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Adolescents' Perceptions of Scientific Occupations

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ABSTRACT

Four-hundred-seventeen ninth and twelfth grade students in Virginia were surveyed about their perceptions of three scientific careers (biology, chemistry, and psychology) and three control occupations. Substantial inaccuracies, lack of information about careers in science, and stereotypic impressions about scientific work recommend attention to providing students with accurate information about careers in science.

INTRODUCTION

A number of recent reports have suggested that within a generation, there will be a shortfall of half a million scientists in the United States (ETS, 1988; IAEEI, 1988; NSF, 1983). Although much of the responsibility for this shortfall is attributed to inadequate training in science and mathematics in the primary and secondary schools (Hawkins, 1990), there are clearly other factors which lead to the nonselection of scientific careers and courses of study. One important factor is the affective nature of science classes. In their analysis of the responses to the affective component of the National Assessment of Educational Progress in Science, Yager and Penick (1984) found that few adolescents reported that their science teachers take a personal interest in them or encourage them, and less than half of the 13-year-olds and fewer than a third of the 17-year-olds like going to science class or think that science class is fun.

Another potential contributor to the avoidance of science careers is whether adolescents have accurate concepts and positive perceptions about the nature of scientific occupations. Most of the research in the area of adolescents' perceptions of science is derived from a classic paper by Meade and Metraux (1957) in which it was found that high school students stereotyped scientists as being smart, elderly, always reading and making notes, looking for sudden solutions, working in a laboratory setting, and doing work that is dangerous for the scientist himself and for society at large. This work was closely replicated with highly similar findings by Beardslee and O'Dowd (1961), extended to younger children by Lowery (1967), and Ashton and Meredith (1969) found similar stereotypes among British students.

The present paper examines whether such stereotypes of the scientist still exist and extends the study of the scientist's "personality," by including questions related to adolescents' knowledge and perceptions of aspects of scientific occupations.

METHOD

Subjects

Questionnaires were administered to 417 students, drawn from college-bound and advanced placement English classes in three Virginia school systems (one urban [N = 167], one rural [N = 122], and one small city [N = 138]), approximately the same number from the 9th (N = 221) and 12th (N = 196) grades. It was decided to survey English classes in order to obtain a representative sample of college-

bound students, as all students take English each year, while science and mathematics courses are elective during the 12th grade.

Measurement

The first part of each survey asked students to check which of 15 characteristics applied to six occupations, three scientific (chemist, biologist, and psychologist) and three nonscientific (police officer, politician, and astronaut). A yes/no response format was used. The phrasing used for these characteristics were: "makes a good salary," "needs to go to college," "works hard," "is honest," "is smart," "needs to know math," "is considered a scientist," "reads a lot," "writes a lot," "is kind," "is good looking," "is strong," "is brave," "is most likely a man," and "is most likely young." The second part of the survey asked students to write brief descriptions of what persons from the six occupations do "when they go to work." Age, sex, and career aspiration demographic information was also collected. Twelfth grade students were asked to list the science and math courses in which they were currently enrolled.

RESULTS AND DISCUSSION

Table 1 shows the overall results of Part I of the surveys. All traits were compared using the χ^2 statistic. Because of multiple comparisons, the 0.01 level of significance was used. Significant differences were found for all traits across the six occupations.

Comparisons of traits were also made by age and sex of respondents. No significant differences between boys and girls were observed at the .01 level among the three scientific occupations. Table two reports age differences for the three scientific occupations. Here a single comparison was significant at the 0.01 level (fewer 12th grade students indicated that chemists were kind than 9th grade students). That there was little change is not surprising in light of Chambers (1983) study which found that stereotyping of scientists is well established by second and third grade. There were significant differences related to age and in the three comparison professions (e.g., honesty ratings increase with age for police and decreased for politicians; boys and girls had significantly different ratings of sex-type in politicians and astronauts).

The lack of change in perceptions of scientific professions over age would be of little concern if the perceptions of the younger students were accurate. In general, however, neither the younger nor the older college-bound students provided particularly accurate descriptions for the scientific professions. The majority of students did not view reading and writing as important parts of any of the scientists' roles. While mathematics was viewed as part of the chemist's occupation/training by 87% of the respondents, only 45% of the students indicated that biologists needed mathematics and only 38% said that psychologists needed mathematics. Seventeen percent of the students did not believe that a chemist needed a college education. While 84% of students indicated that psychologists should be kind, only 29% considered them scientists, and only 49% indicated one had to be smart to be a psychologist.

