The Impact of Nonacademic Variables on Performance at Two Medical Schools

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Recent research shows that nonacademic variables must be taken into account when analyzing the indicators of medical student success. However, most previous studies have been limited to a single institution or population. This study investigated the relationship between nonacademic variables and performance at two very different medical schools. The Noncognitive Questionnaire was administered to 104 students at School A (predominantly white and historically oriented toward women) and 102 at School B (predominantly black). Correlation and multiple regression analyses were conducted to determine the relationship among nonacademic variables, undergraduate academic variables (Medical College Admission Test, undergraduate grade point average, and college quality), basic science grades, and US Medical Licensure Exam Step I (USMLE I) scores. At School A, leadership/decisiveness, expected difficulty, and motivation predicted higher USMLE I scores and higher basic science grades each semester. At School B, expected difficulty was correlated with higher first semester grades only. For School A women, initiative/commitment was positively associated with both higher grades and higher USMLE scores. For black students at School B, expected difficulty was positively associated with higher grades. Identifying school-specific nonacademic variables of performance is critical to developing improved student support services. (*J Natl Med Assoc.* 1997;89:173-180.)

Key words: medical education ◆ medical schools ◆ academic performance ◆ nonacademic performance ◆ medical students

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Medical school administrators must make early predictions about students' academic performance in order to plan effective admission and academic support programs. Prior research on predictors of successful medical school performance often has focused on three conventional academic variables: Medical College Admission Test (MCAT) score, undergraduate grade point average (GPA), and competitiveness of the undergraduate institution. Mitchell's review[1] of the literature from 1980 to 1990 confirmed that these academic variables are important predictors: they explain 49% of the variance in grades and 58% of the variance in National Board of Medical Examiners Part I (NBME I) scores. However, these variables alone do not predict academic success.[2]

The emerging research into nonacademic variables

Table 1. Demographic Information*

	No.(%) School A	No.(%) School B
All students	104	102
Males	47 (45.2)	49 (48)
Females	57 (54.8)	53 (52)
Black	16 (15.4)	74 (75.5)
White	57 (54.8)	7 (7.1)
Asian	28 (26.9)	7 (7.1)
Other	3 (2.9)	14 (13.7)

*The mean age for School A students was 23.93 years and 22.41 years for School B students.

reveals that personality characteristics and attitudes provide predictive power of medical student performance beyond that provided by academic measures alone. A student's confidence in the correctness of his or her test answers, external locus of control (belief that events result from external forces), and degree of independence all are predictive of scores on the NBME I.[3,4] Confidence in test answers and possession of a thinking and sensing personality type predict medical school test grades.[4,5]

There is also growing evidence that for certain subpopulations of medical students, nontraditional variables are important factors of performance. Dawson[6] found that academic variables alone did not explain the difference between performance of male and female medical students on the NBME Part I. Other researchers have found that for women, admissions interview ratings, prior health-care experience, personality variables, and demographic factors are better predictors than are academic variables.[7,8] In minority populations, academic variables are less predictive of medical school performance than in majority populations.[9] Internal locus of control[10] and self-evaluation skills[11,12] both correlate with minority student performance.

However, because the term nonacademic variables encompasses any number of characteristics and attitudes, the identification of one set of nonacademic variables likely to be important in most medical student populations and subpopulations would be helpful. Unfortunately, there are obstacles to basing such an identification on previous research. Most previous studies of nonacademic variables have been limited to one institution. Further, it is difficult to compare studies across institutions because of the lack of common variables studied or instruments used.

Use of carefully selected noncognitive measures to assess variables for several different institutions and populations may begin to overcome obstacles found in earlier studies. Tracey and Sedlacek's Noncognitive Questionnaire[13] predicts college performance, particularly for women and minority students. The nonacademic variables it measures include: positive self-concept/confidence, realistic self-appraisal, knowledge acquired in a field, understanding of racism, preference for long-range goals, strong support person, successful leadership experience, and community service. Sedlacek and Prieto[2] state that these nonacademic variables, which parallel several of the variables others have found predictive (eg, confidence,[4] self-evaluation skills,[11] and prior health experience[6]), may be related to the performance of both general student populations and subpopulations (eg, race and gender).

The purpose of this study was to examine the relationship between medical school performance and selected nonacademic variables. The following questions were asked:

- Does the prediction of performance by nonacademic variables and academic variables differ by institution, gender, or race?
- What is the relative contribution of nonacademic variables and academic variables in predicting performance?
- Is the Noncognitive Questionnaire useful in determining important nonacademic variables in the medical school setting?

