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ENTRANCE OF BLACKS AND WOMEN INTO MANAGERIAL POSITIONS IN SCIENTIFIC AND ENGINEERING OCCUPATIONS: A LONGITUDINAL ANALYSIS

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This longitudinal study of a national sample examined the effects of workers' gender and race on their entrance into managerial positions in public and private organizations over a period of four years. Results suggested that black workers had promotion advantages in both sectors and that women had promotion advantages in the private sector.

Empirical evidence reveals low representation of women (e.g., Auster, 1988; Hartmann, 1987; Kanter, 1977) and blacks in management (e.g., Davis & Watson, 1982; Killingsworth & Reimers, 1983). For the years covered by the current study, 1982–1986, approximately 30 percent of U.S. managers were women, and 3 to 4 percent were blacks (International Labor Office, 1986; Zweigenhaft, 1987: 37) but the overall representation in the labor force of these groups was 44 and 10 percent, respectively. Representation of women and blacks tends to be far lower in the upper echelons of organizations than in lower management. For example, women hold only 2 percent of senior executive jobs (Brenner, Tomkiewicz, & Schein, 1989). Similarly, of the 6,543 directorship positions in the *Fortune* 500, only 2.8 percent are occupied by women (e.g., Dipboye, 1987; cf. Kesner, 1988).

An overwhelming majority of the studies that address organizational promotion are cross-sectional (e.g., Cannings, 1988; Hartmann, 1987; Stewart & Gudykunst, 1982) rather than longitudinal; exceptions include Killingsworth and Reimers (1983), Lewis (1986), and Olson and Becker (1983). Conclusions from a cross-sectional study can be misleading if a trend exists in the years prior to the investigation. Stewart and Gudykunst (1982), for example, found that men had higher hierarchical levels than women but that women received a greater number of promotions. Thus, low representation figures may reflect organizations' past denial of women's and blacks' access

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to managerial positions, without necessarily suggesting that such practices were prevalent at the time of an investigation. Cross-sectional studies cannot separate egalitarian promotion systems introduced by employers in recent years from earlier wrongdoings because managerial positions examined at one point in time reflect both old and recent promotion policies implemented by organizational decision makers.

My main objective in this study was to separate recent from past discrimination practices concerning entrance into management by following a group of employees over a period of four years, 1982–86. I examined their promotion from nonmanagerial to managerial positions and estimated the extent to which gender and race played, *ceteris paribus*, a significant role in promotion practices. In order to account for equal starting points, I compared individuals who were equally qualified in terms of human capital variables, such as experience and education (Becker, 1964), and other individual characteristics; the individuals studied were also equally situated in terms of organizational sector and job definition in 1982 (England & McLaughlin, 1979). Because it compares individuals who occupied identical starting points in 1982, this estimation of discrimination is rather conservative and is unaffected by possible discriminatory processes occurring in the determination of positions prior to 1982. However, I attempted to address the loss of respondents over the period under investigation. Known as sample selection bias, this is one of the most serious problems associated with discrimination studies using longitudinal data, as it may result in biased estimates.

HYPOTHESES

The pertinent literature suggests that women and minority group members are less likely than others to establish managerial careers because of a number of not mutually exclusive factors, such as differential socialization (e.g., Noe, 1988), self-selection (e.g., England, 1984; McCarthy, 1986), tokenism (e.g., Fairhurst & Snavely, 1983; Kanter, 1977), statistical discrimination (e.g., Phelps, 1972), and exclusion practices (e.g., Brass, 1985; Kanter, 1977). It is likely that the low representation of women and blacks in management reinforces the widely held stereotype that women and minority workers are less qualified for managerial positions than other workers. Employers and co-managers therefore tend to prefer to see white males in managerial positions since they ostensibly possess more of the characteristics conducive to good management. Several empirical studies have confirmed this argument (Brenner et al., 1989; Dubono, 1985; Powell & Butterfield, 1989; Taylor & Ilgen, 1981; Zweigenhaft, 1987). Thus,

Hypothesis 1: Women and blacks are less likely to enter managerial positions than equally qualified men and whites.

