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PROFILE OF MILITARY SCIENTISTS AND ENGINEERS

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Office for Laboratory Management

Office of the Director of Defense Research and Engineering
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PROFILE OF MILITARY SCIENTISTS AND ENGINEERS

by

E. M. Glass
Assistant Director

1 September 1969

Management Analysis Report 69-6
Office for Laboratory Management
Office of the Director of Defense Research and Engineering
Washington, D. C. 20301

INTRODUCTION

This profile is based upon a survey of the scientists and engineers ~~(S&E)~~ in field research, development, test and evaluation (RDT&E) activities of the Department of Defense—primarily laboratories, test centers and ranges. These activities do not include headquarters or system project offices. The information was provided by individual scientists and engineers and was forwarded by the organizations involved to the Office for Laboratory Management, Office of the Director of Defense Research and Engineering (ODDR&E).

Information on civilian scientists and engineers has been published in two reports issued during 1969.[1] This report summarizes the characteristics of the military RDT&E work force. The effective date of the information is 1 September 1968.

Programing support was provided by the U. S. Air Force's OSD Information Systems Division, chiefly by Spec. 4 Richard Hein. Beth R. King furnished editorial assistance, and the graphic arts work was done by Robert B. Logan and his associates of the Graphics and Presentations Branch, Office of the Assistant Secretary of Defense (Administration).

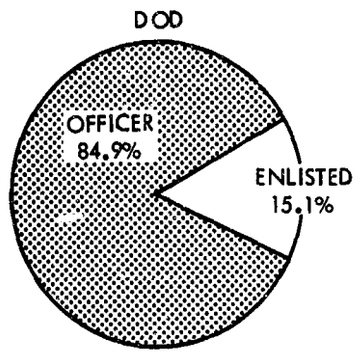
[1] E. G. Haberman and E. M. Glass, *Profile of Civilian Scientists and Engineers in Field RDT&E Activities of the Department of Defense* (Washington, D. C.: ODDR&E, MAR 69-1, 1 July 1969, AD-693 033).
E. M. Glass, *Civilian Scientists and Engineers in Army, Navy and Air Force RDT&E* (Washington, D. C.: ODDR&E, MAR 69-5, 1 September 1969).

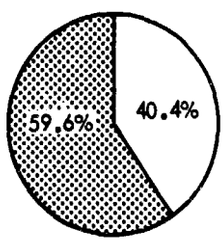
CONTENTS

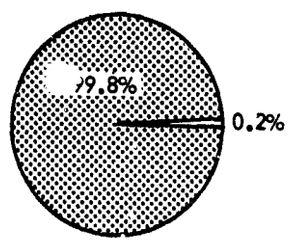
	Page
Introduction	iii
Distribution of Sample	1
Educational Levels	2
Field of Highest Degree	3
Field of Highest Degree, by Degree Level	4
Occupations	5
Technical Mobility	6
Functional Area	7
Supervisory Levels	9
Patent Applications	10
Papers Published	11
Attendance at National Technical Meetings	12
Rank Distribution of Officers	13
Enlisted Rank Distribution	15
Officer Rank, by Degree Level	16
Enlisted Rank Distribution, by Degree Level	18
Age	19
Age Distribution, by Degree Level	20

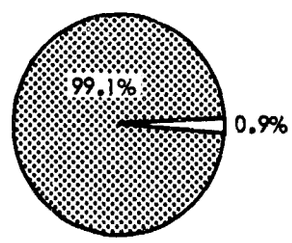
DISTRIBUTION OF SAMPLE

The information for this portion of the DoD survey was provided by 4,540 officer and enlisted personnel in 117 Defense RDT&E activities. Less than 50 percent of the authorized military professional strength responded to the questionnaire. The sample consists principally of officer S&Es, except that 40.4 percent of the Army respondents were enlisted. The Air Force sample included 59.9 percent of the DoD officer total, whereas the Army sample contained 96.8 percent of the enlisted S&Es.





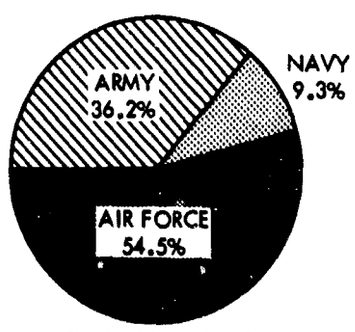




	Army	
	N	%
Officer	931	59.6
Enlisted	630	40.4
Total	1561	

	Navy	
	N	%
Officer	630	99.8
Enlisted	1	0.2
Total	631	

	Air Force	
	N	%
Officer	2328	99.1
Enlisted	20	0.9
Total	2348	

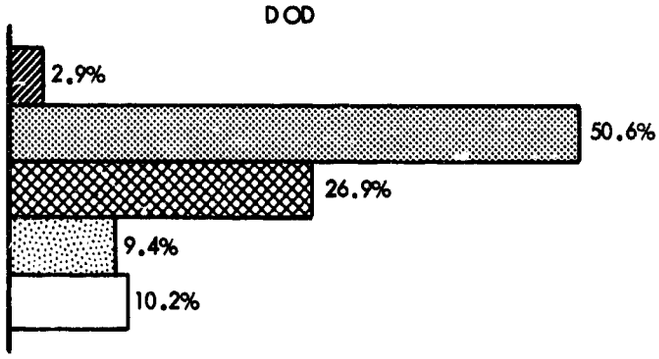


% OF DOD TOTAL

EDUCATIONAL LEVELS

Of those considered S&E professionals in the DoD sample, 97.1 percent have at least baccalaureate degrees, and the Navy has the most nondegreed professionals. Overall, 46.5 percent have advanced degrees, with the highest percentage (50.3 percent) again in the Navy. The Air Force has the largest proportion of Master's degrees, while the Army has the most Ph.D.'s. Approximately one-sixth of the Army and Navy S&Es have M.D., D.D.S. or D.V.M. degrees.

	Army	Navy	Air Force
NO DEGREE	2.8	12.2	1.5
B.S.	51.9	37.6	52.0
M.S.	17.0	25.4	33.8
Ph.D.	12.7	8.5	7.3
MEDICAL	15.6	16.4	5.5



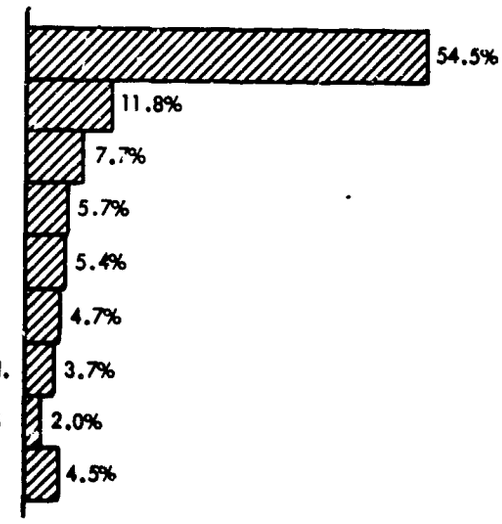
Percentage of DoD Total

	No degree	B.S.	M.S.	Ph.D.	Medical	Total N	Total %
Army	33.9%	37.2%	23.0%	49.0%	55.7%	1561	36.2%
Navy	38.6	6.9	8.8	8.4	15.1	631	9.3
Air Force	27.5	55.9	68.2	42.6	29.2	2348	54.5

FIELD OF HIGHEST DEGREE

Engineers dominate the total sample, varying from 37.1 percent in the Navy to 65.3 percent in the Air Force. Both the Navy and the Army have large percentages of life scientists, which also accounts for their higher proportions of medical-degree holders.