METHOD

Participants

Participation was solicited from all first-year medical students enrolled in two medical schools during the academic year 1992-1993, one predominantly white and historically oriented toward women (School A) and the other historically black (School B). All 104 of the students enrolled in the lecture-based track participated from School A and all 102 students participated from School B. The 24 students participating in the small problem-based learning track at School A were not included in the analyses because their academic experience differed significantly from the lecture-based track.

Procedure

In the fall of 1992, during the orientation week of their first year of medical school, students at both schools completed the Revised Nonacademic Variables Questionnaire. In addition, data were gath-

ered on three academic predictors:

- undergraduate grade point average (GPA),
- Medical College Admission Test (MCAT) total score (the most recent score for the MCAT was used for those who had taken the test more than once), and
- competitiveness of undergraduate college attended (Qual), which was determined using The Gourman Report,[14] an objective, annual evaluation rating institutions on a scale of one to five, based on the quality of students, faculty, curriculum, research, etc.

Five criterion measures were used: first, second, third, and fourth semester grades in the basic science courses and USMLE (US Medical Licensure Exam) Step I scores. The USMLE Step I is the medical licensure examination given nationally and is required for medical licensure in the United States. At the two institutions sampled, it also is required for progression to the third year. Semester grades were calculated by taking the mean of grades received for courses taken that semester.

Instruments

The Revised Nonacademic Variables Questionnaire is a revision of the Noncognitive Questionnaire[12] for use with medical students. A committee of four faculty educators and researchers reviewed the Noncognitive Questionnaire with its author. Items pertaining directly to college students or to the University of Maryland were changed to refer to medical students (eg, "My friends and relatives don't feel I should go to college" was changed to "My friends and relatives don't feel I should go to medical school," or "I am as skilled academically as the average applicant to University of Maryland" was changed to "I am as skilled academically as the average applicant to medical school"). The new questionnaire, which was named the Revised Nonacademic Variables Questionnaire, assesses eight variables demonstrated[13] to be related to the academic success of students. Its 29 items include 6 demographic questions, 2 nominal items on educational expectations, 18 Likert-type items about medical school and self-assessment, and three open-ended questions regarding present goals, accomplishments, group memberships, and leadership offices held.

Two basic sets of analyses were performed. The first set examined the ability of the Revised Nonacademic Variables Questionnaire to confirm the stability of the factor solution in this population. Principal components factor analysis (with varimax rotation) was used to determine whether the items loaded on the eight nonacademic dimensions that were proposed by Sedlacek.

The second set of analyses was designed to establish the validity of the Revised Nonacademic Variables Questionnaire as a predictor of medical student performance. The predictive validity was examined using Pearson correlation and forced-entry multiple regression for each medical school sample. These tests were repeated using subpopulations in each medical school based on gender and race.

RESULTS

Demographic Information

The male-to-female ratio was similar at both institutions. The racial patterns differed, and students entering School A were on average about 1.5 years older than those entering School B (Table 1). Students attending both schools matriculated at undergraduate colleges that were similar in quality (3.29 for School A and 3.21 for School B; t=.17; P=.86). Performances on the MCAT and cumulative GPAs were significantly different: mean MCAT was 26.66 and 22.91 for Schools A and B (t=−6.18; P<.00), respectively, and mean GPA was 3.44 and 3.12 for Schools A and B mean (t=−5.28, P<.00), respectively.

Factor Analysis

Factor analysis of the data obtained using the Revised Nonacademic Variables Questionnaire supported three nonacademic variables. Variables were accepted based on factor loadings >.40. Final Eigenvalue was 1.41 and the cumulative percent of variance explained was 39.5. These variables were named 1) leadership/decisiveness, 2) expected difficulty in medical school, and 3) motivation from self/others. Leadership/decisiveness is a heterogeneous variable. It reflects the self-perception that one is seen by others as a leader and that one is decisive in one's beliefs and actions. Sample questions included "In groups where I am comfortable, I am often looked to as a leader" and "When I believe strongly in something, I act on it." Expected difficulty in medical school described the students' anticipation of the degree of difficulty they would have personally to complete medical school successfully (eg, "I am as skilled academically as the average applicant to medical school," "I expect to have a harder time than most students in medical school," or "It should not be very hard to get passing grades

Table 2. Multiple Regressions on Basic Science Performance: Multiple R^2 Values for Academic and Nonacademic Variables as Predictors of Performance at Schools A and B