Empirical studies regarding the effect of gender on promotion to management have yielded inconclusive results, with some supporting the argu-

ment that gender has an effect (Cannings, 1988) and some not supporting it (Hartmann, 1987; Lewis, 1986; Stewart & Gudykunst, 1982). Furthermore, studies have concentrated on either private firms (e.g., Cannings, 1988) or public organizations (Lewis, 1986). Few have compared the public and private organizational sectors, despite theoretical indications of type of sector's importance in determining rates of entrance into management. In particular, researchers have assumed that organizations in the public sector are sensitive to their normative and legal environments. Studies have shown that political environments (Meyer, 1979; Warwick, 1975), public control (Holdaway, Newberry, Hickson, & Heron, 1975), and external legislation (Bansfield, 1975) influence public sector organizations. Civil rights and their implementation through Equal Employment Opportunity Commission programs and affirmative action laws have become major issues on the public agenda during the last three decades, leading to the expectation that their imprints will be found more often in public organizations than in private firms. Therefore,

Hypothesis 2: Women and blacks are more likely to enter managerial positions in the public sector than in the private sector.

One crucial assumption should be made explicitly. Although it is often maintained that women and blacks are more likely than their male, white counterparts to make conscious decisions not to pursue managerial careers, research has as yet been unable to substantiate this proposition. In fact, some empirical evidence suggests that women are as likely as men to aspire to managerial positions (Bailyn, 1987; Shenhav, 1991; Sutton & Moore, 1985). Thus, for the purpose of this study I assumed that, irrespective of gender or race, all individuals held similar aspirations at the start of the research regarding promotion to managerial positions.

RESEARCH DESIGN

Data

The data used in the analyses are based on a unique longitudinal national survey conducted during the 1980s by the U.S. Bureau of the Census for the National Science Foundation. The survey was administered biennially from 1982 through 1986 (U.S. Bureau of the Census, 1987). The 1982 sample represented individuals defined as belonging to the civilian labor force and pursuing engineering, scientific, or related occupations. Clearly, the occupations addressed in this study are dominated by white men. Women constituted 11.6 percent and blacks 2.8 percent of the three million scientists and engineers in the United States in 1983 (National Science Board, 1985: 235). Although access discrimination, or discrimination affecting entrance, is clearly a problem that needs to be addressed in occupations in which women and blacks are underrepresented, I focused in this study on

treatment discrimination, or discrimination affecting career progress, taking the presence of individuals in these occupations as given.

The census bureau survey was conducted by mail, with a telephone follow-up for nonrespondents. A total of 138,080 persons responded to the survey, constituting 82 percent of the men and 79 percent of the women in the survey panel. Follow-up surveys in 1984 and in 1986 were concerned primarily with updating the educational and work experience data collected earlier. In the analyses, I included individuals who were salaried employees, completed their questionnaires with no missing values for this study's variables, and were employed by private firms or public sector organizations. I excluded those who were already managers in 1982. After these selections, I ended up with 26,540 respondents in 1982. The longitudinal analyses drew on data on 13,509 individuals who responded in both 1982 and 1986.

Estimation

The group providing data for the present study was 49 percent smaller than the original group of 1982 respondents, and the survivors (the 1986 respondents) were more likely to be men and whites than women and blacks. In order to avoid the danger of sample selection bias, I used a method of correction known as the inverse of the Mills ratio (Heckman, 1980). Simply put, use of this variable controlled for differences between subjects in their chances of survival between 1982 and 1986. The inverse Mills ratio representing the probability of each person being included in the sample both times was incorporated into the "logit" regression analyses (Hanushek & Jackson, 1977) conducted at the individual level for time t_1 (1982, $N = 26,540$) and for the period $t_1 - t_2$ (1982-86; $N = 13,509$). The estimation of promotion differences was based on the assumption that the model was fully specified. In the absence of variables correlated both with gender or race and promotion, discrimination estimates might be upwardly biased.

The inverse Mills ratio was calculated on the basis of a "probit" equation (Hanushek & Jackson, 1977) estimating the probability of an individual's inclusion at time t_2 . The following variables were included in the probit equation: wage, gender, race, years of work experience, marital status, having small children, holding an M.A. degree, holding a Ph.D. degree, number of work hours per week, age and age squared, and two dummy variables indicating the discipline area of a respondent's highest academic degree; all variables were based on 1982 data. A significant positive coefficient for the inverse Mills ratio would indicate that individuals who had survived the selection process over the period under investigation were more likely to have entered managerial positions than those who had dropped out. Conversely, a significant negative coefficient would indicate that individuals who had dropped out were more likely to have entered management than those who had survived. Heckman (1980) and Blau and Beller (1988) provide further discussion and an example of the use of the inverse Mills ratio.

