PATTERNS OF CHANGE IN THE LONG-RUN CAREER FIELDS OF JUNE, 1961, COLLEGE GRADUATES

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An important element in the process of allocating the current scarce supply of trained manpower to the wide range of positions that must be filled is the decisions of the individuals involved. Persons may change their minds regarding their field of study or the one they are preparing to work in during college and after graduation as well. Such decisions may have an impact on the distribution and quality of talent available to a given field. This paper is a preliminary analysis of changes in the prospective career fields of one college graduating class, covering a time span from the freshman year to three years after graduation.

In the spring of 1961 the National Opinion Research Center began a longitudinal survey of that year's June college graduating class. After a sample of 135 institutions was drawn, officials at each were asked for lists of prospective recipients of the collegiate bachelor's degree. All 135 co-operated, and from their lists a sample of about 41,000 names was drawn. Each of the students in the sample received a self-administered questionnaire to fill out and return to NORC. New questionnaires were sent in the spring of each year through 1964. In 1961, 85 per cent returned usable questionnaires. The figures for subsequent waves are: 1962, 76 per cent; 1963, 71 per cent; and 1964, 60 per cent. The last was in response to a very long mailed questionnaire of twenty-four pages for the men and forty-four for the women.[1]

Each of the questionnaire waves included questions on current career decisions, such as planned or actual enrollment in graduate school, employment, and plans for the future--expected career field, anticipated career activities, etc. The senior-year questionnaire also asked about college experiences, social backgrounds, and so on. All in all, we have a rather complete set of data on the aspirations and activities of our sample and how these have changed over time.

This paper deals with changes in respondents' long-range plans regarding the field--generally corresponding to an academic discipline--in which they plan to work during their career. The actual question is:

> Which field from the list. . .best describes your anticipated career field? Please enter the code number of the field you expect to be your long-run career and ignore any stop-gap job or temporary military service which might precede it.

The list contained about one hundred fields, ranging from classical languages to veterinary medicine. These detailed fields have been grouped for this analysis into the following twelve broad categories: physical sciences, biological sciences, social sciences, humanities, engineering, medicine, health fields other than medicine, education, business, law, the remaining fields listed--here called "other professions"--and NEC (not elsewhere classified), which for the men who are the subject of this paper refers to a code indicating that no field on the list closely corresponds with the person's career field intentions.

There are many approaches to the analysis and description of changes taking place in longitudinal data. Transition probability matrices can be compared to see if the change processes are the same over two or more different time spans. They can also be compared across categories of an independent variable to see whether different conditions imply different change processes. Another approach is to try to fit the observed process to a statistical model: Markov chains, or the stayer-mover model, for example.[2] Still another method is that adopted by James A. Davis for dealing with the first part of the data presented here. Using the same categories listed earlier, he analyzed the associations of a variety of independent variables with being in a field as a freshman, staying in it, or leaving it during college.

My concern today is different from those just enumerated, the enumeration being to specify what I am <u>not</u> going to do. In an effort to see whether there are patterns of change among fields regardless of the number of people entering and leaving them, independence values were computed just as with chi-square. These are compared with the observed values, with the cells markedly exceeding chance used as the basis for describing the patterns of change. A clearer idea of the procedure will come with discussion of the actual results. This discussion will be confined to men in order to avoid the complications that might arise concerning women's rather different career aims.

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[2]Leo A. Goodman, "Statistical Methods for Analyzing Processes of Change," <u>American Journal of Sociology</u>, LXVIII (1962), 57-78, and "Statistical Methods for the Mover-Stayer Model," <u>Journal of the American Statistical Association</u>, LVI (1961), 841-68.

