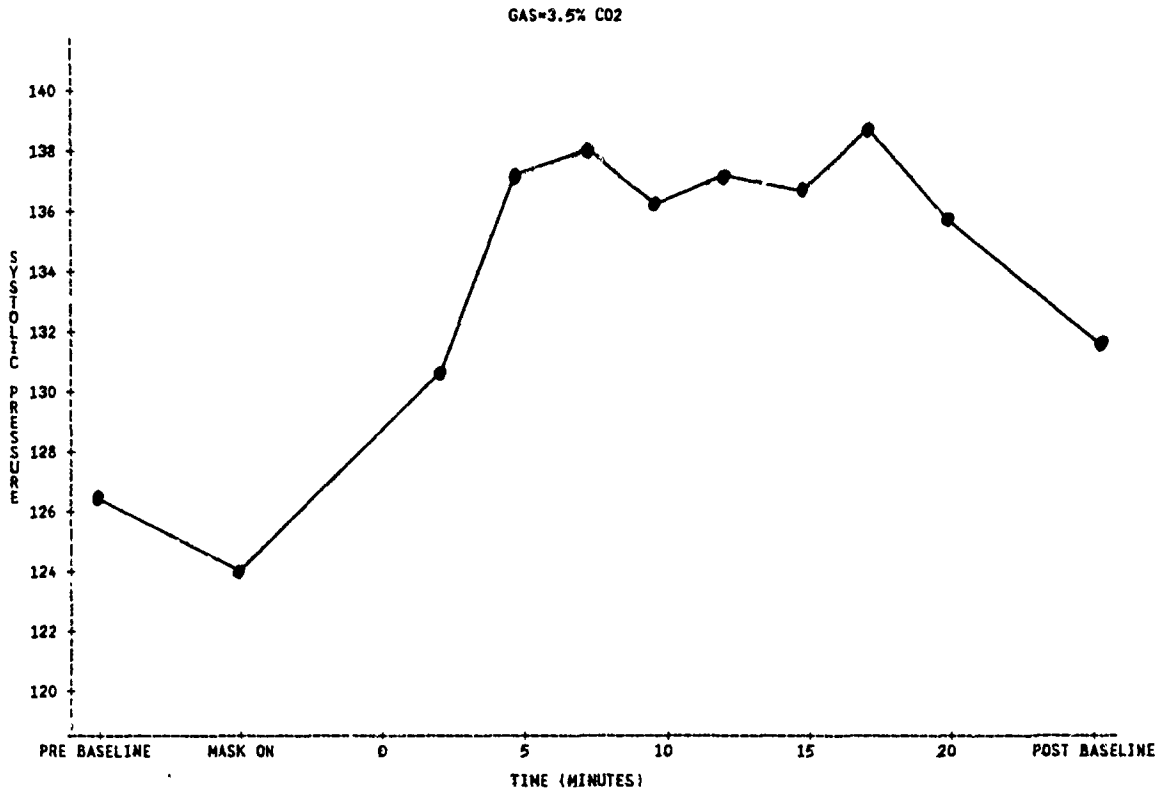

FIG. 13A. MEAN SYSTOLIC BLOOD PRESSURE WHEN BREATHING 3.5% CO2 (MM HG), N=7.

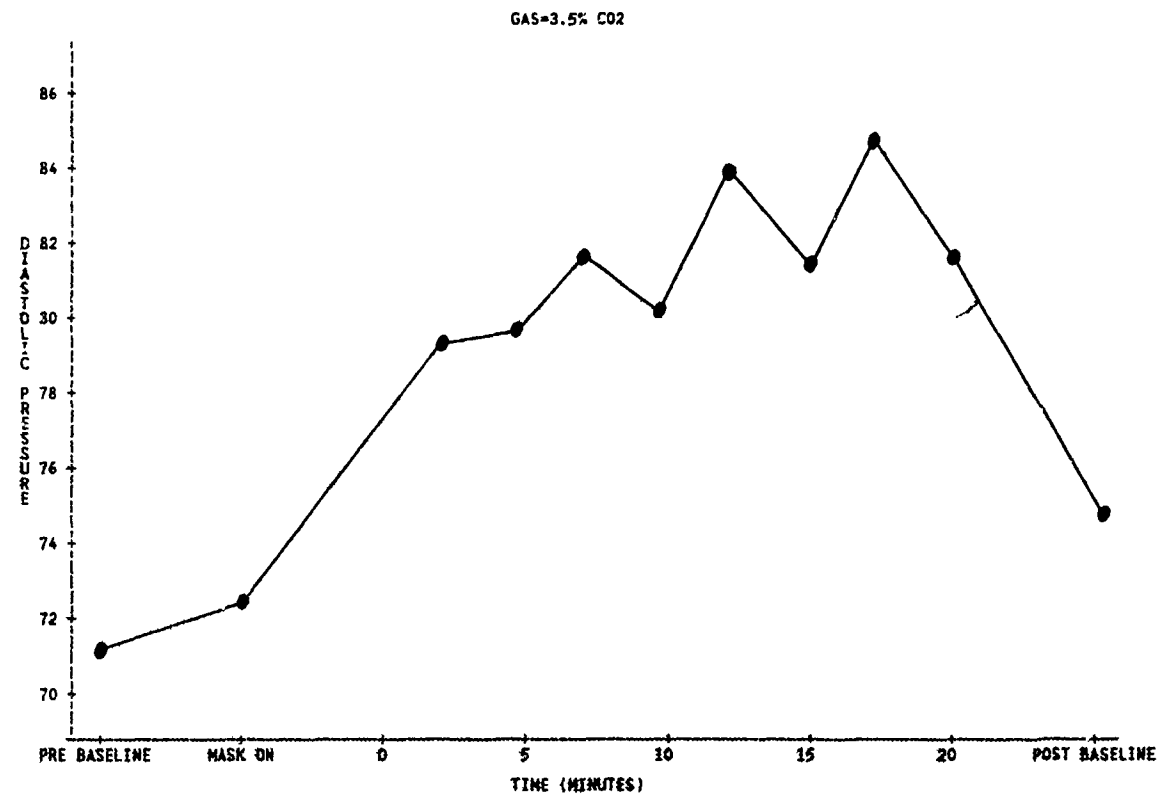

FIG. 14A. MEAN DIASTOLIC BLOOD PRESSURE WHEN BREATHING 3.5% CO2 (MM HG), N=7.

Fig. 15A. Photo of Subject