Army	Navy	Air Force	
42.0%	37.1%	65.3%	ENGINEERING
17.0	26.3	6.2	LIFE SCIENCES - HEALTH
7.8	3.8	8.3	PHYSICS
8.2	4.5	4.2	CHEMISTRY
9.1	7.5	2.7	LIFE SCIENCES - OTHER
5.9	2.0	4.3	MATH & STATISTICS
3.3	7.6	3.4	SOCIAL SCIENCES & PSYCH.
2.6	2.0	1.5	OTHER PHYSICAL SCIENCES
4.1	9.3	4.1	ALL OTHER FIELDS



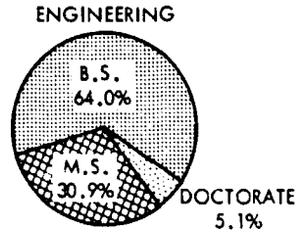
FIELD OF HIGHEST DEGREE, BY DEGREE LEVEL

The Navy has the highest relative number of advanced-degree S&Es in all fields shown except mathematics and statistics, in which the Air Force is higher, with 29.6 percent. In the life sciences, doctorates represent almost three-fourths of the total, varying from 71.4 percent in the Navy to 78.3 percent in the Air Force.

Engineering

	Army	Navy	AF	DoD
B.S.	71.2%	58.8%	61.4%	64.0%
M.S.	21.4	37.4	34.3	30.9
Doct.	7.4	3.8	4.2	5.1

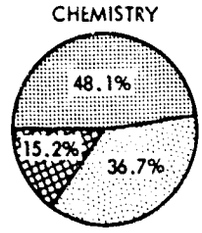
ENGINEERING



Chemistry

	Army	Navy	AF	DoD
B.S.	49.6%	37.5%	47.9%	48.1%
M.S.	11.2	31.3	17.7	15.2
Doct.	39.2	31.2	34.4	36.7

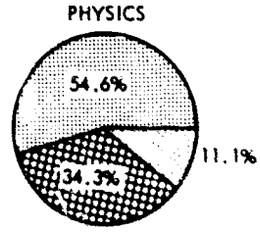
CHEMISTRY



Physics

	Army	Navy	AF	DoD
B.S.	66.9%	46.2%	47.7%	54.6%
M.S.	17.8	38.5	44.0	34.3
Doct.	15.3	15.4	8.3	11.1

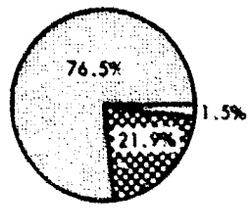
PHYSICS



Mathematics and Statistics

	Army	Navy	AF	DoD
B.S.	84.4%	71.4%	69.4%	76.5%
M.S.	14.4	28.6	27.3	21.9
Doct.	1.1	--	2.3	1.5

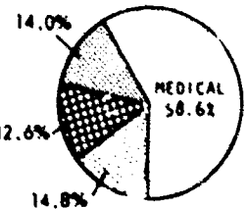
MATHEMATICS & STATISTICS



Life Sciences

	Army	Navy	AF	DoD
B.S.	17.2%	8.4%	11.1%	14.0%
M.S.	11.4	20.2	10.6	12.6
Ph.D.	12.9	16.8	17.4	14.8
Med.	58.6	54.6	60.9	58.6

LIFE SCIENCES



OCCUPATIONS

All the types of work done by personnel surveyed were categorized into 30 occupations. The Air Force sample is about 17 percentage points higher than the other Services in engineering, and the Army has the highest relative numbers of physical, life, social and behavioral scientists. This category includes S&Es with no degree.

Army	Navy	Air Force	OCCUPATION	DOD
2.4%	10.[illegible]	17.4%	AERO & ASTRO ENG.	11.3%
1.0	0.0	0.2	CERAMIC ENGINEERING	0.5%
3.1	1.2	0.9	CHEMICAL ENGINEERING	1.7%
3.7	6.0	1.2	CIVIL ENGINEERING	1.2%
11.3	8.0	18.6	ELECTRICAL & ELECTRONIC	15.0%
0.5	0.7	0.4	ENGINEERING MECHANICS	0.5%
1.0	0.0	0.4	INDUSTRIAL ENGINEERING	0.6%
0.6	0.0	0.9	MATERIALS ENGINEERING	0.7%
11.5	0.7	7.3	MECHANICAL ENGINEERING	8.2%
0.4	0.2	0.4	METALLURGICAL ENGINEERING	0.4%
1.5	0.0	1.3	NUCLEAR OR REACTOR ENG.	1.3%
0.1	0.2	0.0	OCEAN SCIENCE ENGINEERING	*
0.1	0.0	0.1	SANITARY ENGINEERING	*
4.0	18.9	8.1	ALL OTHER ENGINEERING	7.6%
(41.2)	(40.6)	(57.2)	TOTAL ENGINEERING	49.8%
5.3	1.2	6.6	PHYSICS	10.4%
7.8	1.5	2.3	CHEMISTRY	5.2%
0.0	0.0	*	ASTRONOMY	*
1.3	0.2	0.5	ATMOS., EARTH, MARINE, SPACE SCI.	0.8%
4.5	0.0	3.2	MATHEMATICS	3.4%
(18.9)	(2.9)	(12.6)	TOTAL PHYSICAL SCIENCES	14.0%
16.1	9.2	4.8	BIOLOGY	9.3%
0.1	0.0	0.0	SOCIOLOGY	0.1%
0.0	0.0	*	ANTHROPOLOGY	*
0.1	0.0	*	LINGUISTICS	*
0.3	0.0	0.1	ECONOMICS	0.2%
2.8	3.0	2.4	PSYCHOLOGY	2.6%
(19.4)	(12.2)	(7.3)	TOTAL OTHER SCIENCES	12.6%
2.6	0.5	0.6	INTERDISCIPLINARY	1.3%
5.2	9.0	6.6	SYSTEMS ANALYSIS/ENGINEERING	6.3%
4.4	11.4	10.8	MULTIDISCIPLINE SCIENCE & ENG.	8.5%
(12.3)	(20.9)	(18.0)	TOTAL (LAST THREE ITEMS)	16.1%
8.4	23.1	4.8	OTHER SPECIALTIES	7.8%

* 4 OR FEWER

TECHNICAL MOBILITY

The primary work activity is compared here to the field of highest degree. A significant number of military scientists and engineers identify themselves with disciplines other than those in which they received their academic training. Individuals with no degree are not included in this category.