Variables

Complete definitions of variables appear in the Appendix. The dependent variable, entrance, was dichotomous, and reflected entrance into or no entrance into a managerial position between 1982 and 1986. The two main independent variables were gender and race. I included several control variables in the equations to hold constant the possible effects of individual promotion-related characteristics on entrance into managerial positions: individual characteristics in 1982, change in individual characteristics during 1982–86, and job characteristics. Positive gender and race effects significantly greater than zero would indicate that women or blacks had greater chances of entering managerial positions than did men or whites having the same attributes at time t_1 .

RESULTS

Table 1 presents the correlations among all the variables examined in the study. Table 2 presents descriptive statistics and the coefficients resulting from the logit regression analysis.

Results from further analyses are not presented in the tables owing to space limitations. In general, those data revealed that higher proportions of blacks and women were found in the public sector than in the private sector. In 1982, women constituted 30 percent and blacks 7 percent of those employed in public institutions. The equivalent figures in the private sector were 18 and 5 percent. Higher proportions of men were in managerial positions in both sectors: 36 percent of men versus 23 percent of women in the private sector, and 39 percent and 26 percent, respectively, in the public sector. Surprisingly, in the public sector, almost identical proportions of black and white workers were found in managerial positions: 35 percent of whites versus 23 percent of blacks in the private sector, but 36 and 35 percent, respectively, in the public sector.

Examining data on those who entered managerial positions between 1982 and 1986, I found differences between the private and public sectors. By and large, identical proportions of women and men were promoted to management in the private sector (21 percent), but the proportions differed in the public sector, with 23 percent of men and 16 percent of women promoted to those jobs. On the other hand, blacks enjoyed a slightly higher promotion rate than whites in the public sector (23 versus 21 percent), but not in the private one (17 percent for blacks and 21 percent for whites). However, these comparisons are insufficient to corroborate the existence of discrimination; logit analyses were necessary to compare the promotion rates of individuals who were equally qualified and equally situated.

Table 2 presents the logit coefficients for two equations each computed for employees in the two sectors; these are (1) a full equation including all the independent individual variables, since the discrimination estimation assumes otherwise identical characteristics among compared individuals

TABLE 1
Correlations^a

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1. Change to manager																									
2. Sector	-.01																								
3. Experience	-.01*	-.09*																							
4. Marital status	.04*	.02*	.16*																						
5. Children	.01*	.00	.02*	.06*																					
6. M.A.	.04*	.00	-.05*	-.01*	-.01																				
7. Ph.D.	-.02*	-.14*	.01	.01	.01	-.22*																			
8. Social sciences specialization	.00	-.13*	-.04*	-.01	.01	.00	.14*																		
9. Engineering specialization	-.04*	.15*	.10*	.06*	-.01	-.11*	-.15*	-.21*																	
10. Change to single	.01	-.00	-.02*	.07*	.01	-.01	.00	-.00	-.03*																
11. Change to married	.01	.01	-.15*	-.39*	-.04*	.00	-.02*	.00	-.02*	-.05*															
12. Children change	-.02*	.03*	-.21*	.02*	-.11*	.01	-.02*	.01	-.00	-.04*	.13*														
13. Education change	-.01	.00	-.03*	-.03*	-.00	-.02*	-.01*	-.00	-.00	-.00	.01	-.01													
14. Race	.01*	.04*	.04*	.03*	-.01*	-.02*	.02*	-.00	.04*	-.02*	-.00	-.00	-.00												
15. Gender	.02*	.13*	.23*	.19*	.04*	-.04*	.02*	-.05*	.25*	-.03*	-.08*	-.09*	-.01	.01											
16. Research	-.05*	-.19*	-.02*	-.01	.01	.02*	.35*	.05*	-.12*	.00	-.01	-.00	-.00	-.00	-.06*										
17. Technical writing	.00	-.09*	-.01*	-.03*	-.01	.02*	.00	.08*	-.05*	.02*	.02*	.01	.00	.00	-.06*	-.07*									
18. Design	-.04*	.10*	.04*	.03*	.01	-.02*	-.09*	-.09*	.29*	-.01	-.01*	-.01	.01	.01	.10*	-.14*	-.08*								
19. Quality control	-.01	-.03*	-.01*	-.02*	.01*	-.03*	-.05*	-.03*	-.01*	-.01	-.01	-.00	.01	-.03*	-.03*	-.09*	-.05*	-.10*							
20. Production	.06*	.02*	-.01	-.02*	-.01	-.07*	-.11*	-.05*	.07*	-.01	-.00	.01	-.01	.01	.06*	-.15*	-.08*	-.16*	-.11*						
21. Marketing	.05*	.10*	.00	.01	.01	-.05*	-.07*	.01*	-.10*	.01*	.01	-.01	.00	.02*	.02*	-.10*	-.06*	-.11*	-.07*	-.12*					
22. Statistical work	.01	-.03*	-.02*	-.02	-.00	.02*	.02	.14*	-.12*	-.01	.01	.02	-.00	-.00	-.04*	-.08*	-.04*	-.08*	-.06*	-.09*	-.06*				
23. Consulting	-.01	.05*	.05*	.05*	.02*	.05*	-.01*	.00	.04*	-.00	-.01	.00	-.00	.02*	.04*	-.10*	-.05*	-.10*	-.07*	-.11*	-.08*	-.06*			
24. Computer applications	.00*	.05*	-.06*	-.04*	-.02*	.01	-.04*	.01*	-.14*	.01*	.02*	.01	-.01	-.01	-.10*	-.10*	-.06*	-.11*	-.07*	-.12*	-.08*	-.06*	-.08*		
25. Other activity	-.01	-.17*	-.02*	-.03*	-.01	.03*	.01*	.03*	-.12*	.00	-.00	.00	-.00	-.02*	-.13*	-.07*	-.04*	-.07*	-.05*	-.08*	-.05*	-.04*	-.05*	-.06*	-.06*