Before turning to the data on changes in career plans, one manpower-related question can be answered rather quickly. As Table 1 shows, the distribution of career fields for the men changed markedly between the freshman and senior years. Business, the social and biological sciences, education, and the humanities made marked relative gains; engineering, medicine, and other health fields suffered marked losses. After graduation, however, the picture is rather different. The distribution for the senior year is quite similar to that for the third year after graduation. With the exception of "NEC," which is too ambiguous to analyze, the largest absolute change is the 5 per cent gain for business, a 21 per cent relative gain. Other absolute changes do not exceed 2 per cent; relative ones rarely exceed 10 per cent. In the years immediately after college graduation none of the broad fields gains or loses much in comparison with the others, and the supply of manpower to various fields provided by this cohort, at least, does not shift markedly from one field to another.

Table 1 gives only the net balance among fields and says nothing about the number of individuals who may have changed fields in bringing that balance about. Table 2 gives the percentages of men who reported the same field for each of the two time periods. Overall, 58 per cent of all respondents reported the same career field in the senior year as in the freshman, and 70 per cent made the same report for the period spanning the senior year and the third year after graduation. (This is not a direct estimate of stability, since some of these men may have moved out of a field and then back into it again during the time period in question.) It seems apparent, however, that there was considerably less changing after graduation than before in all fields except education.

Such stability poses problems in the analysis of changes. If the analysis were to be done on all men in the sample, changers and nonchangers alike, patterns of change would tend to be swamped by the overriding presence of the nonchangers. The method adopted here--comparing observed with expected values as in chi-square computations--suffers particularly from this drawback. Accordingly, all cases which failed to show a change from one time to the next were eliminated before the computation of expected values. These are the cases in the top left to lower right diagonal of the tables.

Expected values were computed on the basis of statistical independence between time 1 and time 2. However, the statistic analyzed is not the traditional single-valued chi-square, but the ratio of observed to expected values. There is, of course, one of these ratios for every cell in the table, just as there is an expected value for every cell. This fact is at present the source of some difficulty, since there are expected values for the diagonal which was made empty by excluding nonchangers. This means that all off-diagonal expected values are slightly too low, on the average by a factor of one-twelfth. A gross adjustment to take this problem into account has been made and will be described shortly.

The matrix of O/E values contains 132 (144 - 12) cells of interest, the values of which range from zero up. Since scanning the matrix was done by the "eyeball" method, two criteria were established in order to simplify the search for structure: the higher was an O/E value of 2.000 or greater, the lower a value ranging from 1.500 to 1.999. The former characterizes all ratios that occur at least twice as often as chance, the latter ratios between one and one-half and twice as likely as chance. A crude adjustment for the presence of expected values in the diagonal was made by multiplying two, and one and one-half, by 13/12 to give the cutting points actually used, 2.167 and 1.625.

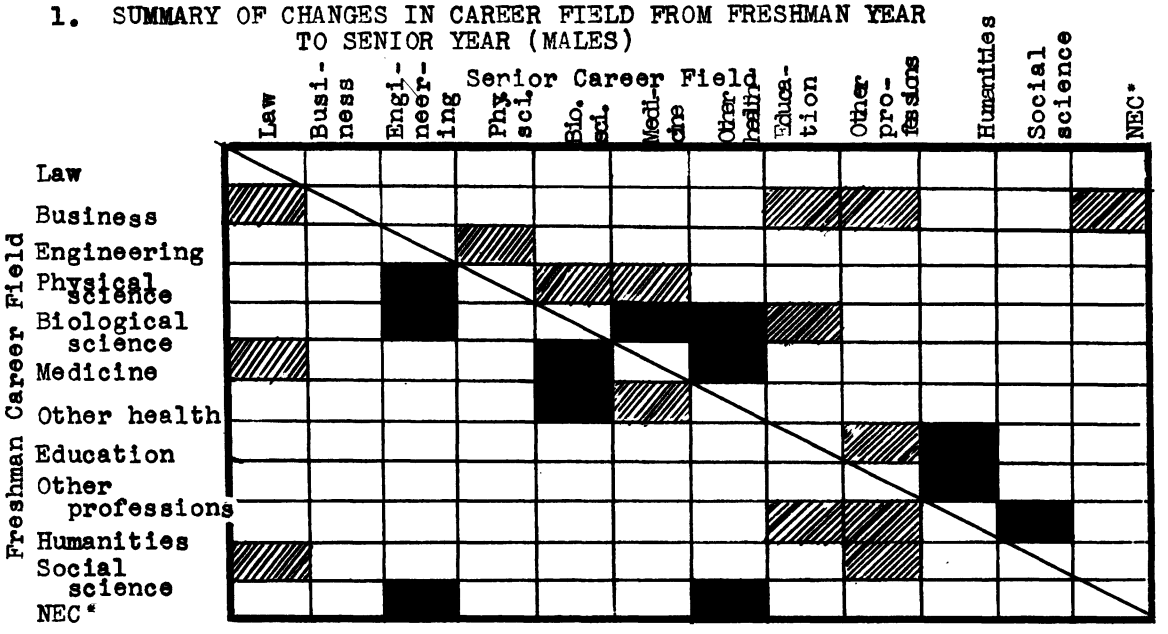
The O/E values for two time periods are shown in Charts 1 and 2--(1) from the freshman to senior years in college, and (2) from the senior year to three years after graduation. Chart 1, summarizing patterns of change during the earlier time period, shows a rather definite structure which will be clarified in the later one. Starting at the top and going down to the right, we see some sign of a relation between law and business, more definite links between engineering and the physical sciences, and a triplet composed of the life sciences-related fields of biology, medicine, and "other health." Finally, there is a rather amorphous cluster including humanities-education and humanities-social science doublets.[3]