Variable	Semester 1 (SE)	Semester 2 (SE)	Semester 3 (SE)	Semester 4 (SE)	USMLE I (SE)
School A (n=104)					
Nonacademic factors* (alone)	.12† (7.64)	.14‡ (6.59)	.11† (5.82)	.14‡ (5.35)	.11† (20.22)
Academic factors* (alone)	.22§ (7.05)	.36§ (5.58)	.34§ (5.01)	.30§ (4.93)	.38§ (16.0)
Academic + nonacademic factors	.25§ (7.13)	.40§ (5.62)	.38§ (4.96)	.40§ (4.61)	.42§ (16.3)
School B (n=102)					
Nonacademic factors* (alone)	0.06 (6.35)	.01 (3.94)	.03 (5.73)	.01 (4.93)	0.07 (20.1)
Academic factors* (alone)	.22§ (5.49)	.26§ (3.26)	.22§ (4.91)	.26§ (4.11)	.42§ (15.0)
Academic + nonacademic factors	.25‡ (5.54)	.26‡ (3.32)	.23‡ (5.12)	.27‡ (4.09)	.48§ (14.8)

Abbreviations: (SE)=standard error and USMLE I=US Medical Licensing Exam Step 1.
*Academic factors: expectation of academic difficulty, leadership/decisiveness, and motivation; nonacademic factors: Medical College Admissions Test, grade point average, and college quality.
†$P<.05$.
‡$P<.01$.
§$P<.001$.

in medical school"). Motivation from self/others reflected the desire of self and others to do well in medical school (eg, "My family has always wanted me to go to medical school" and "I want a chance to prove myself academically"). The results thus demonstrate support for three of the factors identified in Tracey and Sedlacek's undergraduate analysis.[12] Factor scores were used in further analyses.

Predictors of Performance

General Student Population for Schools A and B. For both School A and School B, expected difficulty correlated with grades first semester ($r=.23$ and .24, respectively; $P<.05$). No other nonacademic variables were significantly related to performance for School B. However, for School A, leadership/decisiveness correlated with grades every semester ($r=.25$, .23, .24, and .27; $P\leq.05$) and expected difficulty correlated with USMLE Step I scores ($r=.24$; $P\leq.05$).

Multiple regression was performed using the three Revised Nonacademic Variables Questionnaire variables as predictors, with USMLE scores and grades as criterion measures. In the first analysis, nonacademic variables as a group were entered. In the next analysis, academic variables as a group were entered. In the final analysis, both academic and nonacademic variables were entered together. The results (Table 2) showed that for School A students, nonacademic factors do predict USMLE scores ($R^2=.11$; $P\leq.05$) and grades (median $R^2=.13$). Leadership/decisiveness and motivation were the nonacademic variables most predictive of grades. Leadership/decisiveness was also the most predictive of USMLE scores. Moreover, the nonacademic variables as a set significantly ($P\leq.05$) increased (by 0.10) the ability of academic variables to predict grades in the fourth semester. None of the nonacademic variables tested were predictive of performance for School B students.

Academic variables as a group were also significant ($P\leq.05$) predictors of USMLE performance ($R^2=.38$) and grades (median $R^2=.32$) for School A. For school B, academic factors were as predictive of USMLE scores ($R^2=.42$), but somewhat less predictive of grades (median $R^2=.24$) than for School A. Grade point average was most consistently predic-

Table 3. Pearson Correlation Coefficients for Academic and Nonacademic Variables and Medical School Course Grades for Women at Schools A and B

Measure	L/D	DIFF	MOTIV	GPA	MCAT	QUAL
School A (n=56)						
Semester 1	.25	−.07	.29	.39*	.62*	.10
Semester 2	.30*	.00	.28	.62	.42*	.15
Semester 3	.38*	.16	.21	.59*	.42*	.07
Semester 4	.34*	.19	.12	.53*	.31*	.10
USMLE I	.37*	.18	.17	.52	.58*	.12
School B (n=53)						
Semester 1	−.06	.27	.20	.26	.28	−.12
Semester 2	−.04	−.12	−.21	.09	.25	.25
Semester 3	−.01	.11	.08	−.14	.17	.41†
Semester 4	.13	−.19	−.00	−.18	.37†	.40†
USMLE I	−.03	.07	−.03	.01	.52‡	.17

Abbreviations: L/D=leadership/decisiveness, DIFF=expectation of academic difficulty, MOTIV=motivation, GPA=grade point average, MCAT=Medical College Admissions Test, and USMLE=US Medical Licensing Exam Step 1.
*$P<.05$.
†$P<.01$.
‡$P<.001$.

tive of performance for School A, whereas MCAT and college quality, not GPA, were the consistent predictors for School B.