TECHNICAL MOBILITY
(Column %)

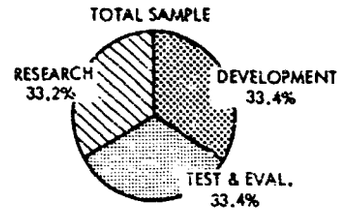
Field of Highest Degree	Engineering	Chemistry	Physics	Other Physical Sciences	Life Sciences: Health-Related	Life Sciences: Other	Social and Behavioral Sciences	Mathematics and Statistics	All Other Fields	Total	Percentage of Totals: DoD	Percentage of Totals: Army	Percentage of Totals: Navy	Percentage of Totals: Air Force
Engineering:														
Aeronautical and astronautical	18.7	0.8	0.6	7.3	--	0.9	1.3	5.1	11.9					
	427	2	2	6	--	2	2	10	21	472	11.3	2.5	11.4	17.1
Chemical	2.9	2.1	--	--	0.2	--	--	--	--					
	67	5	--	--	1	--	--	--	--	73	1.8	3.2	1.4	0.9
Electrical and electronic	25.0	2.5	5.9	2.4	--	--	0.6	4.6	8.5					
	569	6	19	2	--	--	1	9	15	621	14.9	11.0	6.8	18.6
Mechanical	14.6	1.3	0.9	--	--	--	--	1.0	4.5					
	332	3	3	--	--	--	--	2	8	348	8.3	11.7	0.6	7.6
Nuclear	1.7	1.3	3.4	--	--	0.4	--	1.0	--					
	38	3	11	--	--	1	--	2	--	55	1.3	1.6	--	1.3
Other	23.6	8.4	12.3	13.4	1.2	3.1	12.3	18.4	37.5					
	537	20	40	11	6	7	19	36	66	742	17.8	15.5	24.4	18.3
Physics and astronautics	1.1	3.4	59.3	9.8	0.6	0.4	--	0.5	1.7					
	26	8	192	8	3	1	--	1	3	242	5.8	5.4	1.4	4.7
Chemistry	0.5	61.2	0.9	1.2	1.8	5.3	--	--	--					
	12	145	3	1	9	12	--	--	--	182	4.[illegible]	8.0	1.7	[illegible].4
Atmospheric and space sciences	0.2	0.4	1.5	23.2	--	1.3	0.6	--	--					
	4	1	5	19	--	3	1	--	--	33	0.8	1.3	0.3	0.5
Biology and agriculture	0.0	1.7	--	2.4	51.9	56.8	1.9	--	1.7					
	1	4	--	2	257	129	3	--	3	399	9.6	16.7	10.2	4.8
Social and behavioral sciences	0.1	0.4	--	1.2	1.4	0.9	68.4	0.5	1.1					
	2	1	--	1	7	2	106	1	2	122	2.[illegible]	3.3	3.4	2.6
Mathematics and statistics	0.6	--	1.9	1.2	0.2	0.4	--	61.7	1.1					
	13	--	6	1	1	1	--	121	2	145	3.5	4.6	--	1.2
Other specialties	11.0	16.5	13.3	37.8	42.6	30.4	14.8	7.1	31.8					
	251	39	43	31	211	69	23	14	56	737	17.7	15.2	38.4	16.1
Total	2279	237	324	82	495	227	155	196	176	4171	100.0	100.0	100.0	100.0
Percentage: DoD	54.6	5.7	7.8	2.0	11.9	5.4	3.7	4.7	4.2	100.0				
Army	42.3	8.3	7.8	2.7	17.1	9.2	3.3	6.0	3.4	100.0				
Navy	37.2	4.5	3.7	2.0	26.4	7.4	7.7	2.0	9.1	100.0				
Air Force	65.4	4.2	8.3	1.5	8.2	2.7	3.4	4.3	4.0	100.0				

FUNCTIONAL AREA

The overall sample is divided almost equally among research, development, and test and evaluation. Nondegreed professionals tend to work more in test and evaluation, while doctorate S&Es are in research assignments. The higher the degree level is, the greater the migration toward research.

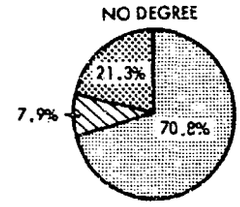
Total

	Army	Navy	AF
Res.	44.7%	34.6%	25.5%
Dev.	23.1	23.6	41.9
T&E	32.2	41.8	32.8



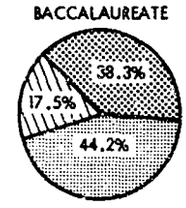
No Degree

	Army	Navy	AF
Res.	14.0%	6.1%	2.9%
Dev.	23.3	12.2	31.4
T&E	62.7	81.7	65.7



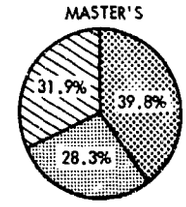
B.S.

	Army	Navy	AF
Res.	24.9%	11.3%	13.3%
Dev.	27.5	27.8	46.7
T&E	47.6	50.9	40.0



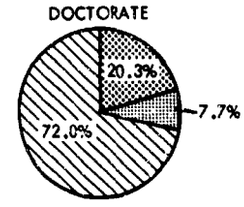
M.S.

	Army	Navy	AF
Res.	40.2%	37.4%	28.4%
Dev.	33.5	33.3	42.7
T&E	26.3	29.4	28.9



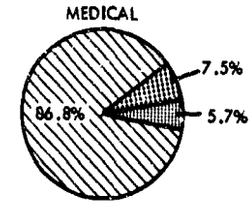
Doctorate

	Army	Navy	AF
Res.	79.8%	64.7%	64.5%
Dev.	14.6	23.5	26.2
T&E	5.6	11.8	9.3



Medical

	Army	Navy	AF
Res.	92.2%	89.4%	75.0%
Dev.	3.7	7.6	14.8
T&E	4.1	3.0	10.2

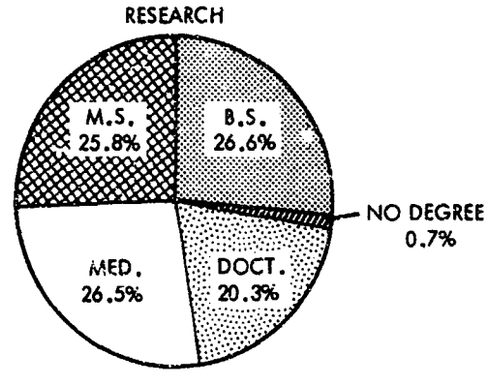


FUNCTIONAL AREA (continued)

Of all S&Es engaged in research, nondegreed people represent a tiny fraction. The remainder are almost equally divided among the four degree levels. Of those in development and in test and evaluation, between 88 and 89 percent have either a B.S. or an M.S. degree; the development area has a somewhat higher level of M.S.'s.

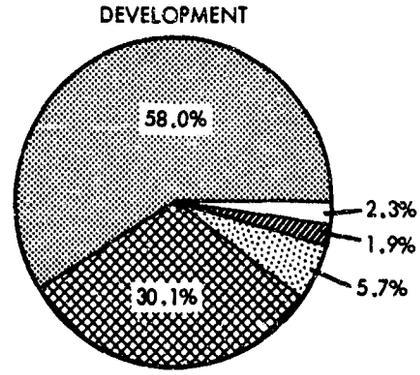
Research

	Army	Navy	AF	DoD
No degree	0.9%	2.2%	0.2%	0.7%
B.S.	28.9	12.2	27.2	26.6
M.S.	15.3	27.3	37.8	25.8
Doctorate	22.6	15.8	18.7	20.3
Medical	32.2	42.4	16.1	26.5



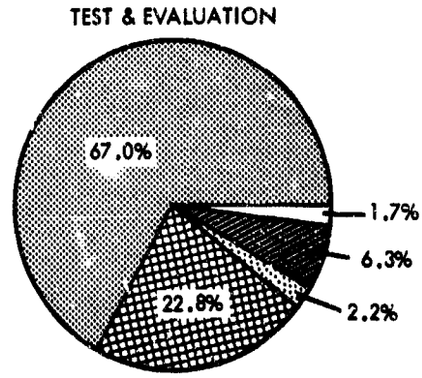
Development

	Army	Navy	AF	DoD
No degree	2.8%	6.3%	1.1%	1.9%
B.S.	61.9	44.2	57.9	58.0
M.S.	24.7	35.8	34.5	30.1
Doctorate	8.1	8.4	4.6	5.7
Medical	2.5	5.3	1.9	2.3