On the whole, results for the period beginning with the senior year are similar to those for the earlier period, as Chart 2 shows. The business-law cluster is joined by an engineering-business pair. Engineering and the physical sciences continue to be linked; the biological sciences are related to the physical sciences as well as to the two health-related categories. In fact, the fields ranging from law to "other health" form a kind of chain whose links are directional. That is, the flow of changers may exceed independence values both into and out of a given pair of fields, like engineering and the physical sciences. In the chain from Chart 2 all links are two-directional except the first; law does not supply a disproportionately large number of recruits to business, perhaps because prospective lawyers were still in school and lacked the employment experiences that might bring about such a change.

Continuing down the diagonal of Chart 2, we see that the amorphous cluster mentioned in connection with Chart 1 has split into two pairs--the social sciences with "other professions" and humanities with education. Even so,

[3]Since the charts merely summarize the data, two sets of tables are appended: the actual numbers of weighted cases involved and the O/E values on which this discussion is based.

1. SUMMARY OF CHANGES IN CAREER FIELD FROM FRESHMAN YEAR TO SENIOR YEAR (MALES)

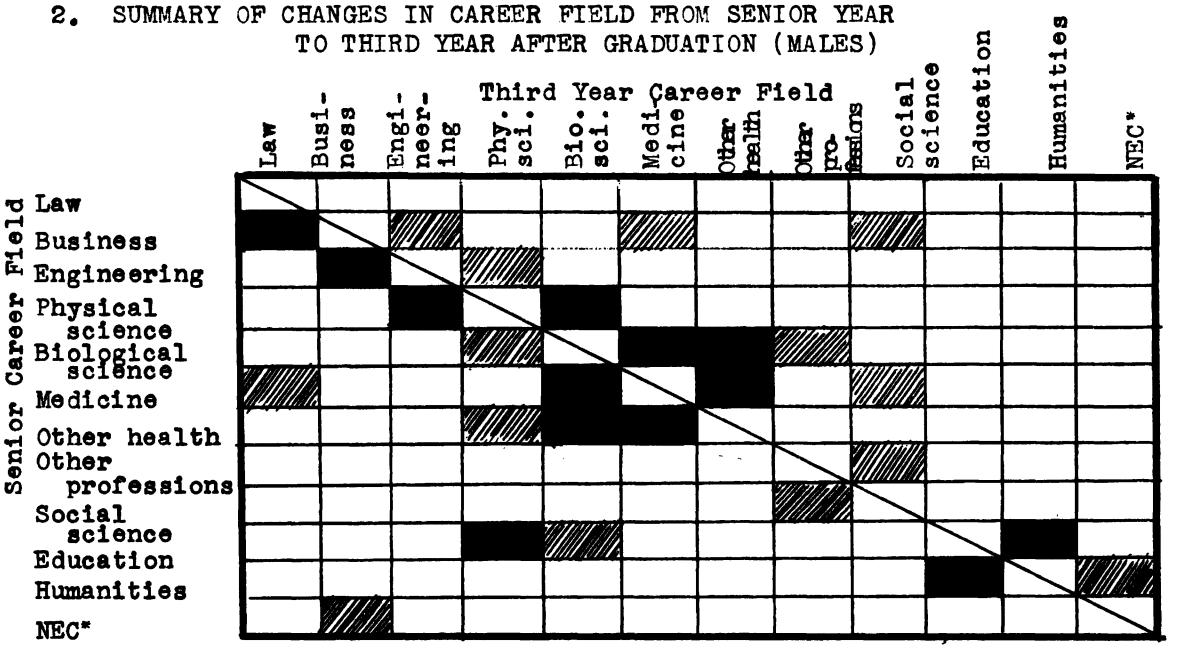


*NEC is "not elsewhere classified."

O/E > (13/12) 2.000

(13/12) 1,999 > O/E > (13/12) 1.50

2. SUMMARY OF CHANGES IN CAREER FIELD FROM SENIOR YEAR TO THIRD YEAR AFTER GRADUATION (MALES)



*NEC is "not elsewhere classified."

O/E > (13/12) 2.000

(13/12) 1,999 > O/E > (13/12) 1.50

the pattern of Chart 2 is on the whole quite similar to that for the college period.

But some of the differences are rather interesting. It is a well-known fact of life in the business world that some engineers will move into management; otherwise their career mobility is likely to be limited. Also, some engineers function as salesmen, drawing on their professional training to some extent. There is no evidence for such a switch in career plans during the college years, but it is quite clear for the period after graduation. There is also a weaker movement in the other direction. Perhaps some businessmen see a rosier future in the technical sphere.

