GENDER AND AGE DIFFERENCES IN SCIENCE: THE CASE OF SCIENTIFIC PRODUCTIVITY IN ADMINISTRATIVE SCIENCES

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Abstract

The objective of this study was to find out the influence of gender and age on scientific productivity among lecturers in Administrative Sciences. Data were obtained from 176 faculty members in Administrative Sciences drawn from 11 universities in Quebec Canada. The result of our findings showed no statistically significant difference between total article and total book production of male faculty members and those of their female colleagues. However, there were significant differences between male and female members in the production of multiple authored books and papers presented at refereed conferences. Similarly, there was no statistically significant relationship between age and scientific productivity. Except for multiple authored chapters in books which were negative and significantly related to age, none of the other scientific productivity measures was significant. Based on these findings, it was concluded that gender and age appear to have considerably less impact on scientific productivity.

Keywords: Scientific productivity, gender, age

Introduction

There are significant number of studies (Rerstad and Aksnes, 2015, Sotudeh & Khoshian, 2013, Fox 2005) on gender and age differences in scientific productivity in engineering, mathematics and technology. In all these studies, women's scholarly productivity has been characterized as low compared to their male counterparts. Studies (Rorstad and Aksnes,, 2015; Winefield and Anstey, 1991; Adeoye et.al. 2014) have also shown that publication production declines with age.

However, in all these studies, there is no significant study on gender and age differences in scholarly productivity in administrative sciences. The cognitive structure of scientific fields differs. Fields in the physical and chemical sciences like physics, and chemistry, have what Kuhn (1970) calls highly developed paradigms. Empirical knowledge in these fields is compacted, and

precise; therefore, graduate students can discover quickly the current state of their field from text books and can commence work on the research frontiers while still graduate students. This is not the case in fields like administrative sciences, zoology and biology, which has less developed paradigms, since more experience is required to gain competence.

Giving the cognitive structure of the field of management sciences, the objective of this study is to find out the influence of gender and age on scientific productivity.

Based on the above objectives, the following hypotheses are presented:

Ho_1: There will be a significant difference between publication production of male faculty members and those of their female colleagues.

Ho_2: There will be a positive and significant relationship between publication production and the age of the faculty member.

Review of Literature

Gender: Over the last decade, a significant number of studies have focused on the extent, to which scholarly inquiry is influenced by the sex difference of the practitioner (Sotudeh and Khosman, 2013; Stack 2004, Fox 2005; Ceci and Williams, 2011). These studies have argued that men and women see the world and organization of problems within it differently. This difference, according to Mackie (1985: 193) goes beyond topic choice to the methodological foundations of the discipline. Consistent with Mackie's (1985) assertion, Stanley and Wise (1983: 146) believe that women do experience reality differently, just by having different bodies, different physical experiences, to mention a few.

Bernard (1973) claims that sex differences are associated with preferred research mode, with the 'agentic' method being more congenial to male sociologists and the 'Communal' method, being more congenial to female sociologists. 'Agency tends to see variables, communion to see human beings' (Bernard, 1973: 784). In the same vein, Collins (1983: 267) believes that women's enhanced presence and power in sociology would seem to give them some 'clout' in affecting what comes to count as scientific knowledge.

Perhaps we should ask: to what extent does sex difference affect publication production in administrative sciences?

Cole (1979) has pointed to the fact that it is believed that women scientists individually, and of course collectively, do not contribute as much as men; they are simply less productive. Family obligations and careers further account for much of the observed difference. Cole (1979) further adds that the process of accumulating disadvantage which begins during primary socialization is one of the reasons for the low production by women.

Polachek (1975) has suggested that the productive value of women depreciates during periods of maternity; the longer they stay at home the more their productive value depreciates.

A study conducted by Simeon (1983) on the status of faculty in the United States showed that Women continue to comprise less than one quarter of all academic personnel and to be located within certain fields and types of institutions. They hold lower status than men with respect to

salary, rank and tenure. They are more likely to be teachers than researchers, and to be evaluated harshly than men, particularly if their work is of a feminist nature. They are perceived by others within the constraints of stereotypically female roles, and are excluded from informal networks of communication with male colleagues. They are more disadvantaged than men by their marital and family status, lacking the institutionalized supports which men receive.