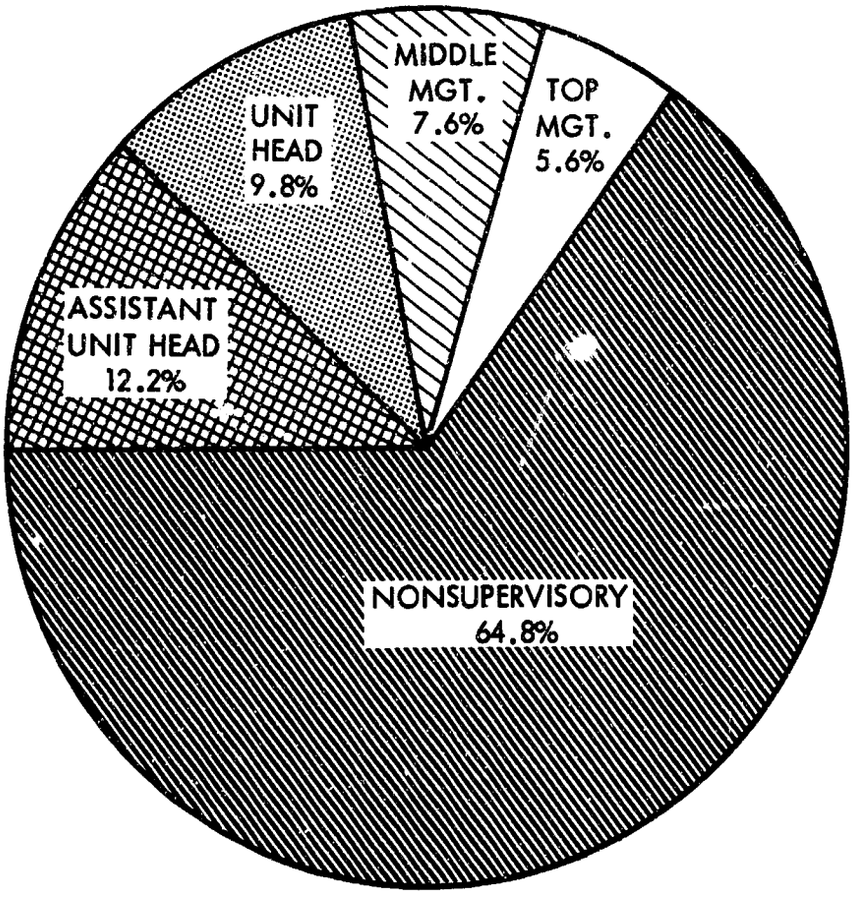
Test and Evaluation

	Army	Navy	AF	DoD
No degree	5.4%	23.8%	3.0%	6.3%
B.S.	76.5	54.8	63.4	67.0
M.S.	13.9	17.9	29.8	22.8
Doctorate	2.2	2.4	2.1	2.2
Medical	2.0	1.2	1.7	1.7



SUPERVISORY LEVELS

The Army tends to use a greater proportion of its military R&D staff in nonsupervisory positions. Part of this may be accounted for by the Army's greater percentage of enlisted personnel. In the Navy, 55 percent of the military S&Es are in supervisory positions.



Notes: Assistant unit head—primarily technical supervision.
Unit head—lowest level for hire/fire recommendation, preparation of performance ratings, etc.
Middle management—administration and direction of several units.
Top management—staff and policy-making personnel.

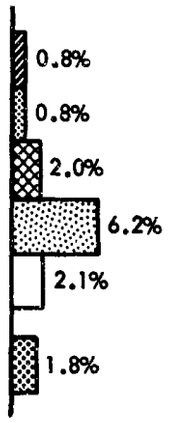
	Army	Navy	AF	DoD
Nonsupervisory	73.9	45.0	62.2	64.8
Asst. unit head	10.2	15.7	12.9	12.2
Unit head	7.4	13.9	10.7	9.8
Middle management	3.6	12.4	9.5	7.6
Top management	4.9	12.9	4.8	5.6

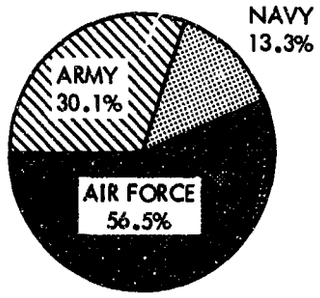
PATENT APPLICATIONS

S&Es with doctorates are more likely to apply for patents than people at any other degree level. Although they represent only 9.4 percent of the sample, they apply for 37.8 percent of the patents. The Navy S&Es represent 9.3 percent of the DoD sample but apply for 18.9 percent of the DoD patents.

	Army	Navy	Air Force
NO DEGREE	-	2.0	-
B.S.	0.9	1.3	0.7
M.S.	0.8	2.9	2.3
Ph.D.	5.6	5.9	7.0
MEDICAL	1.2	3.0	3.1
TOTAL	1.5	2.5	1.8

% APPLYING FOR PATENTS (DOD)

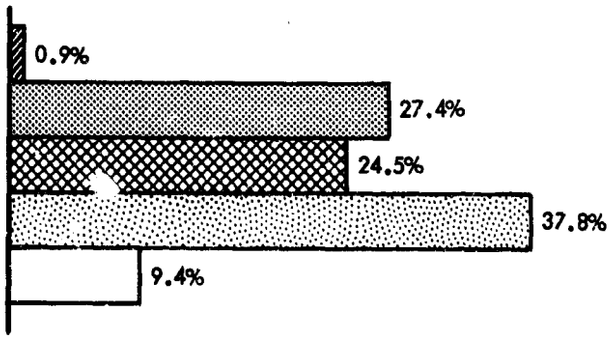


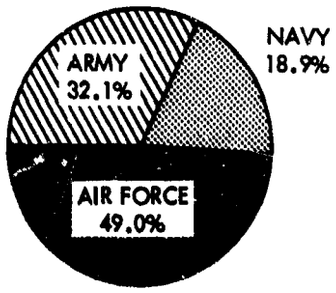


% OF DOD

	Army	Navy	Air Force
NO DEGREE	-	5.0	-
B.S.	47.1	10.0	21.2
M.S.	8.8	15.0	38.5
Ph.D.	35.3	55.0	32.7
MEDICAL	8.8	15.0	7.7