Another difference between the two time spans involves the undergraduate linkage between the humanities and social sciences, which disappears after graduation. Instead the social sciences become consumers, as well as producers, of "other professionals." The actual fields involved in this interchange are probably sociology and clinical psychology on the one side and social work on the other.

The humanities-education link is a stable one, probably indicating movement of English and history people in terms of teaching those subjects to high school versus college students. Interestingly enough, the humanities are the only supplier of educators. In other words, physical, biological, and social scientists are not extraordinarily likely to add to the supply of trained elementary and secondary school teachers. These data apply to men only, of course. Perhaps this deficit is made up by the women.

One general configuration underlying the clustering seems to be a back-and-forth movement between substantively similar fields along a pure-applied dimension: engineering-physical sciences, biology-medicine, social sciences-"other professions," etc. Another reflects patterns of career development in the business world, engineering to business. That career field changes exceed chance among groupings of similar fields can be explained in part by the constraints imposed by training. If one is going to change fields, it is easier to go into a field with which one has some familiarity than to start all over again. An interesting problem raised by the existence of these clusters is the correlates of movement in one or the other direction. For example, do the abler men move from the applied to the pure fields or in the opposite direction; or is ability unrelated to such changes?

Up to this point, I have paid little attention to the order in which the fields have been presented except to note the chainlike relations among certain fields in the second time period. The order, which maximizes the number of cells adjacent to the diagonal, was partially dictated by the data--partially because more than one order is possible, even under the diagonal-maximizing criterion.

The order for the first time period is different from that for the second. Of the twenty-seven first-period ratios meeting the 1.625 minimum, sixteen, or 59 per cent, were as close to the diagonal as they could be.[4] For the second time period, eighteen of the twenty-seven values (67 per cent) were as close to the diagonal as possible. If the post-college order were imposed on the college data, the "fit" to the diagonal would be 13/27, or 48 per cent, a decline of 11 per cent.

