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Women study technology: Goals and restrictions

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Why do girls prefer other academic disciplines to technology? Two possible causes are: (1) They are *restricted* in their choice by their family background and by female personality characteristics; and (2) their goals generally do not accord with the perspective a university degree can offer. To verify both explanations a comparison was made between first year female students in technology and those in education. The results support some of the predictions about the differences between the two groups in regard to goals and restrictions in choice.

Introduction

If all girls in the Netherlands who are qualified took a degree in technology or engineering, our universities of technology would have five times as many women students as they do at present. Girls enrolled in Dutch universities of technology are currently a distinct minority; only about three per cent of the students in electrotechnical departments are females. In the last few years there has been some improvement in the enrolment of girls in technology, but mainly in the departments of architecture, management sciences and mathematics. Why do we find so few women in technology?

In this paper we understand enrolment to be based on choice. This choice is determined by the restrictions each student encounters and by her personal values or 'goals'. As far as *restrictions* are concerned, we are interested in female stereotypes and in family backgrounds that favour role changes. We define *goals* as 1) study purposes and 2) ambitions for future professional and family life.

These factors were included in a 1979 questionnaire that was addressed to first-year students in technology and in education in the Netherlands (van Vonderen and de Raaff 1981). Respondents were 123 (68%) female first-year students at three universities of technology and 101 (54%) first-year female students in education at two Dutch universities. Five family background factors were explored in the questionnaire:

- father's profession (technical or non-technical);
- mother having a job;
- having a brother;
- being the eldest child; and

- identification with father's attitude toward work.

These background factors refer either to role models in the family for future (technical) work or to conditions that have been found to stimulate masculine behaviour in girls (Tangri 1972, Zuckerman 1985). Girls' attitudes towards their families might also influence their choice. This was covered by a question about their identification with their father's attitude to work. It was hypothesized that having a technologically oriented father, a working mother, no brother, being the eldest child and identifying with father's attitude to work would predispose girls to study technology.

Personality characteristics that may restrict choices include self-esteem, femininity, masculinity and achievement motivation (Horner 1972, Lenney 1977, Spence 1983, Stein and Bailey 1973, Sutherland 1978, Zuckerman 1985). It was predicted that high self-esteem, masculinity and high achievement motivation would favour the choice of a technical discipline, and that femininity would disfavour that choice.

As far as *goals* are concerned a distinction was made between study purposes and life goals. To measure *study purposes* the questionnaire contained a study orientation scale (Van der Zee 1976). Sub-scales measured scientific interest or orientation, general professional orientation, socio-economic orientation, community orientation and liberal arts orientation. Socio-economic orientation may be understood as a dimension of the general professional orientation. Community orientation refers to humanitarian concerns and criticisms of society; as such, it can be understood as a dimension of the liberal arts orientation. It was predicted that having professional orientation towards studying would favour the choice of a technical discipline.

With respect to *life goals and ambitions* the questionnaire contained the following items:

In the future I want:

● a full time job;	● scientific recognition;
● a part time job;	● social recognition;
● a research job;	● to raise a family; and
● a job in industry;	● to interrupt my career to educate
● to reach the top;	my children

In the Netherlands technical studies are known to prepare for professional life more than social studies. So it was predicted that ambitions for a full time job, a job in industry and a job at the top would be positively related to the choice of a technical discipline; raising a family and interrupting a career to educate children would be negatively related to that choice.

Data analysis

The analysis of the data will be reported here in brief, leaving out most of the technical details. In all sections, of course, the main distinction is the one between the choice of a technical discipline (T) and education (E). This distinction is related to family background (restrictions), including identi-

Table 1. Percentage of girls studying technology by each family factor.