% OF PATENTS APPLIED FOR



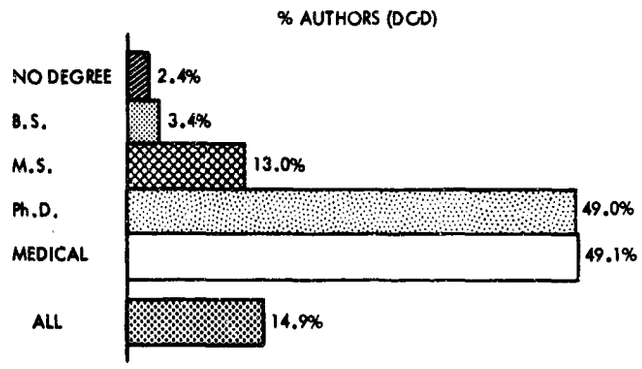


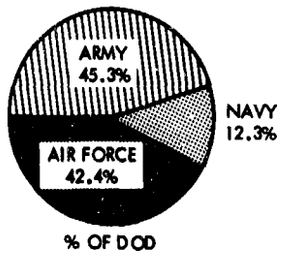
% OF DOD

PAPERS PUBLISHED

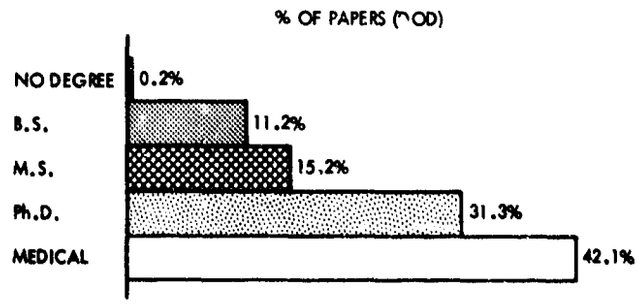
Of the total military sample, 14.9 percent were authors of at least one published paper; there was an average of 2.2 papers per author. Almost 50 percent of the holders of doctorates wrote and published 73.4 percent of the papers. The Army, with 36.2 percent of the military S&Es, has 45.3 percent of the authors in the DoD and publishes 46.7 percent of the papers.

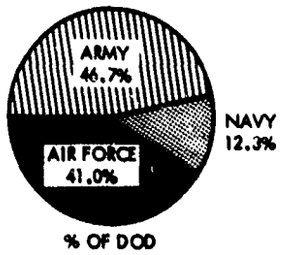
	Army	Navy	Air Force
NO DEGREE	-	4.1	2.9
B.S.	2.7	6.6	3.5
M.S.	14.7	20.6	11.5
Ph.D.	51.5	50.0	45.9
MEDICAL	52.5	43.9	45.3
ALL	18.6	19.7	11.6





	Army	Navy	Air Force
NO DEGREE	-	1.1	0.2
B.S.	6.9	6.8	17.5
M.S.	9.4	18.1	21.0
Ph.D.	30.6	18.1	36.1
MEDICAL	53.2	55.9	25.3

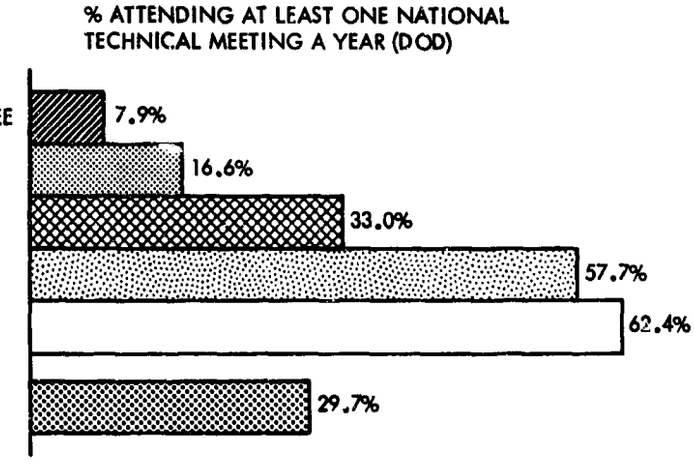


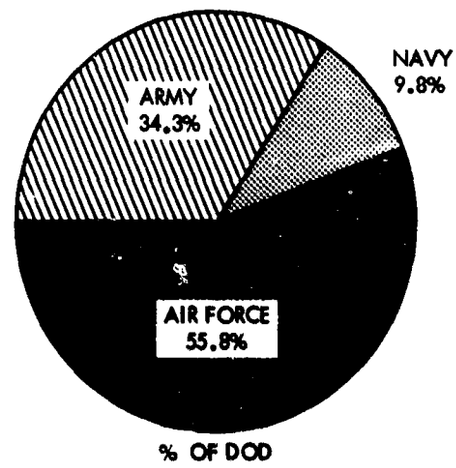


ATTENDANCE AT NATIONAL TECHNICAL MEETINGS

Slightly more than one S&E professional in four attended a meeting of a national technical society. Attendance at meetings was almost directly proportional to the sample size in each Service. There appears to be a high correlation between attendance at meetings and papers published within each of the degree levels.

Army	Navy	Air Force	
4.7	8.2	11.4	NO DEGREE
10.7	20.5	20.1	B.S.
26.7	36.3	34.7	M.S.
56.1	55.9	59.9	Ph.D.
69.3	53.0	68.8	MEDICAL
28.2	31.3	30.5	ALL