The ordering of Chart 1 is interesting for another reason. Table 1 is arrayed according to the magnitude of relative change among the twelve fields over the undergraduate years, starting with the largest net gain and ending with the greatest net loss. When the freshman-senior net turnover data are arranged in that order, the fields with the greatest gains make those gains from nearly every field "under" them, and the fields with greatest losses lose to nearly every field "over" them.[5] Yet the order of Table 1 is very different from that of Chart 1. In other words, an adequate description of the net gains and losses between fields does not correspond with the ordering which describes the links between them.[6] This is not to say that one or the other of the two different descriptions is more desirable or accurate than the other, only that they refer to different aspects of the same data.

In addition to the table summarized in Chart 2, data are available for each of the three one-year time spans (including that beginning with the senior year) of the post-college period. Though the data are not presented here, they have a structure which closely resembles that of the four-year span reported here. The optimum order originally found was somewhat different from that given here, but when the present order is imposed the percentages along the diagonal are exactly the same for two of the time periods and less by one cell for the other, clustering around 70 per cent. Most of the doublets from the longer span occurred in the one-year ones, and the triplet was always present. The off-diagonal cases differed to a greater extent and were not nearly as stable as the ones next to the diagonal. In other words, the year-by-year patterns of change are reflected in Chart 2, which covers the entire post-college period.

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[4] The biological sciences-"other health" links are one step removed from the diagonal, which is as close as they can be, since they are members of a triplet.

[5] Cf. James A. Davis, Undergraduate Career Decisions (Chicago: Aldine Publishing Company, 1965), 23-26.

[6] This difference stems, in part, from logical necessity. Of any two fields, only one may gain at the expense of the other. But, where this is the dominant pattern for the college years, it is much less important after graduation.

TABLE 1

DISTRIBUTION OF LONG-RUN CAREER FIELD OF MEN, FRESHMAN AND SENIOR YEAR IN COLLEGE, AND THIRD YEAR AFTER GRADUATION

Long-run Career Field	Freshman Year	Senior Year	Third Year after Graduation	Relative Change	
				Freshman-Senior (Per Cent)	Senior-Third Year (Per Cent)
NEC[a]	1.7	3.6	2.4	+112	-33
Social science	2.0	3.6	3.2	+ 80	-11
Business	15.7	23.8	28.7	+ 52	+21
Humanities	3.4	4.6	4.2	+ 35	- 9
Education	11.7	15.7	15.3	+ 34	- 3
Biological science	1.5	2.0	2.2	+ 33	+10
Law	5.1	6.0	6.0	+ 18	0
Other professions	10.9	11.5	12.2	+ 6	+ 6
Physical science	9.2	8.0	6.0	- 13	-14
Other health	3.5	2.2	2.2	- 37	0
Medicine	7.6	4.7	4.2	- 38	-11
Engineering	27.8	14.5	12.5	- 48	-14
Total	100.1	100.2	100.0		
Base N	17,545	19,324	19,180	$\lvert\Sigma\rvert$ 506	132
NA	2,148	369	513	$\lvert\bar{X}\rvert$ 42	11
Total weighted N[b]	19,693	19,693	19,693		

[a]NEC = "not elsewhere classified."

[b]Students in the larger undergraduate institutions were over-sampled, leaving some of the smaller schools underrepresented. Responses from the smaller colleges have been weighted so that the sample corresponds to a straight probability one.

TABLE 2

PERCENTAGE OF MEN WITH SAME CAREER FIELD AT AT TIME 2 AS AT TIME 1, BY CAREER FIELD

Long-run Career Field	Freshman-Senior	Senior-Third Year
Law	59.9 (877)	73.5 (1,142)
Business	76.2 (2,735)	81.9 (4,484)
Engineering	49.6 (4,825)	73.1 (2,743)
Physical science	54.2 (1,613)	69.9 (1,513)
Biological science	44.2 (258)	64.7 (374)
Medicine	50.7 (1,324)	82.5 (874)
Other health	41.6 (603)	71.1 (412)
Other professions	58.9 (1,883)	64.7 (2,175)
Social science	37.5 (344)	49.2 (666)
Education	74.4 (2,017)	72.6 (2,925)
Humanities	46.6 (583)	55.1 (856)
NEC[a]	66.8 (292)	17.4 (674)
Total	58.3 (17,354)	70.5 (18,838)
NA, Time 1 or Time 2	2,339	855
Total weighted N[b]	19,693	19,693

[a]See footnote, Table 1.