A majority of students believed chemists, police, politicians, and astronauts "made a good salary," while less than half felt psychologists or biologists did so. Fewer students believed that scientists worked hard, compared to police and

TABLE 1. Percent of students answering "yes" to which characteristic applied to an occupation.(Occupations were PSY-Psychologist, CHE-Chemist, BIOL-Biologist, AST-Astronaut, POLI- Police officer, POLI-Politician)

	OCCUPATION					
CHARACTERISTIC	PSY	CHE	BIOL	AST	POLI	POLT
1. Good salary	47	85	43	71	59	92
2. Needs college	97	83	96	93	27	44
3. Works hard	67	59	69	77	74	33
4. Is honest	85	92	81	90	66	28
5. Is smart	49	88	62	71	41	27
6. Needs math	38	87	45	39	21	19
7. Is a scientist	29	99	99	72	3	4
8. Reads a lot	40	38	44	32	28	55
9. Writes a lot	32	34	45	12	44	51
10. Is kind	84	55	64	50	40	9
11. Is good looking	34	33	41	78	26	61
12. Is strong	23	20	34	60	91	17
13. Is brave	41	16	60	97	77	12
14. Is a man	14	28	20	33	45	77
15. Is young	22	27	21	44	38	16

TABLE 2 Comparison of the percentages of 9th and 12th grade students answering "yes" for characteristics which applied to scientific occupations.

	OCCUPATION					
	PSYCHOLOGIST		CHEMIST		BIOLOGIST	
CHARACTERISTIC	9th	12th	9th	12th	9th	12th
1. Good salary	51	43	83	88	40	46
2. Needs college	95	99	79	87*	95	96
3. Words hard	64	70	55	63	66	73
4. Is honest	88	83	92	91	85	78
5. Is smart	55	45	87	88	60	64
6. Needs math	33	43*	85	88	44	45
7. Is a scientist	27	32	98	100	99	100
8. Reads a lot	36	44*	36	40	43	45
9. Writes a lot	28	34	33	35	42	48
10. Is kind	80	88	61	49**	63	66
11. Is good looking	30	37	32	34	39	43
12. Is strong	24	21	18	24	30	38
13. Is brave	43	39	14	18	55	66*
14. Is a man	17	11	30	27	22	17
15. Is young	19	25	25	28	20	22

** $p < 0.01$.
* $p < 0.05$.

TABLE 3. Most Frequent Descriptions of Work Activities. [Numbers in parentheses are the percent of responses which included these descriptions.]

Chemist
1. Works in a factory (23)
2. Makes drugs (20)
3. Mixes chemicals (18)
4. Makes cosmetics/perfume (17)

Biologist
1. Finds cures for/treats diseases (20)
2. Studies marine mammals/fish (19)
3. Watches other animals (17)
4. Looks through microscopes (15)

Psychologist
1. Listens to people's problems (42)
2. Helps people solve problems (16)

Astronaut
1. Flies around in space (33)
2. Prepares to fly around in space (28)

Police
1. Arrests people (30)
2. Solves crimes (22)
3. Directs traffic (16)
4. Hassles people (12)

Politician
1. Lies (37)
2. Makes speeches (17)
3. Writes laws (11)

astronauts. It is worth noting, however, that scientific careers were less male-sex-stereotyped than the comparison occupations.

Thirty-seven students indicated that they planned to pursue a scientific career (10 biology, 4 chemistry, 2 physics, 3 "scientist," 5 engineers, and 13 psychology); 12 students indicated an interest in a career involving computers; and 23 students planned on careers in health care. It is of some interest that there were no differences in the percentage of seniors planning science-related careers (N = 34) who were taking science courses (50%) or math courses (61%), compared to those seniors indicating a non-scientific career goal (N = 129; 48% science, 58% math) or those who did not have a career goal (N = 33; 52% science, 64% math).

Table 3 presents the components of the job descriptions written by students that were included in a minimum of 10% of the responses. Chemists were characterized

as working in factories making drugs and cosmetics. Biologists were seen as finding cures for and treating diseases and observing animals, particularly sea mammals. Psychologists were described entirely in terms of counseling.

Unlike the study by Meade and Metraux, only 20% of the students mentioned laboratory work for any of the science occupations, and less than 2% of the students mentioned danger. Less than 3% of the students mentioned the scientific method or experimentation. Only four responses mentioned teaching. Twenty percent of students indicated that they did not know what psychologists did, 24% did not know what chemists did, and 13% did not know what biologists did.

In general, these results indicate that students know very little about scientists. The perceptions of the students seem much more influenced by popular media accounts of scientists' careers (hence the emphasis on marine biology, industrial chemistry, and counseling psychology) than by a broader view of the professions. It is perhaps too much to ask of public school science educators to provide career information in addition to instruction; organizations such as the Virginia Academy of Science, colleges and universities, and research corporations, as well as individual scientists, could provide the necessary resources to give students more accurate information about scientific training and career options.

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