	Choice		<i>N</i>
	<i>Technology</i>	<i>Education</i>	
A. Father			
technical	87	13	67
non-technical	39	61	157
	$\chi^2 = 63.016; p < 0.001$		
B. Mother			
job	62	38	63
no job	52	48	161
	$\chi^2 = 1.746; \text{n.s.}$		
C. Brother(s)			
no	75	25	48
yes	49	51	176
	$\chi^2 = 10.426; p < 0.01$		
D. Eldest child			
yes	57	43	91
no	53	47	133
	$\chi^2 = 0.309; \text{n.s.}$		
E. Identification			
with father			
strong	60	40	121
weak	49	51	103
	$\chi^2 = 3.126; p < 0.10$		

fication with father; the effects of personality characteristics (restrictions as well) and study purposes (part of the goals); and to life goals and ambitions (other parts of the goals).

Family background and identification

With respect to family background and identification the results are presented in table 1. From these data we conclude that father's professional technical orientation and the absence of brother(s) both stimulate the choice of a technical discipline. On the other hand, a working mother, rank of birth and identification with father do not seem to influence the choice process. However, with regard to identification the distribution shows a tendency in the predicted direction.

Considering only the two strongest factors, father having a technical orientation and the absence of brothers, we have the combinations shown in table 2. Here it is obvious that there is an interaction effect. Few girls whose fathers have technical jobs study education, whether or not they have brothers, but if their father's jobs are non-technical, the absence of brothers has a strong relation to the choice of a technical study.

Table 2. Percentage of girls studying technology by combination of father's technical work and having brothers

Father	Brother(s)	Choice		N
		Technology	Education	
technical	no	83	17	18
technical	yes	96	4	49
non-technical	no	70	30	30
non-technical	yes	31	69	127

Study purposes and personality factors

In table 3 the correlations between choice of discipline and several study purposes and personality factors are presented. It is evident that a strong socio-economic orientation, a weak community orientation and a strong achievement motivation contribute to the choice of a technical discipline. High self-esteem and a low femininity score seem to contribute as well, though somewhat less. Perhaps surprisingly the correlations with masculinity are very small.

To get an idea of the combined contribution of these variables to the choice of discipline a regression analysis was carried out. The results are also shown in table 3. The small differences between the correlations and the corresponding standardized beta-weights indicate that these factors do not overlap substantially. However, only 28% of the total variance in choice of a discipline is explained by these variables.

Life goals and ambitions

In table 4 the correlations between choice of discipline and agreement with items on life goals and ambitions are presented.

Table 3. The relation between chosen subject and purposes and personality factors: Correlations and corresponding beta-weights†

	Correlation	Beta-weights
Scientific orientation	0.10	0.01
General professional orientation	0.01	-0.07
Socio-economic orientation	0.40	0.34
Community orientation	-0.30	-0.25
Liberal arts orientation	0.08	0.07
Self-esteem	0.16	0.07
Femininity	-0.15	-0.11
Masculinity	0.10	0.03
Achievement motivation	0.23	0.17
Multiple correlation (R)		0.53
Total explained variance (R^2)		0.28

† A positive sign means that the choice of a technical discipline is associated with a high score on the purpose or personality scale.

Table 4. The relation between chosen subject and agreement with items on life goals and ambitions: correlations and corresponding beta-weights.[†]

	Correlation	Beta-weights
Full-time job	0·11	−0·07
Part-time job	−0·10	−0·03
Research job	0·30	0·10
Job in industry	0·61	0·47
Reaching the top	0·41	0·14
Scientific recognition	0·43	0·23
Social recognition	0·01	−0·04
Raising a family	0·10	0·05
Interrupting career	0·08	0·01
Multiple correlation (<i>R</i>)		0·69
Total explained variance (<i>R</i> ²)		0·47

[†] A positive sign means that the choice of a technical discipline is associated with this ambition.

It is evident that in this area some variables play an important role, in particular the most specific ambition items. As these variables explain an impressive 47% of the total variance in choice of a discipline, ambition is obviously an influential factor in the choice process. The differences between correlations and corresponding beta-weights are substantially greater here than was the case with personality factors. This is because scientific recognition, research job, reaching the top and social recognition have one underlying unidimensional attribute in common. They can be combined into a Guttman scale (Mokken 1971). This ‘ambition scale’ discriminates firmly between technology and education students as can be seen from table 5. (The scale consists of just three items because two items, reaching the top and research job, appeared to have the same popularity. In that case only one of these two can be accepted for this type of scale.)