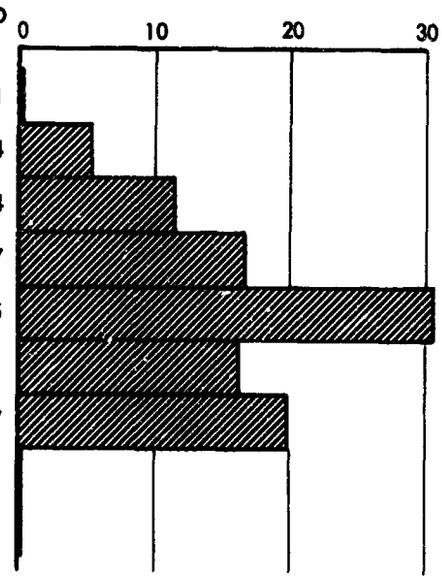




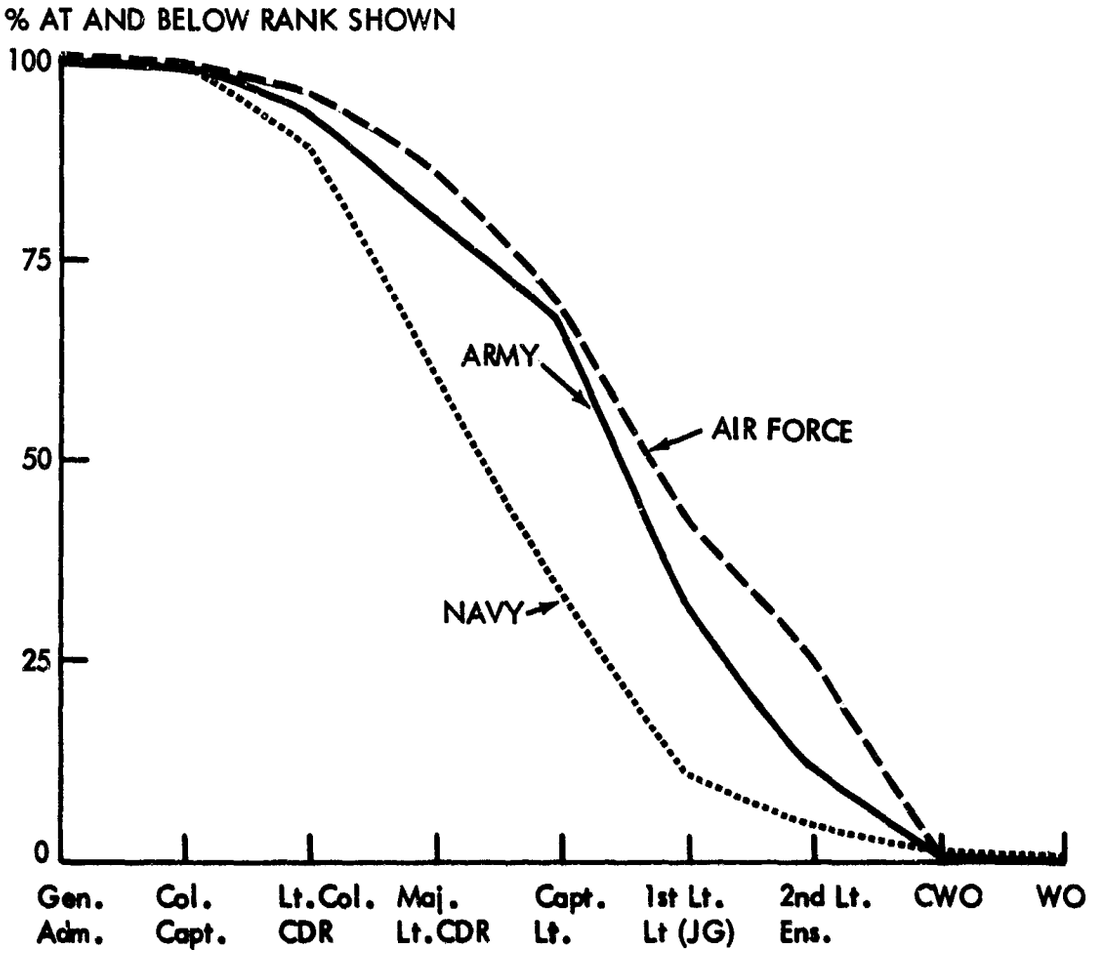
RANK DISTRIBUTION OF OFFICERS

The rank of Captain/Lieutenant represents almost a third of the total sample. The Air Force ranks the lowest of the Services, with 70 percent at or below the rank of Captain, followed closely by the Army with 67.3 percent. The Navy has 33.1 percent of its officers at the grade of Lieutenant or below.

Army	Navy	Air Force		DOD %
0.2	0.2	0.1	GEN./ADM.	0.1
6.0	11.2	4.1	COL./CAPT.	5.4
13.4	19.2	9.2	LT.COL./CDR.	11.4
13.0	26.2	16.5	MAJOR/LT. CDR.	16.7
35.4	32.7	28.2	CAPT./LT.	30.5
19.9	6.2	16.2	1st LT./LT.(J.G.)	16.1
11.9	3.0	25.6	2nd LT./ENS.	19.7
0.1	0.5	0.0	CHIEF WARRANT OFFICER	0.1
0.0	0.7	0.0	WARRANT OFFICER	0.1

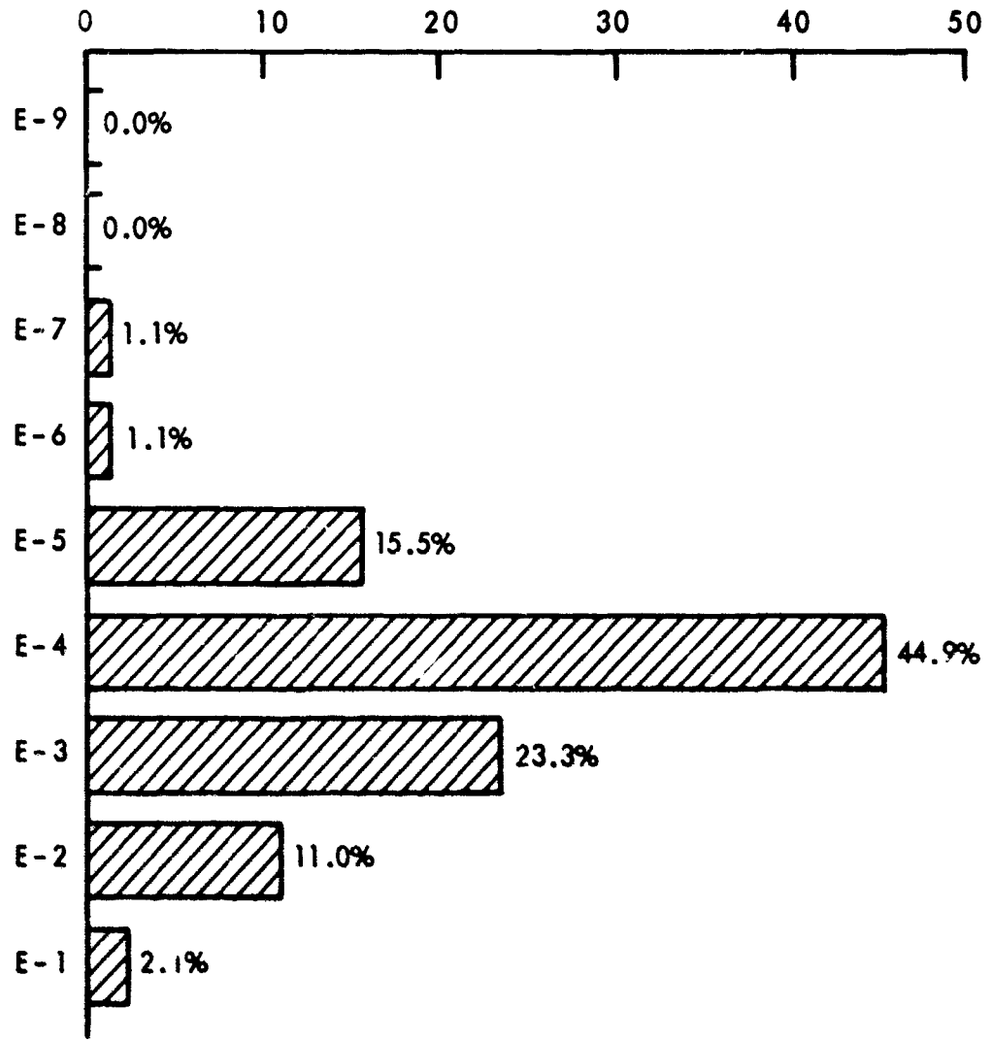


RANK DISTRIBUTION OF OFFICERS (continued)