[b]See footnote, Table 1.

Two possibilities are opened up by these findings. The first is encompassed by the present discussion: the cells with O/E values of at least 1.625 can be treated as doublets and triplets which tend to form a chain. Taking the O/E values, or rather their reciprocals, as quantitative measures of the distance between fields, one could attempt to construct a higher dimensional model which took account of all 132 cells and not just the largest ones. The results would probably be rather complex, however, and might extend beyond the third dimension, in which case visualization would be impossible.

The second possibility for further analysis is the pinpointing of pairs and triplets. Movement between these groups can be analyzed along lines traditional in survey research. What are the characteristics of the changers, and do these characteristics differ when movement is in one direction rather than another, etc.?

In summary, then, the procedure of eliminating stable cases and examining the O/E values for men who changed their long-run career fields has shown that "affinities" exist between certain pairs or triads of fields. Since there are more changers in some fields than in others, these affinities do not necessarily describe those fields furnishing large numbers of recruits to other fields. However, these findings do describe, for the period immediately after college graduation, an important facet of the interchange between broad classes of fields.

TABLE A-1

FRESHMAN CAREER FIELD BY SENIOR CAREER FIELD

(N)

Freshman Career Field	Senior Career Field											
	Law	Business	Engineering	Physical Sciences	Biological Sciences	Medicine	Other Health	Other Professions	Social Sciences	Education	Humanities	NEC[a]
Law	525	140	3	7	2	8	3	58	27	40	38	26
Business	102	2,084	19	24	2	10	2	147	60	181	45	59
Engineering	162	903	2,392	388	35	56	36	241	98	289	77	148
Physical sciences	53	162	86	875	41	53	8	83	44	101	56	51
Biological sciences	0	13	13	3	114	20	8	23	15	41	6	2
Medicine	82	137	28	52	77	671	62	46	54	55	36	24
Other health	19	104	13	10	30	19	251	50	14	84	4	5
Other professions	47	174	40	28	28	9	8	1,109	64	187	149	40
Social sciences	26	49	6	4	1	5	2	50	129	42	24	6
Education	25	119	27	35	26	2	10	125	54	1,501	77	16
Humanities	10	43	2	15	0	12	5	67	48	97	272	12
NEC[a]	5	17	10	8	0	2	9	18	3	23	2	195

N	16,111
NA on either freshman or senior career field	3,582
Total N	19,693

[a]See footnote, Table 1.

TABLE A-2

FRESHMAN CAREER FIELD BY SENIOR CAREER FIELD

(Observed/Expected Values)

Freshman Career Field	Senior Year Career Field											
	Law	Business	Engineering	Physical Sciences	Biological Sciences	Medicine	Other Health	Other Professions	Social Sciences	Education	Humanities	NEC[a]
Law	0.000	1.546	0.250	0.251	0.170	0.839	0.403	1.313	1.154	0.721	1.520	1.374
Business	2.135	0.000	0.855	0.465	0.092	0.567	0.145	1.799	1.387	1.765	0.973	1.686
Engineering	0.907	1.443	0.000	2.010	0.430	0.850	0.700	0.789	0.606	0.754	0.446	1.132
Physical sciences	0.979	0.854	3.414	0.000	1.661	2.651	0.513	0.896	0.897	0.869	1.068	1.285
Biological sciences	0.000	0.351	2.645	0.263	0.000	5.128	2.627	1.273	1.567	1.807	0.587	0.258
Medicine	1.711	0.816	1.256	1.004	3.526	0.000	4.490	0.561	1.244	0.535	0.776	0.684
Other health	0.736	1.149	1.082	0.358	2.548	1.993	0.000	1.132	0.598	1.515	0.160	0.264
Other professions	0.827	0.874	1.514	0.456	1.082	0.429	0.489	0.000	1.244	1.534	2.710	0.961
Social sciences	1.648	0.886	0.818	0.235	0.139	0.859	0.440	1.853	0.000	1.240	1.571	0.519
Education	0.660	0.897	1.533	0.855	1.507	0.143	0.917	1.931	1.574	0.000	2.101	0.577
Humanities	0.438	0.538	0.188	0.608	0.000	1.425	0.760	1.717	2.322	1.980	0.000	0.718
NEC[a]	0.702	0.681	3.020	1.040	0.000	0.761	4.388	1.479	0.465	1.505	0.290	0.000