^a N = 13,509.

* p < .05, two-tailed test

** p < .01, two-tailed test

TABLE 2
Means, Standard Deviations, and Results of Logit Analyses^a

Variables	Private Sector						Public Sector					
	Equation 1			Equation 2			Equation 1			Equation 2		
	Means	s.d.	b	s.e.	b	s.e.	Means	s.d.	b	s.e.	b	s.e.
Dependent	.21	.41					.21	.41				
Entrance												
Independent												
Gender	.82	.38	-.52**	.10	-.41**	.09	.70	.46	.06	.13	.07	.13
Race	.95	.24	-.69**	.19	-.46**	.16	.92	.28	-1.40**	.31	-1.30**	.27
M.A. ^b	.31	.46	-.21**	.08	-.11	.07	.34	.47		.11	.12	.11
Ph.D. ^b	.05	.22	-1.20**	.19	-.90**	.15	.17	.37	-.44*	.19	-.36*	.17
Experience	14.30	10.30	.01*	.00	.01*	.00	14.30	9.60	.01	.01	.01	.01
Marital status	.78	.52	-.14	.11			.73	.30	-.02	.15		
Children	.25	.43	-.03	.07			.23	.42	-.16	.12		
Change to single	.02	.14	.01	.13			.02	.15	-.05	.26		
Change to married	.04	.19	.23	.12			.04	.19	-.18	.24		
Education change	.00	.04	-.51	.62	-.50	.62	.00	.04	.20	1.10	.27	1.12
Children change	.05	.23	-.31**	.10			.05	.23	-.42	.20		
Social sciences ^c	.04	.19	.08	.14	.05	.14	.12	.32	.01	.15	.01	.15
Engineering ^c	.45	.50	-.87**	.09	-.73**	.07	.23	.42	-.46**	.16	-.40**	.15
Research ^d	.07	.26	-.72**	.24	-.61*	.24	.23	.42	-.46	.28	-.37	.26
Technical writing	.03	.17	-1.10**	.22	-.92**	.21	.08	.27	-1.10**	.37	-.98**	.32
Design	.14	.35	-.69**	.22	-.58**	.22	.05	.21	-.42	.27	-.25	.25
Quality control	.06	.24	-.34	.21	-.23	.20	.08	.27	-.30	.27	.20	.24
Production	.16	.37	.10	.20	.12	.20	.13	.34	.76*	.37	.81*	.37
Marketing	.11	.31	-.34	.23	-.24	.22	.02	.13	-1.00**	.31	-.90**	.29
Statistical work	.04	.20	-.81**	.22	-.68**	.21	.07	.25	-.22	.32	-.15	.31
Consulting	.08	.27	-.93**	.22	-.76**	.21	.04	.18	-.46	.30	-.37	.27
Computer applications	.09	.28	-.93**	.31	-.77**	.21	.07	.25	-.62*	.30	-.50	.27
Other activity	.02	.13	-1.40**	.23	-1.20**	.22	.14	.35	-1.40**	.30	-1.21**	.26
Mills ratio	$-.93 \times 10^{-11}$	.78	-5.20**	.67	-4.00**	.44	$.29 \times 10^{-9}$	.78	-5.10**	1.00	-4.60**	.79
Constant				4.70		3.19				4.13		3.39
N		20,806		10,517		10,517		5,734		2,992		2,992
χ^2				274.5		256.0				118.0		112.0

