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EFFECT OF FACULTY ON RESEARCH COOPERATION AND PUBLICATION: EMPLOYING NATURAL LANGUAGE PROCESSING

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ABSTRACT. This study continues a series of studies on the effectiveness of scientific conferences. This topic has not been sufficiently investigated although it receives large funds, assuming that these conferences have added value for staff members' academic-professional development. Predicated on questionnaires filled by 96 academic staff members from 17 different departments, we found that when choosing conferences to attend, the type of faculty affect the search for cooperation. Moreover, staff members from the Faculty of Natural Sciences attribute more significance to conferences that result in publications than staff members from the Faculty of Health. The Faculty of Engineering creates negative mediation in the correlation between gender and cooperation. Namely, the Faculty of Engineering does not urge cooperation and even has a negative effect, but its effect is evident mainly among men. This finding complements prior research findings showing that women are more inclined to cooperation (Eckhaus & Davidovitch, 2018a). The current findings show that the inclination to cooperation is not related only to gender issues rather the faculty has an effect as well. The current findings might have a contribution to the significance of the faculty as an influential factor of conferences on cooperation – and in fact on the professional development of staff members.

Introduction

Studies on the performance of academic staff members found that the faculty has a significant effect on the academic output of staff members (Davidovitch, Soen, & Sinuani-Stern, 2011; Davidovitch, Sniuani-Stern & Soen, 2014). The general aims of higher education in Israel have been affected by three dominant approaches from Germany, the US and the UK. The impact of these approaches is evident in the relative significance attributed by the higher education system to research, teaching and community service. Paradoxically, despite the US influence on the conception of higher education in Israel, manifest in the establishment and flourishing of regional colleges as a response to an essentially social need, we note that the higher education in Israel is substantially university-based and research-oriented. In fact, this

concept of the research university dictated the manner of organization of the entire higher education system. Thus, the function of professional training became an integral function of academic institutions in Israel, only at a later stage in their development.

The relationship between input and output in academia

Academic output has academic implications for input and for funding significance. Most academic institutions have a "performance-based funding" policy. Performance-based funding is provided based on compatibility between performance measures and funding (Yair, Gueta, & Davidovitch, 2017).

Utilization of public funds, together with the growing size of the system of higher education and the demand for accountability, led many countries to embrace a new model of funding and resource allocation, while according extra significance to the evaluation and measurement of academic outcomes. Where in the past the main measure for funding was the number of students at the institution, today the number of articles, citations, and journals standards are significant measures of performance. The emphasis is on competition and outcome-dependent incentives, with the intention of transforming universities into efficient and productive systems, both by promoting research and by improving decision making for resource allocation.

Israel has 67 institutions of higher education: 8 research universities, an Open University, 38 academic colleges, and 21 academic colleges of education. All the institutions, including the Open Universities, serve a total of over 300,000 students (CHE, 2014). In 2014 he higher education budget amounted to 9 billion shekels (Student Association, 2013). The main organs responsible for maintaining the balance between academic liberty and supervising management of the system of higher education are: the Council for Higher Education (CHE) and the Planning and Budgeting Committee (PBC). These are in charge of the academic, administrative, and financial aspects of higher education. In addition, the CHE and the PBC, who are directly responsible for the system of higher education, also have a certain responsibility for the activities of the institutions of higher education and for their functioning (Student Association, 2014).

In Israel, most of the institutions' funding comes from the government, in the form of an annual grant (global budget), with the institution not required to provide details of all parts of the budget and entitled to utilize it following its exclusive considerations (aside from the obligation to provide full budgetary reports throughout the year). In addition to the global budgetary grant, each institution also receives funding based on outcome measures. Unlike the global grant, which is allocated for regular operational expenses of the institution, outcome-based funding is provided to the institution based on performance (CHE, 2012). The funding model operated at universities includes two components: teaching and research. At colleges, the budgeting model includes only the teaching component, which has been adjusted to fit these institutions.

The research component is based on competitive resource allocation and calculated by each university's relative proportion of all universities in Israel. The five outcomes measured in order to determine the outcome proportion are receiving competitive research awards, receiving other research awards, training research students for PHD, publications in scientific journals, and number of students earning a Master's degree in the thesis track. Each component has a relative weight that reflects its relative significance in determining the distribution of the budget. In this hierarchy, the two major outcomes in the research component are receiving competitive research awards and scientific publications.

The current study examines the effectiveness of scientific conferences by faculty, assuming that these conferences have added value for staff members' academic-professional development.

