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ABSTRACT

An instrument to measure the 13 personal characteristics of productive researchers described by C. J. Bland and others (1986, 1990) was developed and evaluated. The total eligible sample was 404 full-time assistant professor faculty members in the tenure track at Case Western Reserve University in Cleveland (Ohio). A random sample of 100 respondents received a follow-up telephone call urging response to the survey developed for the study. A final sample was selected, consisting of 49 successful and 27 less successful researchers. Univariate analysis of the survey responses indicated that 62% of items significantly discriminated successful and less successful researchers. On the average, successful researchers exhibited more of the identified characteristics than did the less successful ones. Factor analysis identified four stable factors; only two were needed to achieve maximum discrimination--scholarly habits and research activities/environment. The two-factor approach identified 92% of the successful researchers and 93% of the less successful researchers. Eight characteristics measured by the two factors were: (1) research skills; (2) motivation; (3) adequate research time; (4) multiple projects; (5) vital networks; (6) external/internal orientation; (7) supportive departments; and (8) in-depth content knowledge. Implications for encouraging researchers are discussed. A 15-item list of references and two tables are included. (SLD)

Evaluation of an Instrument to Predict Successful Medical Researchers

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Introduction

There is increasing concern about the diminishing supply of clinical investigators and the amount of clinical investigation being conducted by departments in academic institutions. Of the estimated 20,000 physicians who are clinical investigators, about five percent every year discontinue their research careers. The lack of a uniform standard for measuring faculty research productivity and the atheoretical nature of the variables often used to measure research productivity stimulated the need for this study. Research that helps to explain variation in faculty productivity has found two types of characteristics that promote research productivity: personal and environmental. In a comprehensive literature review, Bland et al examined 13 personal characteristics of productive researchers, their training and their work environment.

The aim of this study was was to develop and evaluate an instrument to measure the 13 characteristics described by Bland et al. Two hypothesis were tested: successful researchers will exhibit more characteristics than less successful researchers; and not all thirteen characteristics identified by Bland et al will be necessary but a core subset will be critical.

Methods

The survey design of the study consisted of all faculty at Case Western Reserve University (CWRU), a private, research university, meeting the following inclusion criteria: full time, assistant professor faculty in the tenure track. Faculty in the tenure track are judged on their research productivity at the time of promotion. Therefore, tenure track status was the main inclusion criteria. The total eligible sample was 404.

A random sample of 100 respondents from the sample population of 404 was drawn for telephone follow-up. Each participant was contacted to

determine if he/she received the survey and were planning to complete the instrument. Enumeration of this sample served as a check on the representativeness of the respondents.

Instrumentation

The first phase of the study was devoted to the design and development of the survey questionnaire to measure the thirteen characteristics identified by Bland et al (See Table One). Eleven reiterations were completed with consultation from Drs. Bland and Blackburn. The original number of items was reduced to two pages and the instrument was pilot tested. In the second phase, the survey was mailed to the home address of each faculty member.

Data analysis strategies were selected to address the specific hypothesis posed. For hypothesis one, that successful researchers would display more characteristics than less sucessful faculty, all faculty were categorized into three groups: successful, productive but not yet at a high level and less successful. Categorization was based upon two hard outcome criteria: the successful researcher would produce at least two publications per year over the past two years, and the successful researcher would receive funding for a formal federal or foundation grant. The less successful researcher would have neither of these outcome criteria and the productive researcher would have one, but not both.

Initial analyses were only performed between the two extreme groups to maximize design variability. Chi-square statistics were used to evaluate the categorical items and t tests for the continuous items such as years of experience in research. Hypothesis two, that all thirteen characteristics would not be needed to fully differentiate successful researchers, was addressed by factor analysis and stepwise discriminant analysis.

Results

Four hundred and four faculty were eligible for participation in this study (See Table 2). Two hundred and fifty-seven participants (64%) returned the survey. Two groups were deleted from the 257 respondents: 97 persons with less than two years of experience and 16 faculty from the humanities department who felt the instrument was inappropriate to their discipline.

Seventy eight percent of the respondents (n=188) were medical school faculty. After deleting the 78 faculty with less than two years of experience, the remaining sample of 110 was categorized into three groups: successful researchers (n=49), productive faculty (n=42), and faculty who fell into the less successful group (n=27).

Eighty-eight percent of the faculty selected for the random sample returned the questionnaire. Of the 100, 88 returned the survey, seven left the university and may not have returned the survey, and five did not return it even though they agreed to participate. Examination of the demographics reveal no significant differences between the random sample and the total number of respondents.

The two extreme research groups, the successful and the less sucessful are the focus of this presentation and will be referred to as the study sample (n=76). Table 2 describes the demographics of the full sample of respondents in comparison with the study sample of medical school faculty. The study sample did not differ significantly from the full sample on age, gender, degree, or number of years as assistant professor. The median age of the medical school faculty is 40. Seventy-five percent of the medical school faculty are male. On the average, these faculty are in the fifth year of the tenure track and 58% are physicians. Medical school faculty in the tenure track have nine years to apply and be awarded tenure.

Univariate analysis of the items revealed that 62% (44/67) of the items significantly discriminated successful and less successful researchers. Consistently for all items, successful researchers on the average exhibited more of the characteristics than less successful researchers, thus confirming hypothesis one.

To reduce the size and complexity of the data and to obtain empericially derived measures for the study sample, the 44 discriminating items were entered into a factor analysis. For ease in scoring, each item was reduced to a unit scoring system, ie. one point being assigned per item depending on the response alternatives. A principal axes factor analysis solution with oblique rotations produced four stable factors: research activities/environment, local mentors, specific off campus networking, and scholarly habits. Several critieria were evaluated before interpreting a factor: eigen value; scree test, number of items and reliability.