^a The number of cases for means differs from the number of cases for coefficients. The descriptive statistics are based on the representative data in 1982, before the number of cases was reduced in 1986. Whereas the 1982 group was unbiased, the reduced group was biased and required correction.

^b Reference category is "B.A."

^c Reference category is "all other disciplines."

^d Reference category for this and all following variables is "development."

* $p < .05$, two-tailed test

** $p < .01$, two-tailed test

and (2) a partial equation excluding family-related variables, which are arguably irrelevant to promotion to managerial positions and could bias estimates of discrimination.

The results of the logit analyses differed for gender and race. Surprisingly, the coefficient for race was negative in both private and public organizations. This finding suggests that, in general, black workers enjoyed better promotion opportunities than equally situated white workers in both sectors. Better promotion opportunities for blacks were also consistently found in separate analyses conducted for men and women (data are available upon request). In order to study the hypothesis regarding the sector effect, I conducted a test for differences in the regression coefficients of the public and private sector equations. The test, computed by the method Gottfredson suggested (1981: 547), yielded a *t*-statistic of 2.9, which suggests that the coefficient for race is significantly higher in the public sector. In other words, despite the fact that blacks enjoyed higher promotion opportunities than whites in both sectors, these opportunities were better in the public sector. However, workers' gender was significant in the private sector only where women enjoyed better promotion opportunities than equally qualified and situated men. The test for the differences between the public and private sectors regarding gender yielded a *t*-statistic of 3.5, suggesting that women's opportunities were significantly better in the private sector than in the public sector. Further analyses suggested that this finding was true for white women compared with white men but not for black women compared with black men.

It should be noted that the negative coefficients obtained in both sectors for the inverse Mills ratio suggest that, among individuals with otherwise similar characteristics, including race and gender, those who dropped out of the study were more likely to enter managerial positions than those who survived. It is important to note that there were no differences between the partial and the full equations regarding gender and race.

For purposes of comparison, I also conducted cross-sectional analyses, using the same variables, for the 1982 data. In the private sector, the gender and race coefficients were positive and significant. That is, women and blacks were less likely to be promoted to managerial positions than their male, white counterparts. In the public sector, the gender coefficient was positive and significant, whereas the race coefficient was insignificant. Obviously, these results differ substantially from those obtained via the longitudinal models. Had I relied on cross-sectional data only, I could have wrongly concluded that discrimination existed against women in both sectors, and against black workers in the private sector. The longitudinal models are undoubtedly superior to the cross-sectional ones. They compare promotion rates between 1982 and 1986 for workers who were equally situated and qualified in 1982, whereas the cross-sectional models do not control for such equal starting characteristics. Thus, the frequent reliance on cross-sectional models in previous research may result in estimations that reflect

past wrongdoings rather than contemporary processes. The differences between the two models' findings demonstrate the strength of the current research.

DISCUSSION

At the outset of this article, I suggested that longitudinal data may shed some light on previous conflicting results regarding gender and racial differences in promotion to managerial positions during the 1980s. I also suggested that minority workers enjoy more advantages in promotion in the public sector than in the private sector. No support emerged for the first hypothesis, that managerial opportunities are less available to women and blacks than to men and whites. On the contrary, with the exception of women in the public sector, women and blacks enjoyed better promotion opportunities than equally qualified and situated white male workers. The prediction of the second hypothesis regarding promotional advantages in the public sector was substantiated only for race. Women enjoyed better opportunities than men in the private sector but not in the public one.

However, managers must not take these results as evidence that affirmative action is no longer necessary. Although direct data are lacking, it is most likely that blacks and women achieve managerial positions partly because of firms' efforts to find minority candidates for managerial positions. But no less important, the results call for four notes of caution concerning equalized opportunities. First, the promotional advantage of women and blacks by no means indicates the absence of a white male advantage in occupying managerial positions. The longitudinal model examines whether people with similar qualifications continue to be promoted equally over time. However, in most cases, white men are found in managerial positions more frequently than their black or female counterparts because of better starting points. Evidently, during 1982–86, more men than women in both sectors and more whites than blacks in the private sector were promoted to managerial positions.