Although conferences are a dominant component in the activities of scholars, it is still under investigated. Only several recent papers by Echkaus and Davidovich have investigated the decision process and factors affecting the selection of academic conferences. Davidovitch and Eckhaus (2018) found that birth country has an effect on the tendency to select an academic conference according to the conference themes, the tendency to look for research cooperation, and even the geographic destination. Eckhaus and Davidovitch (2018a) found that the size of the conference is affected by gender, and that female faculty members are more oriented towards seeking research cooperation in conferences. They did not investigate, however, the tendency of male faculty members towards cooperation in academic conferences. Finally, Eckhaus & Davidovitch (2018b) proved that seniority is an important parameter, affecting the selection process of academic conferences. They (ibid) also note that it may be valuable to "investigate the impact of … the effect that different faculties and departments may have on the faculty staff, regarding the decision and selection process of conferences".

The role of research in higher education

The changes that have occurred in Israeli institutions of higher education began with the first university in Jerusalem and are the basis of discussions on the current topic as manifested in the present diverse academic institutions with their variegated organizational-administrative structure, assorted goals, and uniquely distinctive students studying varied courses.

The ethical transitions within Israeli higher education are associated with the general aims of all higher education, the goals of schools of higher education, and the unique aims of courses offered to their students. The transitions that have taken place are changes in attitudes towards the needs of science, society, and the individual, and they stem from developments in educational philosophy in general and changes in Israeli society in particular. After World War II there was an increase in autonomy, individualization, and democratization within global educational systems.

In addition to the large number of students who joined schools of higher education, Israeli academic institutions grew in number and variety. These institutions, although established after the first university (the Hebrew University), continued in the direction it had outlined, with varied emphases according to the needs of time and place. Disputes regarding the essence and direction of the Hebrew University aroused questions regarding the future of all academic institutions: Should they be research institutions, teaching institutions, or institutions of professional training which will award their graduates degrees and train them for specialized professions? Universities all over the world, both new and old, pondered these questions (Iram, 1978; Davidovich, 2004).

The general goals of Israeli higher education were influenced by three dominant conceptions: those of Germany, England, and the U.S. The influence of these conceptions is evident in the goals of Israeli higher education, i.e. in the relative significance attributed to research, teaching, and civil service. Paradoxically, despite the American and British influence on the Israeli concept of higher education, manifested by the opening of regional colleges and their establishment as an essentially social response, Israeli higher education is mainly university- and research-oriented. The concept of the research university dictated the manner in which Israeli higher education was constituted. The function of professional training within academic institutions became an inseparable part of the system only at a later stage.

Motivations to attend academic conferences

Although conferences are a dominant element in scholarly activities, little study has been conducted on this topic. Several recent papers by Echkaus and Davidovich have investigated the decision process and factors affecting the selection of academic conferences

by academic staff. Davidovitch and Eckhaus (2018) found that birth country has an effect on several conference-related factors including topic, potential research collaborations, and the geographic location of the conference. Eckhaus and Davidovitch (2018a) found that a gender effect in conference selection considerations and specifically that female faculty members are more oriented towards seeking research cooperation in conferences than their male counterparts. Finally, Eckhaus & Davidovitch (2018b) demonstrated that seniority is an important parameter that affects the selection of academic conferences, and call to investigate the potential impact of departmental affiliation on the conference selection process.

The comparison between research outputs have been understudies, with only several studies. Harzing and Alakangas (Harzing & Alakangas, 2016) found that in the Web of Science, the average Life Science academic has more than 50 times as many citations as the average Humanities scholar and 3.5–5 times as many citations as the average scholar in Engineering and the Social Sciences . These findings point to Life Sciences' high orientation for publications.

Wilson and Tenopir (2008) found that while Helath Sciencs show strong research culture, it is to a lesser degree in engineering. Furthermore, Engineering cited more onference papers and dissertations, which corresponds to their use of technical reports for much of their research, as opposted to other citations such as monographics, which Sciences cited the most. The authors also found that Engineering staff write less books and book chapters among all faculties, and that nearly a quarter of engineering respondents indicated that their last reading helped resolve technical problems. These findings suggest that engineering staff are more oriented towards technical solutions then academic research. Academic research which can be defined as " *the systematic, rigorous investigation of a situation or problem in order to generate new knowledge or validate existing knowledge*" (Majid et al., 2012, p. 394).

Based on previous literature, we hypotheize that academic staff will select conferences on the basis of their interest in the publication and collaborative research opportunities that conferences offer, and that these considerations will differ by academic affiliation. Specifically, we formulated the following research hypotheses:

H1. Social Sciences staff members are more oriented towards research cooperation opportunities compared to Engineering staff members.