The next tables represent the four factors and some examples of specimen items and their loadings. As you can see, the first factor is labeled research activities/environment. Items that loaded on this factor included: percent of time spent on research, number of grants on which the individual was principal investigator, number of colleagues contacted each month regarding research, number of research groups, and degree of support from department chair. The remaining factors addressed: local mentors, specific off campus networking, and scholarly habits. Items specific to local mentors included whether there was a senior person on campus who gave advice, assisted in writing grants and articles, facilitated participation in research projects, and introduced junior faculty to other researchers. Off campus network items included: how many colleagues are contacted off campus and with what frequency, maintaining currency with the literature, and locating professional colleagues. The last factor, scholarly habits,

included items such as: number of presentations during the past two years, location of those presentations, number of publications currently in progress, and annual research meetings or postgraduate courses attended.

Scale scores were derived from the factors by simply adding the individual unit weighted items. Adequate internal reliability was attained for each scale with Cronbach alpha statistics ranging from .70 to .83. High scores on each factor represent more of the items answered in the positive or successful direction. Thus the results indicate the questionnaire could be reduced to a smaller subset of items representing four distinct and reliable scales. Finally, due to the greater unreliability of individual items, all further analyses were carried out using the four scale scores.

Initial evidence of the discriminant validity of the scale scores was addressed by comparing mean factor scores for the 49 successful and 27 less successful faculty by the t statistic. All four scales discriminate between the two groups at the $p < .001$ level. The two strongest factors in identifying successful faculty were scholarly habits ($t=9.78$, $p<.001$) and research activities/environment ($t=9.83$, $p<.001$). Since these factors were derived from an obliquely rotated factor analysis solution, some correlation exists among the factors. Thus to identify the best discriminators of success level, a stepwise discriminant analysis was performed.

The results of the discriminant analysis are shown in table 4. Only two of the four factors were needed to effect the maximum discrimmination. Once scholarly habits and research activities/environment were entered, the two remaining factor scores did not contribute to the level of research success. Thus, off campus networking and local mentoring were redundant once the first two factors were shown.

The sensitivity and specificity of the two factor equation was such that 92% of the successful faculty were correctly identified by the equation and 93% of the less successful. The positive predictive value of the two factor screen was 94%. Thus greater than 9 out of 10 faculty with a score above the cutoff on the two factor composite are correctly classified as successful and they account for 92% of all the successful faculty.

Discussion

The results of these analyses suggest major differences in the initial preparation of tenure track faculty to conduct independent research. The findings confirm our two hypothesis. The eight characteristics measured by the two most predictive factors include: research skills, motivation, adequate research time, multiple projects, vital networks, external/internal orientation, supportive departments and indepth content knowledge. The overall findings have major research and faculty development implications. Findings from the study support the literature indicating that department chairs are instrumental in identifying key faculty to work with junior faculty, providing release time, and sponsoring faculty for membership on faculty committees, editorial boards and research teams. Findings also suggest that having access to personnel for technical support and content expertise for assistance with tasks such as data entry and analysis, literature searches and consultation are also important to increasing productivity.

The second most important factor in predicting faculty research productivity is scholarly habits. Findings suggest that faculty maintain their research skills and productivity by participating actively at meetings of their professional organization(s). This active participation involves presenting papers, committee participation, or committee leadership. Active involvement

gives the faculty member an opportunity to network with junior and senior colleagues which often leads to the development of joint publications or participation on Task Forces or Working Groups of professional organizations.

The findings suggest that the instrument has a high degree of specificity for categorizing faculty. Still, the diversity that exists among faculty in research productivity across academic medical centers leads us to question whether these criteria are generalizable to other institutions. Two groups excluded from the study sample are faculty who have been at CWRU less than two years and faculty who fell into the productive group. The productive group are those faculty who have only one of the outcome criteria. Department chairs and educators must develop strategies for each group to encourage high levels of scholarly productivity and keep faculty challenged.

Implications

Based upon this study, several recommendations emerge. First, there is a need to revise and test the instrument in other academic medical centers to determine if it is generalizeable. Second, three nodal points exist for implementation of faculty development strategies to encourage faculty research productivity. The first nodal point is the department chair. Department chairs need to carefully and systematically recruit research faculty who possess the personal predictors essential to research productivity. Department chairs must provide leadership in identifying resources and providing a milieu that meets the needs of varying levels of faculty working on scholarly activities. The entry-level research faculty member represents the second nodal point and the productive faculty member represent the third nodal point. Following a cohort of these faculty in the tenure track with specific interventions designed for each level may

facilitate increased individual research productivity and enhance departmental status within the institution.

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Table 1.

Mean Factor Scores by Level of Success

Scale	Less successful n=27		Successful n=49		t	p
	Mean	(SD)	Mean	(SD)		
Research Environment	1.0	(1.2)	4.8	(2.1)	9.83	<0.001
Local Mentoring	1.4	(1.4)	3.1	(2.3)	3.73	<0.001
Off Campus	1.8	(1.3)	3.5	(1.4)	5.21	<0.001
Scholarly Habits	1.7	(1.7)	5.4	(1.5)	9.40	<0.001

Table 2.

Stepwise Discriminant Analysis for Classification

of Successful and Less-Successful Faculty

Step No.	Variable Entered	Means		F to Enter	P
		Less Success	Success		
1	Scholarly Habits	1.7	5.4	95.7	0.001
2	Research Environment	1.0	4.8	22.2	0.001
3	Off-Campus Networks	-	-	0.67	N.S.
4	Local Mentoring	-	-	0.05	N.S.

For 2-Variable Equation: $F=72.7$ ($df=2,73$), $p<0.001$