Gender and Race Subpopulations of Schools A and B. For women at School A (Table 3), leadership/decisiveness correlated significantly ($P\leq.05$) with grades for all but one semester (median $r=.34$) and with USMLE scores($r=.37$). However, the relationship between nonacademic variables and performance for any other group, ie, men at School A or for men or women at School B, was not significant. With regard to the academic variables, MCAT and GPA correlated with grades and USMLE scores at School A whereas MCAT and college quality correlated with scores at School B.

For the 74 black students at School B (Table 4), expected difficulty correlated ($P\leq.05$) with performance first semester, but for the 16 black students at School A, there was no correlation between performance and nonacademic variables. Although MCAT and college quality correlated with black student performance at School B, no academic variable correlated with performance at School A.

For the 57 white students at School A, motivation was significantly ($P\leq.05$) related to grades (median $r=.40$) as was GPA (median $r=.40$). Both MCAT ($r=.47$) and GPA ($r=.44$) correlated significantly with USMLE scores. Because there were only 7 white students at School B, no analysis was done on that sample.

DISCUSSION

These findings suggest that three nonacademic variables, leadership/decisiveness, motivation, and expected degree of difficulty, may predict medical student performance for at least one institution. However, it also highlights the difficulty of finding one set of nonacademic variables that are important at differing institutions or that add to the ability of academic variables to predict performance.

Relationship Between Nonacademic Variables and Performance for Each Institution

As demonstrated in other studies, the academic variables MCAT and GPA were the strongest predictors of academic performance at both institutions. They accounted for up to 58% of the variance in medical school grades. This study's focus, however, was the nonacademic variables predicting performance. The primary finding in terms of nonacademic factors was that the patterns of relationships between nonacademic variables and performance may be institution-specific. Although leadership/decisiveness, motivation, and expected degree of difficulty were all related to performance, the pattern of relationships differed at the two institutions. At School B, only one

Table 4. Pearson Correlation Coefficients for Academic and Nonacademic Variables and Medical School Course Grades for Blacks at Schools A and B

Measure	L/D	DIFF	MOTIV	GPA	MCAT	QUAL
School A (n=16)						
Semester 1	−.35	−.45	.05	.24	.15	−.43
Semester 2	.02	−.43	−.10	.45	.32	.32
Semester 3	−.01	.17	−.40	.28	.13	.28
Semester 4	−.12	.38	−.30	−.10	.01	−.10
USMLE I	.08	.48	−.10	.09	−.28	.29
School B (n=74)						
Semester I	.01	.28*	.17	.20	.29†	−.09
Semester 2	−.05	.01	−.11	−.02	.29*	.17
Semester 3	−.06	.06	.16	−.15	.18	.36†
Semester 4	.06	−.07	−.01	−.21	.20	.30*
USMLE I	.02	.22	.01	−.05	.46	.02

Abbreviations:L/D=leadership/decisiveness, DIFF=expectation of academic difficulty, MOTIV=motivation, GPA=grade point average, MCAT=Medical College Admissions Test, and USMLE=US Medical Licensing Exam Step 1.
*$P<.05$.
†$P<.01$.

nonacademic variable, expected difficulty, correlated significantly with performance, and this was true only at the start of the basic science years. There was no other relationship between the nonacademic variables tested and performance. By contrast, at School A, all three nonacademic variables predicted performance, with leadership/decisiveness making the greatest contribution.

Why were nonacademic variables more consistently related to performance at School A than at School B? Neither population was "100% black" nor "100% white": there were 74% black and 15% white students at School B. Similarly, there were 57% white and 16% black students at School A. Therefore, while racial composition might appear the most obvious explanation, it is probably not the best one. It is more likely that different nonacademic variables carry relatively different weights at each school. Two institutions with very different cultures were chosen. It seems reasonable to assume that the culture of each school itself attracts its own following, and different student characteristics would be important for success at each.