Discussion

In this study a positive contribution to the choice of a technical discipline by girls was predicted by family background, personality factors, study

Table 5. Percentage of girls in technology by score on ambition scale.

Ambition score	Choice		<i>N</i>
	Technology	Education	
3	96	4	24
2	69	31	67
1	41	59	90
0	35	65	34
TOTAL	55	45	215

$\chi^2 = 38\cdot3; df = 3; p < 0\cdot001$

purposes and life goals. It was found that father's professional technical orientation and the absence of brothers were significantly related to the choice of a technical discipline. Also the identification with father's attitude to work may not be excluded as a source of influence. Obviously, as reported elsewhere (Gaudart 1975, Raat and de Vries 1985), the educational choices of girls (and boys) are influenced by their familiarity with the chosen subject and with a possible perspective on future work. The importance of the absence of brothers may indicate that it is difficult to distinguish between traditional masculine and feminine behaviour in a family where there are no boys.

As was predicted, lower femininity and higher achievement motivation scores correlated positively with the choice of a technical discipline. Masculinity was not significantly related to this choice. Higher self-esteem had an initial positive correlation with choice of technology, but this was reduced when other factors were taken into account.

Of all the study purposes only the specific socio-economic orientation was in accord with the prediction, related to the choice of a technical discipline; the community orientation was related to the choice of education. Probably, girls' interests in professional technical education would increase if they were socialized like boys with regard to future wage earning. To reach this aim educational practices have to change, as well as the demand for women in the Dutch labour market.

The ambitions of the female students in technology appear to be really different from those of the students in education as far as their professional life is concerned. This is in conformity with the difference in study purposes. The two groups cannot be distinguished in aspirations for future family life. This is as remarkable as the absence of a significant difference between the scores on masculinity. The choice of a technical discipline does not mean that girls want to abandon their traditional goal of having a family or interrupting their career, nor do these girls see themselves as particularly masculine. They merely add to the goals that all girls share the ambition to succeed in a career.

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References

- ECCLES (PARSONS), J. Expectancies, values, and academic behaviours. In J. T. Spence (ed.), *Achievement and Achievement Motivation* (Freeman, San Francisco) 1983.
- GAUDART, D. 1975, Zugang von Mädchen und Frauen zu technischen Berufen. *Oesterreichischer Bundesverlag für Unterricht* (Wissenschaft und Kunst, Wien).
- HORNER, M. S. 1972, Toward an understanding of achievement related conflicts in women. *Journal of Social Issues*, Vol. 28, pp. 157-175.
- LENNEY, E. 1977, Women's self-confidence in achievement settings. *Psychological Bulletin*, Vol. 84, pp. 1-13.

- MOKKEN, R. J. 1971, *A Theory and Procedure of Scale Analysis* (Mouton, Amsterdam).
- RAAT, J. H. and DE VRIES, M. 1985, *Wat vind je van Techniek?* MENT-project (Eindhoven University of Technology).
- SPENCE, J. T. 1983, *Achievement and Achievement Motivation* (Freeman, San Francisco).
- STEIN, A. H. and BAILEY, M. M. 1973, The socialization of achievement orientation in females. *Psychological Bulletin*, Vol. 80, pp. 345-364.
- SUTHERLAND, S. L. 1978, The unambitious female: Women's low professional aspirations. *Signs: Journal of Women in Culture and Society*, Vol. 3, pp. 774-794.
- TANGRI, S. S. 1972, Determinants of occupational role innovation among college women. *Journal of Social Issues*, Vol. 28, pp. 177-199.
- VAN VONDEREN, M. L. and DE RAAFF, I. 1981, *De Technische Hogeschool als studiekeuzemogelijkheid voor meisjes* (Eindhoven University of Technology).
- VAN DER ZEE, J. 1975, *Studiemotieven en studiekeuzemotieven van Wageningse Eerstejaars* (University of Agriculture Wageningen).
- ZUCKERMAN, D. M. 1985, Confidence and aspirations: Self-esteem and self-concepts as predictors of students' life goals. *Journal of Personality*, Vol. 53, pp. 543-560.

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