Second, the results do not imply that discrimination does not exist. To be sure, the models encompass women-to-men and black-to-white comparisons of promotion for workers with identical starting characteristics in 1982 who experienced similar changes in those characteristics between 1982 and 1986. However, possible discriminatory processes occurring before and during the determination of the characteristics in 1982 do not affect the gender and racial estimates derived from these models. In other words, the models estimate treatment discrimination occurring between 1982 and 1986 only, given the qualifications and conditions prevalent in 1982. Moreover, by focusing on treatment discrimination between 1982 and 1986, the study left out discrimination that took place in the entrance into the lucrative science- and engineering-based occupations studied, in which women and blacks are underrepresented.

Third, the higher probability of women and blacks dropping out of the sample studied is not only a methodological issue but also a substantive one. Although dropping out could have been the outcome of self-selection and a deliberate decision on the parts of women and black workers to quit organizations, possibly because of better promotion opportunities elsewhere, dropping out could also result from discrimination. Combined with the finding that firms are attempting to overcome past discrimination practices by promoting women and blacks who remained in the organization disproportionately to their numbers and qualifications relative to whites and men, the higher drop-out rate for women and blacks may indicate an alternative form of discrimination. If this possibility is true, it is even more severe in the case of gender, because women who dropped out were more likely to be promoted to management than women who survived in the sample. There were no differences among blacks between survivors and nonsurvivors.

Fourth, managers should pay attention to the fact that among the three groups, black women, white women, and black men, the first has achieved the least. Although black women in science and engineering have been through an arduous selection process, the gender advantages for women in the private sector occur for white rather than black women. I suggest that affirmative action should be implemented more thoroughly for the latter group.

In light of these notes, I also suggest that the current advantages minority workers have be considered as temporary until the proportions of minority and majority workers in management reach parity. Also, I suggest that affirmative action officers could help the scientific community to study discrimination by collecting types of data that are not readily available. For example, this study has shown that blacks and women have higher attrition rates. Unfortunately, there is neither information on the causes of this attrition nor information regarding the readiness of different groups to be promoted to management. Such data might refine future research conclusions regarding discrimination practices. Finally, the results of this study may well be peculiar to the scientific and engineering labor market, in which case they cannot be generalized to other segments of the market. Further study needs to carefully examine this trend within other groups of workers.

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APPENDIX

Definitions of Variables

Dependent Variable

- | | |
|----------|--|
| Entrance | 1 = nonmanagerial position in 1982 and managerial position in 1986 |
| | 0 = nonmanagerial position in 1982 and 1986 |

Independent Variables

- | | |
|------------------|--|
| Gender | 1 = man |
| | 0 = woman |
| Race | 1 = white |
| | 0 = black |
| M.A. | 1 = M.A. in 1982 |
| | 0 = otherwise |
| Ph.D. | 1 = Ph.D. in 1982 |
| | 0 = otherwise |
| Experience | Years of professional experience in 1982 |
| Marital status | 1 = married in 1982 |
| | 0 = otherwise |
| Children | 1 = had child 5 years old or under in 1982 |
| | 0 = otherwise |
| Change to single | 1 = married in 1982 and single in 1986 |
| | 0 = no change in marital status |

Change to married	1 = single in 1982 and married in 1986 0 = no change in marital status
Education change	1 = acquired a higher degree between 1982 and 1986 0 = otherwise
Children change	1 = children born between 1982 and 1986 0 = otherwise
Social sciences	1 = social science specialization 0 = all other disciplines
Engineering	1 = engineering specialization 0 = all other disciplines
Research	1 = performed a research job in 1982 0 = otherwise
Technical writing	1 = engaged in technical writing in 1982 0 = otherwise
Design	1 = performed a design job in 1982 0 = otherwise
Quality control	1 = performed a quality control job in 1982 0 = otherwise
Production	1 = performed a production job in 1982 0 = otherwise
Marketing	1 = performed a marketing job in 1982 0 = otherwise
Statistical work	1 = engaged in statistical work in 1982 0 = otherwise
Consulting	1 = performed a consulting job in 1982 0 = otherwise
Computer applications	1 = engaged in computer applications in 1982 0 = otherwise
Other activity	1 = engaged in any other activity in 1982 0 = otherwise

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