A second reason for the difference may lie in the limited number of nonacademic variables investigated. A study of additional nonacademic variables (for example, realistic self-appraisal as proposed by Sedlacek) will likely reveal others that are important for School B students. Finally, the difference in results at the two schools may simply reflect chance, but more likely type 2 error. Some results may be missed due to small effects and because of the modest numbers of subjects. It is highly unlikely that nonacademic variables play no significant role at School B. Although academic variables were important predictors there, they still did not account for 58% of the variance in performance. The fact that academic variables accounted for somewhat less variance in grades at School B than School A for three semesters further emphasizes the need to find the nonacademic predictors for School B.

Relationship Between Nonacademic Variables and Performance for Different Subpopulations

Gender. The only significant results concerning gender were found at School A. For women at this institution, leadership/decisiveness correlated significantly with board scores as well as with grades in all but one semester. This finding may be related to the fact that School A is historically a women's medical college and its culture supports leadership qualities in women. Perhaps successful female students at School A are those who fit in with this culture. Interestingly, for men, nonacademic variables were not related to performance at all for either school. This gender distinction echos the findings of Willoughby et al[8] in which nonacademic factors were predictive of female, but not of male NBME I performance within a nontraditional program. Further examination of gender differences in

nonacademic predictors within different medical school cultures would be helpful.

Race. While both nonacademic and academic variables were related to black student performance at School B, at School A, neither academic nor nonacademic variables correlated with grades or board scores for black students. One possible reason for this surprising finding is that there were only 16 black students in the data from School A; perhaps more stable correlations would be obtained with a larger sample. Another possibility lies in the fact that only total MCAT scores were used in this study. If MCAT subscores (eg, verbal scores, biological scores, etc) were used, perhaps a stronger relationship between MCAT scores and medical school performance would be evident for School A students. Finally, these preliminary findings may suggest support for the hypothesis that the variables affecting black student performance at predominantly black versus predominantly white schools are different.

As noted, motivation was a consistent predictor for white student performance at School A, but not for nonwhite students at School A or nonblack students at School B. Further study might better elucidate the reasons for this finding.

Use of the Noncognitive Questionnaire

A revised form of the Noncognitive Questionnaire (originally designed for college students) was useful in identifying three nonacademic variables that may be related to academic performance in medical school. Noncognitive variables found important in medical school populations differ from those in the college population, a reasonable outcome considering the different academic and nonacademic challenges facing college and medical students. It is clear, however, that the measurement of additional variables is needed.

CONCLUSION

This study confirms the importance of academic predictors for medical student performance. However, it also suggests support for the relationship of certain nonacademic variables and performance in medical school. In addition, the results suggest that different nonacademic variables may need to be considered with different populations. Finally, since academic variables were poorer predictors of performance for black students than for white students at the institutions investigated, we must continue to search for the nonacademic predictors, especially for minority populations.

There is a need to further test the three variables found important in this initial study (leader ship/decisiveness, expected degree of difficulty, and motivation). First, there is a need to test the replicability of these findings in successive classes within a given institution. Such research should also be expanded to include other schools. Additional variables proposed by Sedlacek and others, such as realistic self-appraisal and social support, currently are being investigated by the authors. Although these results do not allow us to propose one "set" of nonacademic variables that would predict student performance, further research may identify certain variables that are important at certain types of schools. The schools included in this study were both somewhat "nontraditional" in history and demographic makeup; however, they were racially and culturally distinct. To examine the impact of an institution's racial and gender composition on the selection of nonacademic variables, several schools with varying populations must be included in future studies.

Once predictive nonacademic variables are identified, they can be used by intervention programs in designing methods to enhance overall performance in medical school, a goal shared by all institutions.[15] For example, most medical school curricula focus almost exclusively on increasing knowledge base as a means of improving performance on the USMLE examinations. The use of nonacademic variables in preparation programs may strengthen such efforts. The first author has begun to develop prematriculation workshops that help students sharpen certain nonacademic "tools" in preparation for medical school. For example, students identify personal methods of motivating oneself during periods of burnout (burnout being very common in medical school). She also has co-developed a course that provides information about the reality of the medical school culture so that students will have a realistic expectation of difficulty.

Examination of the meaning of the leadership/decisiveness variable in student life may assist institutions in designing appropriate leadership training for students. The latter factor, in particular, may have bearing on the performance of students as they attempt to carry outward duties during their clinical rotations. Additionally, there is already evidence that admissions committees are considering

Sedlacek's eight nonacademic variables, especially with minority applicants.[13] The reliability of these decisions might be enhanced by incorporating additional nontraditional variables with demonstrated predictive validity into the decision-making process. Finally, premedical advisors may supplement their preparations of minority students within these areas, ultimately increasing minority medical school enrollment and retention.

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