H2. Life Sciences staff members are more oriented towards publication opportunities compared to Health Sciences staff members.

H3. Engineering staff members show negative mediation of the relationship between gender and cooperation.

1. Methodological approach

Initial Sample

A six-item questionnaire was used to collect data on academic staff members' motivations for attending conferences and considerations in the conference selection process. The items covered preferences for conference size, publication opportunities, opportunities to meet other researchers and establish joint research projects, the academic status of the conference, and other benefits of attendance.

The online questionnaires were distributed to the senior staff members of a single university in Israel, using Google Docs. Ninety-six respondents (56.5% female) completed questionnaires were collected from respondents in 17 departments in four faculties. Respondents were distributed as follows: Social Sciences (57.4%), Health Sciences (12.8%),

Engineering (14.9%), and Life Sciences (12.8%). Of all respondents, 56.5% were female and 43.5% male. Respondents were distributed by age as follows: 30-39 (7.3%), 40-49 (29.3%), and 50-80 (63.4 %). For each respondent, the responses to all six questionnaire ítems were combined into a single text for analysis, generating 96 units of analysis.

Text Analysis

We employed TEXTIMUS, a software supporting text mining and analysis (Eckhaus & Ben-Hador, 2017). First, we generated n-gram sets of frequencies. N-gram refers to a contiguous sequence of n words from a given text. N-gram is the most popular language model used in recent large vocabulary continuous speech recognition systems (Suzuki, Kuriyama, Ito, & Makino, 2008), and is often used in Natural Language Processing (NLP). Next, we used the Bag-of-Words (BoW) technique, often used in NLP research (Cambria & White, 2014). In to the BoW technique, documents are represented as a collection of words, regardless of grammar and order. A set of keywords is explored in the documents and assigned values according to the frequency of the word's appearance or whether the word appears in a document. Therefore, we analyzed the frequency of all the words, and grouped words with the highest frequency employed for the research variables – *COOP* (cooperation) and *PUB* (publications). Similar to studies that employed the BoW (e.g., Eckhaus, 2016, 2017; Eckhaus & Sheaffer, 2018), we summed the frequencies of the group to form one variable. Finally, in addition to a nominal variable of the four faculties, each of the faculties were coded as a dichotomous variable (1 = belongs to the faculty, 0 = doesn't belong). These are *SOCIAL, HEALTH, ENGINEERING,* and *NATURE.*

Mediation analysis

Mediation models are often assessed using Structural Equation Modeling (SEM). We constructed the perfect saturated model (Ryu, 2014), which included the mediation of *ENGINEERING* on the relationship between *GENDER* and *COOP*. That is, the saturated model has the best fit possible since it perfectly describes the observed data (Brainerd, Wang, & Reyna, 2013).3. Conducting research and results

2. Results

The correlations, means, and standard deviation values between the research variables are presented in Table 1. All correlations were conducted using Spearman correlations, except *PUB* and *COOP*, which were performed using Pearson correlations.

Table 1. Spearman correlation matrix, means, and SD

	SOCIAL	*HEALTH*	*ENGINEERING*	*NATURE*	*COOP*	*PUB*	*GENDER*
SOCIAL	-						
HEALTH	-.44***	-					
ENGINEERING	-.49***	-.16	-				
NATURE	-.44***	1	-.16	-			
COOPERATION	.24*	-.001	-.35**	-.001	-		
PUB	.02	-.22*	-.04	-.22*	.12	-	
GENDER	-.15	-.12	.27**	-.12	-.16	-.11	
Mean	.57	.13	.15	.13	2.12	.69	.44
SD	.50	.34	.36	.34	1.87	1.19	.50

*p < .05   **p < .01 ***p < .001

All hypotheses were supported. In order to ascertain that academic staff in the Social Sciences are more oriented towards academic cooperaiton opportunities than staff in Engineering (H1), we ran a *t*-test. Results indicate a statistically significant difference between staff in Social Sciences and Engineering ($t = 4.80$; *df* = 50.95; $p < .001$) (Table 2), indicating that research cooperation is more frequently mentioned by Social Sciences staff members (M = 2.56; SD = 2.10) than among Engineering (M = .79; SD = .89). However, since the sample size differs significantly between the two faculties, we next ran a Mann-Whitney a-parametric test for independent samples. Results show statistically significant results between the samples ($Z = -3.34$, $p < .001$).

