Journal of Occupational Psychology, 1980, **53**, 177–180. Printed in Great Britain

Differences in stage of occupational field and subfield choice among students of three engineering subfields

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First-year students in three engineering subfields were compared in terms of reported stage of both field (engineering) and subfield choice as well as on several biographical variables. There were some differences, albeit insignificant, in stage at which the field was chosen. However, significant differences were found in stage of subfield choice: electrical engineering students (EE) chose the subfield earlier than did either mechanical (ME) or industrial engineering (IE) students. EE essentially made a one-step choice of both field and subfield, whereas ME and IE, despite differences between them, made a two-step choice process: the subfield was selected at a later stage than was the field itself.

Taylor *et al.* (1979, p. 42) noted that, 'In contrast to that of inter-occupational choice, the literature specifically dealing with intra-occupational choice is rather scant'. The statement applies to various occupational fields, including engineering, which is the focus of the present study. Most studies of engineers or engineering students have tended to view them as a rather homogeneous category, using global and highly generalized terms to characterize them.

In a recent study by Izraeli *et al.* (1979), data collected from students of three engineering subfields, within 2 months after they had started their academic studies, indicated that even at that early stage students of electrical, mechanical and industrial engineering differed significantly with regard to work-related attitudes and preferences. Experiences prior to specialized studies in the chosen subfield could have had a socializing effect, supporting the notion of self-selection into occupational fields (Super, 1957; Holland, 1966) and extending its applicability to choice of subfields as well.

The present study is aimed at identifying stages of subfield choice and biographical variables that may differentiate among students of engineering subfields.

Ginzberg (1951, 1966) defines 'single track' persons as those who follow a 'narrow pattern' characterized by early occupational choice and little consideration of alternatives. Within the 'realistic stage' of occupational choice (Ginzberg, 1966) makes a distinction between two substages: whereas 'crystallization' represents the culmination of the total occupational choice process, it is often followed by a substage of 'specification' which is characterized by choice of a specific specialization within the general occupational field that was selected earlier. Engineering frequently requires the specification of subfield prior to application to an engineering school since admission is directly into the subfield.

This study tests two hypotheses. First, that students from different subfields chose engineering as a general occupational field at similar development stages. Secondly, that the timing of the choice of the specific subfield differed: electrical (EE) and mechanical

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0305-8107/80/030177-04 $02.00/0

engineering (ME) were chosen earlier than industrial engineering (IE). Presented in a somewhat different way, it was hypothesized that EE and ME students chose both the field and the subfield at one stage, or at close stages in life, whereas IE made a two-stage occupational choice process.

METHOD

Sample

Data were collected from 170 first-year engineering students at Tel Aviv University, registered in three subfields selected as their first priority: 79 in electrical engineering (EE), 54 in mechanical engineering (ME), and 37 in industrial engineering (IE). Although students are required to apply for a specific subfield and are admitted by subfield committees, no specialized course is taught in the first year. Eighty per cent of the sample had had compulsory military service.

Procedure and analysis

Within 2 months of starting their first year in the engineering school, students from all three subfields filled in a questionnaire during class time. Included in the questionnaire were biographical variables: type of high school (academic, vocational), high school track (humanities or science in the academic high school, and mechanics, electricity or electronics in the vocational school); work experience on a technical job, and timing of that experience; and military rank. In addition, there were two questions where a student had to self-report the timing of field choice and subfield choice (while at primary school, high school, during military service, or later).

RESULTS

Timing of field choice

Students from three engineering subfields were compared regarding the stage at which they had chosen to become engineers. The χ^2 value was not significant, indicating that the basic choice of the general occupational field had been made at similar stages by all students. Of the total sample, 13 per cent chose engineering as a career line while studying in elementary school, 47 per cent at high school, 29 per cent during military service, and 11 per cent after they had finished the service.

None of the tests for association between timing of field choice and type of high school, high school, track, experience in technical work and timing of technical experience was significant.

State of subfield choice

Table 1 presents frequencies for subfield choice at different stages. As shown in Table 1, the statistical test indicated that the timing of the decision to specialize in a subfield was different for the three subfields. The major differences reside in the high school stage and during military service.

Table 2 indicates that EE students had made essentially one choice: they chose the field and the subfield at the same developmental stage. ME and IE students had made a two-stage choice: the field had been chosen first and at some later stage the specification of subfield was made. ME and IE, however, differed from each other in the timing of those decisions.