The general feeling that women's role is in the kitchen has no doubt affected the advancement of women. This feeling has made most male faculty members find it very difficult to engage in the normal friendly discussion with their female colleagues. They allow the traditional norms governing male-female interaction to influence their relationship. When colleagues pay attention to sex status instead of the professional status, differential evaluation of scholarly contribution could result.

Age: This section begins with the questions 'does publication production improve with age?' Or 'is there a decline in production after the age of fifty or even earlier?' These questions are based on Lehman's (1953) pioneering work on the relationship of age to achievement in a wide variety of scientific fields. Lehman found for example that famous chemists had in most cases made their major significant contribution to science by the time they were 35. Lehman found that the individual's best work was achieved by the time he or she reached 40 in most of the occupations studied.

Following Lehman's (1953) study, Schaie (1958) examined the relationship of age to mental ability and flexibility. Mental ability and flexibility, according to him is the readiness to accept new ways of perceiving things. Schaie (1958) found that mental ability and flexibility reached its crest before the age of 35 and declined more or less subsequently.

In another study Pelz and Andrews (1966) observed a productive peak in scientists in their late 30s and early 40s; they however, found a second peak ten to fifteen years later at age 50.

Analogous with Pelz and Andrews's (1966) study, Bayer and Dutton (1977:250-282) in their study of a cross-section of academic scientists in seven fields, observed that five out of the seven fields had what they call a "spurt-obsolescence" function between age and articles published within the previous two years. The authors concluded that production reached its first peak at about the tenth year of career age, and then a second peaks as the scientist reached retirement age.

Parallel to the above findings, Cole (1979) observes a somewhat curvilinear relationship between age and scientific productivity for a cross-section of academic fields. He observes that productivity rates rise gradually with age up to late 30s or early 40s, and then declines.

Insofar as we agree with the hypothesis that publication production declines with age, we should also mention that this hypothesis may not hold in certain cases for a good number of reasons.

First, individuals have a certain degree of inner motivations that may be an important factor in prolonging their achievement over a broad span of their scientific career. This may be particularly true for the aged faculty member who because of his/her publication achievement has continued support from his/her colleagues, research assistants and even research funding agencies.

Second, scientific fields differ in their cognitive structures. Some fields, like physics, and chemistry are highly developed models. These fields have well established mode of scientific investigation; thus, it is easier for younger scientists to make significant contribution to knowledge than their colleagues in administrative or social sciences which have less developed paradigm. Although, significant work has been done to position social and administrative sciences as a separate field of study, identity crisis has forced the fields to be divided into competing schools, corresponding to what can be called fragmented adhocracy. The lack of uniformity in practice compounds the problems of acceptability of research output of the younger scholars.

Zuckerman and Merton (1973) maintained that in fields like physics and chemistry have well laid down laws. It is therefore, easier for young scientists to make significant discoveries than their colleagues in the soft sciences because of the uniformity in scientific practice. Graduate students in the hard sciences can learn quickly the current state of their field from textbooks and while still graduate students begin work on the research frontier. Second, because there is well developed paradigm there is greater consensus on the knowledge acquired.

Based on the preceding discussion, it is reasonable to say that younger faculty members in the hard sciences are more likely to have important contributions identified, than their aged peers in administrative sciences.

A further reason the hypothesis that publication production declines with age may not hold is what Rhodes (1983:239) calls "psychosocial aging, the systematic changes in personality, needs, exceptions and behavior as well as performance in a sequence of socially prescribed roles and accumulation of experiences. These roles, she continues, carry with them certain expectations for behavior which go a long way to enhance or impede production".

The relationship between age and publication production must also be explained by the operation of the reward system. Scientific productivity requires adequate funding in terms of research grant, technical help, research assistants and graduate students. Since established scientists are more likely to have access to resources than their younger counterparts because of cumulative advantage; it is reasonable to assume that there will be differences in publication rates based on age differences.