To examine whether Life Sciences staff are more strongly oriented toward publication opportunities than are staff in the Health Sciences (H2), we ran a *t*-test. Results indicate a statistically significant difference between Life Sciences and Health Sciences staff, ($t = -2.85$; *df* = 13.93; $p < .05$), indicating that Life Sciences staff mention publication opportunities more frequently (M = 1.36; SD = 1.65) than do Health Sciences staff (M = .08; SD = .29).

No significant direct statistical relationship between gender and COOP was found, However an Engineering affiliation was found to negatively mediate the relationship between gender and cooperation, supporting H3 (Figure 1). The Sobel Test for mediation showed statistical significance ($z = -1.98$, $p < .05$). Furthermore, this mediation implies that an Engineering affiliation the f has a stronger negative impact on interest in cooperation opportunities of male staff members compared to female staff members.
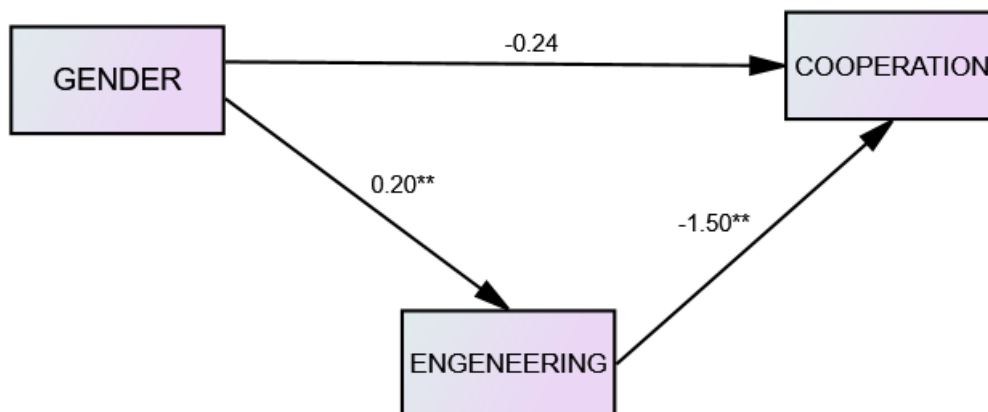
p<.05,
Figure 1. Path and coefficients

3. Conclusion and limitation

Higher education institutions and their faculties invest enormous resources to support staff members' research activities and roles in academic leadership. Conferences and potential cooperations are an important element in such professional development. The current study found that not all staff members have similar considerations in selecting academic conferences for attendance. More specifically, staff members' faculty affiliation was found to be related to their interest in cooperation versus publication opportunities in the conference selection process. It remains to be discovered whether these differing orientations are reflections of specific faculty policies on conference attendance and remuneration and promotion policies.

We found that staff members of the Faculty of Engineering had a low degree of interest in cooperation opportunities of conferences, although female staff members of the Engineering Faculty were more strongly oriented toward cooperation than their male peers.

This finding is interesting because female staff constitute a minority in the Engineering Faculty, in contrast to the other faculties explored in this study. Future studies might explore the factors that drive female Engineering staff members to seek research collaboration opportunities with colleagues outside their faculty, and more deeply explore the relationship between gender and motivations to attend academic conferences in all academic departments.

This pioneering research offers a case study, with respondents across several disciplines within one university. A valuable extension of this study would be to examine the findings based on multiple universities but within a specific discipline, to provide in-depth insights on the effect of departmental affiliation on staff members' decision making and selection process of academic conferences.

While we have provided empirical evidence for differences among faculties in regard to tendency to seek cooperation and publication opportunities in academic conferences, and emphasized gender differences (H3), however, we did not account for other parameters such as career ambitions, fight for citations' level, promotion opportunities, and even conferences as tourism. Studies that will extend the findings of this study by investigating any of these factors, may provide valuable insights regarding factors affecting the selection of academic conferences and even conferences as tourism (Eckhaus, 2017), and specifically differences among faculties. In accordance, Veloutsou & Chreppas (2015) suggest that in the investigation of academic conference selection there is a need for "*series of studies that will hopefully lead to a more quantitative approach and generalized basis for the examination of convention participation*" (p. 121).

Another valuable extension would be to investigate the findings of this study within different cultures. Since birth country affects academic conference selection (Davidovitch & Eckhaus, 2018), investigating the effect of academic affiliation in difference cultures may provide valuable insights on the conference selection process. Other avenues of future study include official policies on conference attendance by academic institutions and their departments, and whether emphasis on publication versus cooperation opportunities meshes with funding policies and with actual conference attendance patterns.

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