Differences in biographical variables

Several analyses were performed to test whether students of different subfields of engineering could be differentiated in terms of biographical variables.

Table 1. *Differences in stage of subfield selection*

Stage	Subfield		
	EE	ME	IE
High school	60% ($n=42$)	38·8% ($n=19$)	29·0% ($n=9$)
Military service	25·7% ($n=18$)	40·8% ($n=20$)	54·9% ($n=17$)
After service	14·3% ($n=10$)	20·4% ($n=10$)	16·1% ($n=5$)

$\chi_4^2 = 11{\cdot}36, P < 0{\cdot}05$.

Table 2. *Percentages of students from three subfields choosing engineering and the specific subfield at each stage*

Stage of choice	EE		ME		IE	
	Field	Subfield	Field	Subfield	Field	Subfield
High school or earlier	62·5	60·0	63·5	38·8	52·9	29·0
Military service	26·4	25·7	28·8	40·8	35·3	54·9
After service	11·1	14·3	7·6	20·4	11·7	16·1

High school type and track. Among graduates of academic high schools (55 per cent of total sample) 89 per cent had specialized in the science-orientated track and 11 per cent in the humanities and social sciences. Among graduates of vocational high schools a significant association was found between high school specialization and subfield choice ($x_2^2 = 10{\cdot}76$, $P < 0{\cdot}01$). There was continuity in subfield specialization among 53 per cent of those who had studied mechanics and 70 per cent of those who had studied electricity.

Experience in technical jobs. Eighty-three students (49 per cent of the total sample) had experienced paid work in technical jobs for a period of at least 3 months. While the χ^2 value for technical experience was not significant, it is worth recording that 60 per cent of EE and 54 per cent of ME students had had technical work experience compared with only 39 per cent among IE students. Significant differences between subfields were found regarding the timing of technical experience ($\chi_2^2 = 13{\cdot}67$, $P < 0{\cdot}01$); ME had had such experience earlier than those in the other subfields. It should be noted that there was no significant association between the timing of technical experience and the stage at which he had chosen either the field (engineering) or the subfield.

DISCUSSION

Students registered in three subfields of engineering – electrical, mechanical, and industrial – differ not only in work values and preferences (Izraeli *et al.*, 1979) but also in characteristic choice patterns of specific subfield. The generalization that engineering is characterized by a narrow pattern of occupational choice requires qualification: it applies

to electrical engineering but not to industrial engineering. Furthermore, and contrary to the hypothesis, mechanical engineering also does not clearly fit into the narrow pattern.

The present data indicate that for a large proportion of EE students there was no separation between crystallization and specification; the majority chose that specific subfield at the time they had decided to become engineers. ME and IE students, on the other hand, first chose the general occupational field and at a later stage decided upon the specific subfield, differing from one another in that the average time interval between field and subfield choice was larger for IE than for ME. Despite seemingly equal opportunities for experience and rehearsal, and although ME had had job experience at an earlier stage, EE was chosen earlier than was ME.

Continuity from the electricity track to EE is greater than is the case from the mechanics track at high school to ME. Support for these findings comes from Doron (1967) who found that compared to high school students in the mechanical track, a higher proportion of those in electricity who entered engineering continued in the same specialization, and among all high school graduates who did not enter engineering a higher proportion of electricity students took jobs in their specialization. It may be suggested that the electricity track is more attractive to its students than is mechanics to graduates of that track, as indicated by perceived differences in subfield characteristics found by Izraeli *et al.* (1979). In that study EE students at the beginning of their first year of academic studies viewed their subfield as more diverse, content-rich, fast-changing and providing more autonomy than did ME students with regard to their own subfield.

Age boundaries of stages and substages of occupational choice are probably somewhat different in Israel than in other countries where there is 3 years compulsory military service for males and 2 years for females. This period extends the specification stage during which new and versatile experiences are added to a person's repertoire and role rehearsal for various occupational fields and subfields is possible. In this study 27 per cent of the students had made the decision to study engineering during army service and 34 per cent had chosen the specific subfield of engineering while still in the army.

The findings of the present study support the concluding statements made by Izraeli *et al.* (1979) that engineering is not a homogeneous occupational category, and that subfields of engineering differ with regard to occupational choice patterns.

ACKNOWLEDGEMENT

The authors are grateful to Mrs Sara Shavit for her assistance in data analysis.

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Received 2 January 1980; revised version received 1 February 1980