Faculty members who work with teams of graduate students, and junior collaborators are more likely to produce multi-authored publications. Parallel to this view, it is reasonable to assume that older faculty members are more likely to have more graduate assistants, colleagues and junior collaborators with whom they do research. It stands to reason therefore that he relationship between age and multi-authored publications will be positive.

Methods

A total of 557 copies of questionnaires were sent to full time faculty members in Faculties of Management Sciences in eleven universities in Quebec Canada. Responses were received from 176 faculty members with the number of participants per faculty ranging from 3 to 41. The response rate for participants 32 per cent, rate falling within the 18 to 57 range found in previous studies of universities (See Everett, 1980; McNeece, 1981; Taylor, et.al. 1984)

Operational Measures of Variables

No single operationalization of scientific productivity will satisfy everyone. Invariably, matters of judgment and preference often intrude to compound the problem of measurement. However, the specific dependent variable to which attention is given in this study is the self reported articles in refereed and non-refereed journals, books, chapters in books, and papers presented or published in refereed conferences during the last five years.[1]

To estimate the validity of the responses, fifty faculty members were randomly selected from our sample, and their self-reported number of publications was compared with counts from the journals from the indicated from the same five –year period. Forty eight out of the 50 (96 per cent) responses were accurately identified, suggesting that the data were adequate for our purpose.

The measure of scientific productivity was derived from answers to the following questions: Please indicate the number scholarly publications or presentations on which your name appears as the sole author in the last five years. Please indicate the number of publications in which your name appears as one of two or authors in the last five years. Because of the difficulty of establishing singular responsibility for joint-publication, no differentiation was made in establishing publication production.

For this study, it was assumed that factors influencing article and book publications are not identical. It was therefore decided to perform separate but parallel analyses of article and book publications. Total articles was operationalized as the summation of all single and multiple authored articles, chapters in books and papers published or presented in refereed conferences. A chapter in a book was regarded as equivalent to an article. Total books included the summation of single and multiple authored books.

Independent variables

Age as defined in this study is the length of time since the faculty member was born expressed in years. Gender- male and female

Analyses

The data were grouped for the whole population. Two separate but parallel analyses were performed on the scientific productivity variables. That is all the single authored and multi-authored publications (except single and multi-authored books) were combined to form one production measure. All technical papers were excluded from the analysis. These are publications which are not diffused externally. The second measure included all single and multi-authored books.

Hypotheses 1 and 2 were tested using multivariate analysis of variance and multivariate regression analysis respectively.

Results

Hypothesis 1 states that there will be a significant difference between publication production of male faculty members and those of their female colleagues.

Our multivariate analysis of variance showed no statistically significant differences between total article production of male faculty members and those of their female colleagues. The mean total article production for male faculty members was 12.90 compared to a mean of 20.00 for the females. The mean total book production for male faculty members was 0.93 compared to a mean of 1.25 for female faculty members. This was statistically significant.

A further analysis was performed on single–authored publication production measures. No significant difference was found between male and female faculty members in the production of single-authored publications.

Extending the analysis to include multiple-authored publications reveals statistically significant differences between male and female members in the production of multiple-authored books, and papers presented at conferences. The mean publication production of multiple-authored books for male faculty members was 0.60 compared to a mean of 1.25 for their female counterparts. This was significantly different at ($F= 3.75$, $DF = 1/102$; $p <.10$). Similarly, the mean publication production of multiple-authored papers presented at refereed conferences for male faculty members was 0.85 compared to a mean of 3.75 for female faculty members. This was significantly different at ($F = 2.78$, $DF = 1/102$; $p < 0.10$).

Although, these findings are consistent with earlier studies on the subject (See Sotudeh and Khoshian, 2013; Stack, 2004, 2002, & Prpic, 2002), caution should be exercised in drawing conclusions from these findings partly because of the small proportion of female faculty members who participated in the study.

Hypothesis 2 states that there is a positive and significant relationship between age and scientific productivity. This was tested with the multivariate regression analysis. The finding in Table 1 shows no significant relationship between age and total article and total book production (beta = -0.01 and -0.02), respectively. A further analysis on total single and multiple –authored articles revealed no statistically significant relationship (beta =-0.04 and 0.03, respectively).