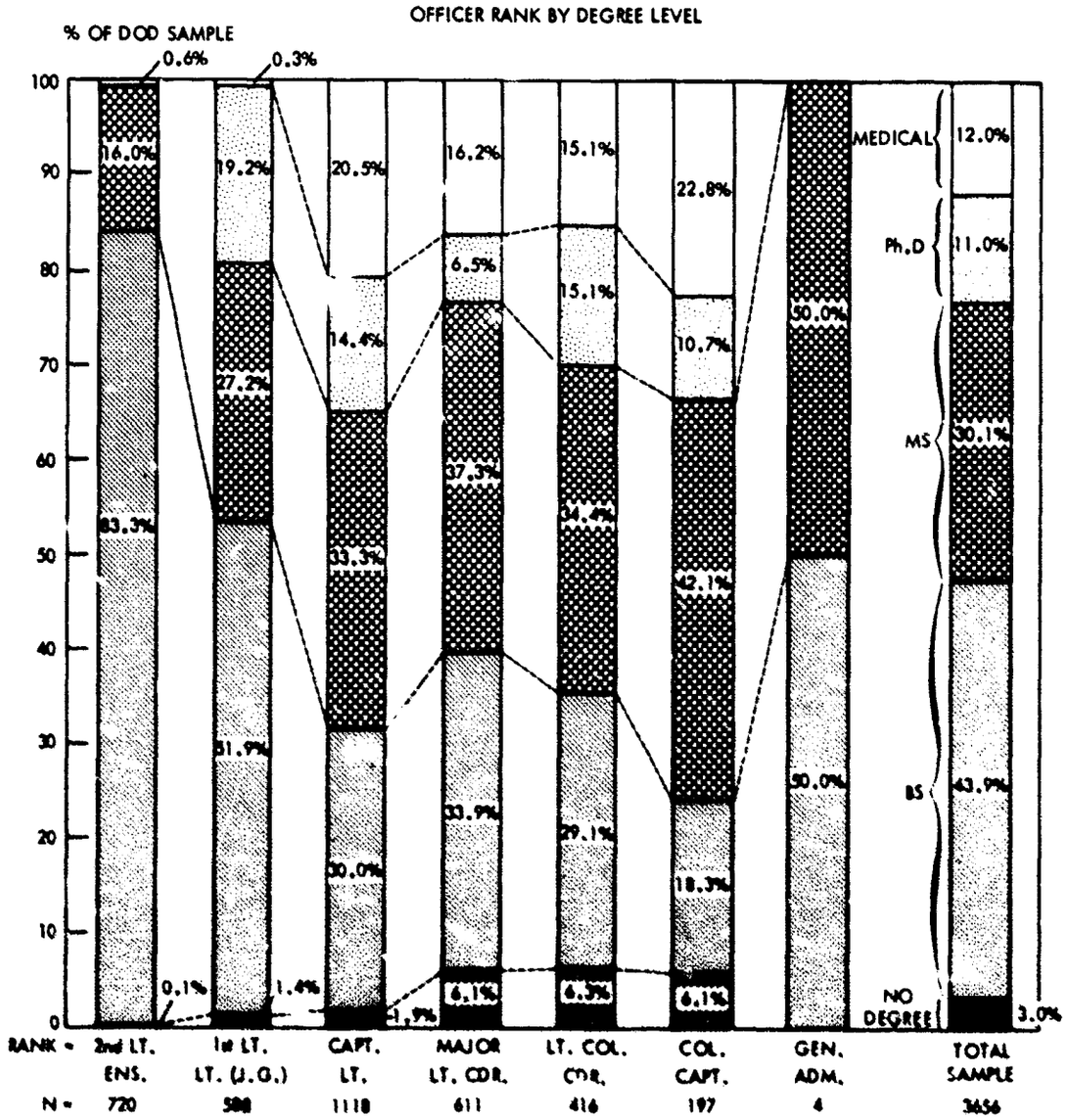
ENLISTED RANK DISTRIBUTION

The rank of E-4 represents almost 45 percent of the total sample. Of the enlisted S&Es surveyed, E-3s and E-4s constitute 68.2 percent.



OFFICER RANK, BY DEGREE LEVEL

From Captain/Lieutenant to Colonel/Captain, 60 percent or more of each rank hold advanced degrees. Overall, 53.1 percent of the officers hold Master's degrees or higher.

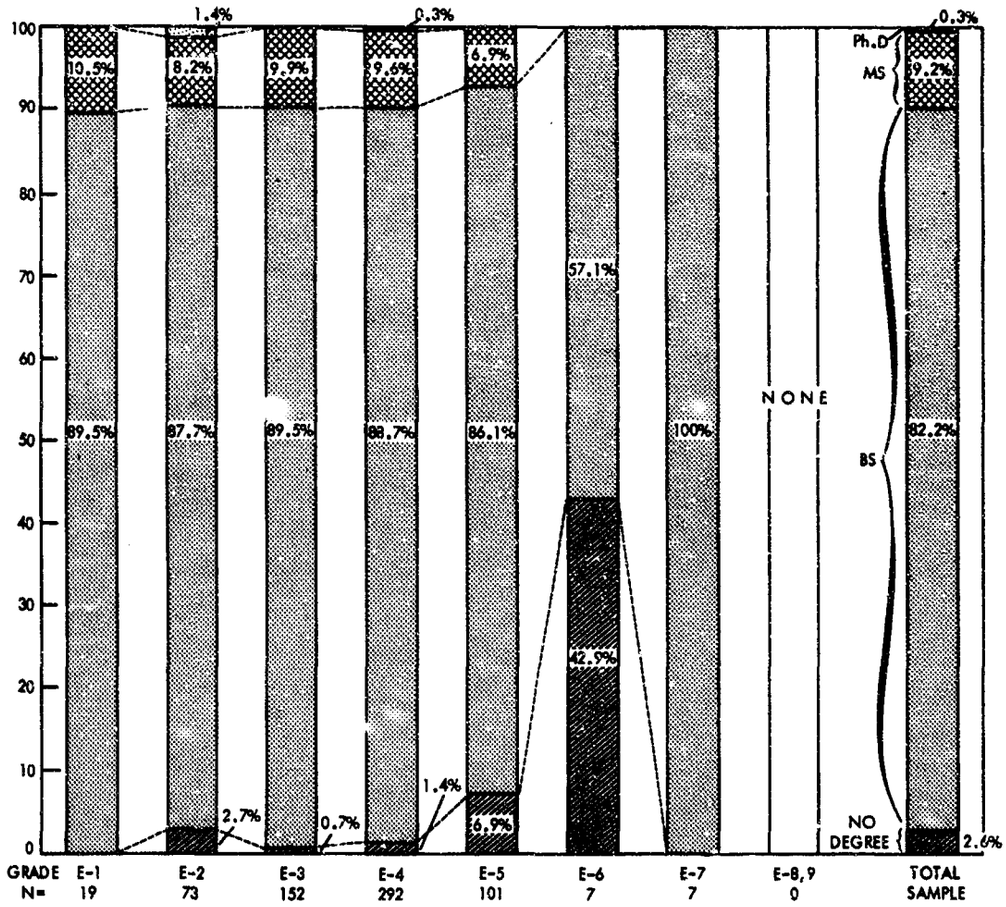


OFFICER RANK, BY DEGREE LEVEL (continued)

	None	B.S.	M.S.	Ph.D.	Med.	Total	%
Army							
General	--	1	1	--	--	2	0.2%
Colonel	4	9	21	5	17	56	6.0
Lt. Colonel	9	39	25	17	35	125	13.4
Major	4	39	30	8	40	121	13.0
Captain	2	26	36	116	150	330	35.4
1st Lieutenant	7	68	58	50	2	185	19.9
2nd Lieutenant	--	71	39	1	--	111	11.9
Total	26	254	210	197	244	931	100.0
Percentage	2.8	27.3	22.6	21.2	26.2	100.0	
Navy							
Admiral	--	1	--	--	--	1	0.2%
Captain	1	10	15	4	15	45	11.2
Commander	9	24	22	13		77	19.2
Lt. Commander	17	39	19	5	25	105	26.2
Lieutenant	15	54	36	9	17	131	32.7
Lieutenant J.G.	1	16	6	2	--	25	6.2
Ensign	1	6	4	1	--	12	3.0
Total	49	150	102	34	66	401	100.0
Percentage	12.2	37.4	25.4	8.5	16.5	100.0	
Air Force							
General	--	--	1	--	--	--	0.0%
Colonel	7	17	47	12	13	96	4.1
Lt. Colonel	8	58	96	33	19	214	9.2
Major	16	129	179	27	34	385	16.5
Captain	4	255	300	36	62	657	28.2
1st Lieutenant	--	221	96	61	--	378	16.2
2nd Lieutenant	--	523	72	2	-	597	25.6
Total	35	1203	791	171	128	2328	100.0
Percentage	1.5	51.7	34.0	7.[illegible]	5.5	100.0	