[a]See footnote, Table 1.

TABLE A-3

SENIOR YEAR CAREER FIELD BY THIRD YEAR CAREER FIELD

(N)

Senior Career Field	Third Year Career Field: Law	Business	Engineering	Physical Sciences	Biological Sciences	Medicine	Other Health	Other Professions	Social Sciences	Education	Humanities	NEC[a]
Law	839	137	15	10	0	4	2	45	21	39	22	8
Business	127	3,671	96	25	3	20	9	206	64	161	23	79
Engineering	29	480	2,005	65	3	5	4	80	3	24	1	44
Physical sciences	7	115	105	1,057	32	3	10	49	9	70	12	44
Biological sciences	0	22	1	10	242	20	18	42	1	14	1	3
Medicine	18	18	1	3	31	721	36	22	12	7	4	1
Other health	3	38	2	9	14	10	293	14	4	23	0	2
Other professions	49	303	40	15	26	6	12	1,407	75	118	57	67
Social sciences	20	75	4	14	1	2	8	109	328	70	26	9
Education	18	201	22	88	44	0	16	183	42	2,124	150	37
Humanities	13	51	10	3	0	5	0	66	18	179	472	39
NEC[a]	20	305	47	10	7	5	5	78	14	52	14	117

N 16,111

NA on either freshman or senior career field . 3,582

Total N 19,693

[a]See footnote, Table 1.

TABLE A-4

SENIOR YEAR CAREER FIELD BY THIRD YEAR CAREER FIELD

(Observed/Expected Values)

Senior Year Career Field	Third Year Career Field: Law	Business	Engineering	Physical Sciences	Biological Sciences	Medicine	Other Health	Other Professions	Social Sciences	Education	Humanities	NEC[a]
Law	0.000	1.441	0.803	0.728	0.000	0.918	0.306	0.924	1.466	0.946	1.303	0.441
Business	2.858	0.000	1.915	0.679	0.127	1.710	0.513	1.576	1.665	1.455	0.508	1.623
Engineering	0.719	2.073	0.000	1.944	0.140	0.471	0.251	0.674	0.086	0.239	0.024	0.996
Physical sciences	0.281	0.804	3.734	0.000	2.424	0.457	1.016	0.669	0.417	1.128	0.472	1.612
Biological sciences	0.000	0.531	0.123	1.672	0.000	10.534	6.320	1.980	0.160	0.779	0.136	0.380
Medicine	2.152	0.375	0.106	0.433	7.000	0.000	10.906	0.895	1.659	0.336	0.469	0.109
Other health	0.461	1.018	0.273	1.669	4.064	5.842	0.000	0.732	0.711	1.420	0.000	0.281
Other professions	1.167	1.258	0.845	0.431	1.170	0.543	0.724	0.000	2.065	1.129	1.332	1.457
Social sciences	1.083	0.707	0.192	0.914	0.102	0.411	1.097	2.006	0.000	1.522	1.380	0.445
Education	0.411	0.800	0.445	2.425	1.898	0.000	0.926	1.421	1.109	0.000	3.360	0.772
Humanities	0.619	0.423	0.422	0.172	0.000	0.905	0.000	1.069	0.991	3.425	0.000	1.696
NEC[a]	0.657	1.745	1.368	0.396	0.434	0.624	0.416	0.871	0.532	0.686	0.451	0.000

[a]See footnote, Table 1.