Except for multiple–authored chapter in books, which was negative, and significantly related to age, none of the other publication production measures was significant (See Tables 2 and 3).

It would appear that faculty members would be more productive in the production of publications at certain ages, in spite of this non significant relationship between age and publication production.

The above results have certain possible explanations. First, it appears that the publication culture within some of the faculties is less stimulating than other. This lack of stimulating environment could account for the non significant relationship between age and publication.

Second, as academics mature in their fields, they tend to dig themselves into narrow specialties, hence creating a certain degree of inflexibility in their publication endeavours. Lack of flexibility impedes publication production.

Third, knowledge in disciplines like management and administrative sciences is less codified or not well developed. The person and social attributes of scientists influence the visibility of their ideas and the reception of their works. As a result work by younger scientists who are less likely known in the field will have less chance of being noticed in the less codified fields.

Fourth, academic position including other factors may account for the variance in scientific productivity more than gender and age.

Finally, individuals are motivated to engage in certain activities from their own ideas, desires for freedom, stimulation from previous work and from curiosity. Lack of inner stimulation could only serve to hinder scientific productivity.

Conclusion

Age and gender appear to have considerably less impact upon scientific productivity than has generally been accepted.

Table 1: Multivariate Analyses of Global Publication Production Measures on Gender and Age Variables (N- 176)

Scientific Productivity Measures	Total Single Articles	Total multiple Articles	Total Articles	Total Books
	B-Weights[a]	B- Weights	B-Weights	B-Weights
Age	-.04	.03	-01	-02
Sex	1.45	2.20	3.64	.47
Intercept	-4.04	1.33	-5.37	1.17
R^2	.34***	.41***	.48***	.29*
F	1.84	2.52	3.25	1.49

[0]p < 0.1, *p <.05, **p < .01 ***p <.001 d.f: degree of freedom = 125 [a] = non standardized

Table 2: Multivariate Analyses of Single Publication Production Measures on Gender and Age Variables (N- 176)

Scientific Productivity Measures	Articles in ref. Jrn.	Articles in non ref.jrn.	Books	Chap. in Books	Papers pub. in ref. conf.	Paper presented at ref. conf.
	B-Weights	B- Weights	B-Weights	B-Weights	B-weight	B-weight
Age	-.07	.02	-00	-01	.03	.04
Sex	.69	.22	.10	.29	.06	.89
Intercept	1.79	.59	.50	.29	-1.26	-4.38
R^2	.32*	.26	.26	,27	.27	.25
F	1.25	.50	.80	.98	.85	.45

[0]p < 0.1, *p <.05, **p < .01 ***p <.001 d.f: degree of freedom = 125 a = non standardized

Table 3: Multivariate Analyses of Multiple Authored Publication Production Measures on Gender and Age Variables (N- 176)

Scientific Productivity Measures	Articles in ref. Jrn.	Articles in non ref.jrn.	Books	Chap.in Books	Papers pub. in ref. conf.	Paper presented at ref. conf.
	B-Weights	B- Weights	B-Weights	B-Weights	B-Weight	B-Weight
Age	.02	.04	-01	.03*	.00	.02
Sex	.04	.14	.83[0]	..14	.90	.2.25[0]
Intercept	2.82	.07	.67	2.13	-4.38	-1.97
R^2	..41***	..32*	..31*	.36**	.30*	.33*
F	2.07	1.20	1.10	1.39	1.05	1.24

[0]p < 0.1, *p <.05, **p < .01 ***p <.001 d.f: degree of freedom = 125 a = non standardized

Notes

[1] *The time parameter 2008- 2013 was chosen for two reasons. First, to eliminate the cumulative effect of sheer professional age on scientific productivity; second, the acceptable form of publication in a discipline may change over time, meaning that a scholar entering a discipline at a particular time may have a large number of one kind of publication. It was therefore assumed that any period longer than five years would not adequately reflect current levels of output.*

Scientific productivity of faculty members who have been in the university for less than five years were adjusted to account for the five year period. This was adjusted as follows: Total number of publications x 5 years/number of years in the academic profession.

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