ENLISTED RANK DISTRIBUTION, BY DEGREE LEVEL

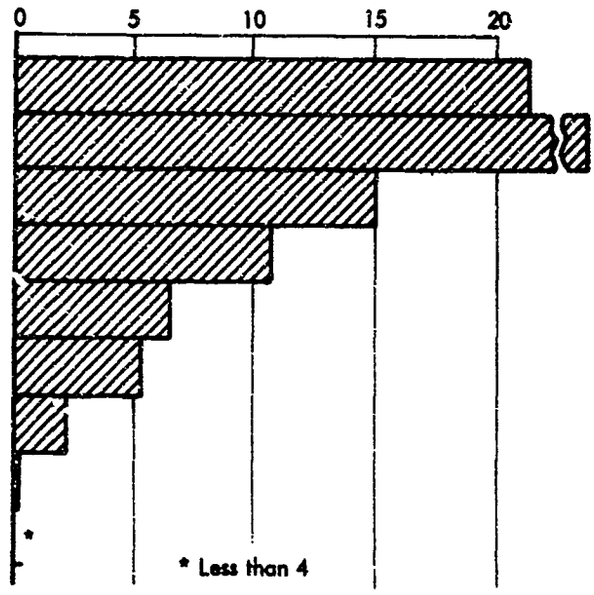
Bachelor's degrees dominate the enlisted S&E sample. From E-1 through E-4, there is a comparable distribution of Master's degrees. There are no advanced-degree S&Es above E-5.

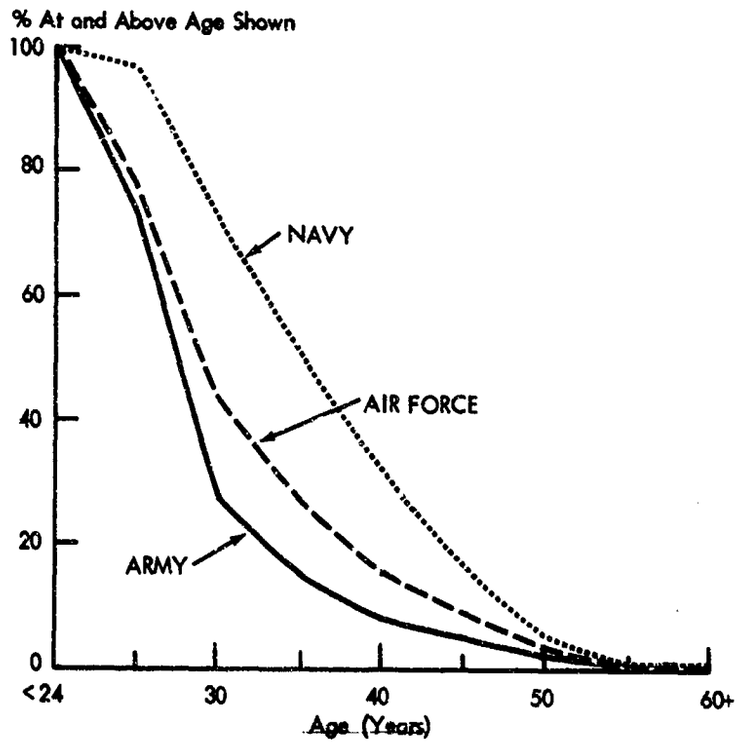


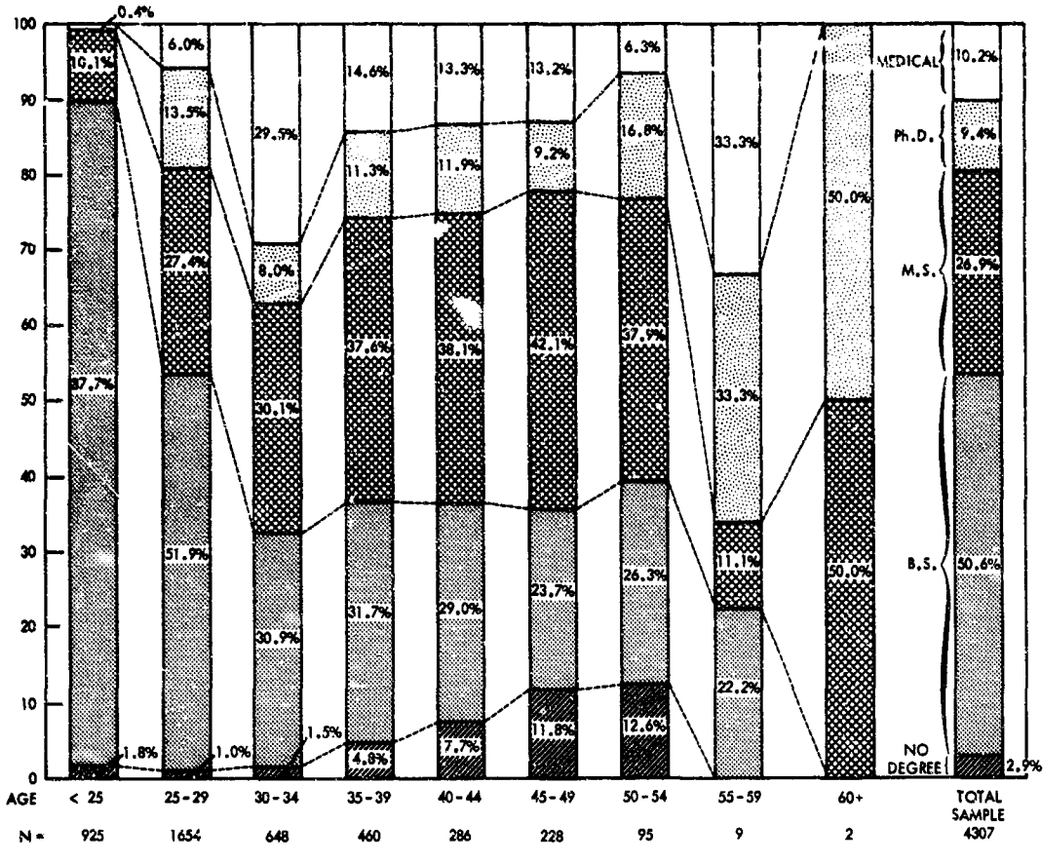
AGE

The Navy is the oldest group, with a median age of about 35 years. The median age of the Army is slightly above 28 years. Only 8 percent of the Army sample is 40 years or older, compared to about 32 percent for the Navy.

Army	Navy	Air Force	AGE GROUP (Years)	%
25.8	3.0	21.8	20-24	21.5
47.3	23.9	35.0	25-29	38.4
11.4	22.9	16.1	30-34	15.0
7.6	18.2	11.5	35-39	10.7
3.6	15.7	7.1	40-44	6.6
2.6	11.2	6.1	45-49	5.3
1.6	4.2	2.3	50-54	2.2
0.3	0.5	0.1	55-59	0.2
-	0.5	-	60+	*





AGE DISTRIBUTION, BY DEGREE LEVEL

The overall military sample shows about 48 percent with advanced degrees. For military S&Es from 30 to 55 years of age, over 60 percent hold advanced degrees. The 30- to 34-year age group contains the highest percentage of doctorates because of the dominance of medical degrees (M.D., D.D.S. and D.V.M.).