Evaluation of Applicants to Predoctoral Dental Education Programs: Review of the Literature

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Abstract: This review finds that college GPA and DAT scores provide dental schools in the United States and Canada with defensible methods for selecting students. College GPA seems the best predictor of academic performance in dental school. The academic average (AA) of the DAT is a better predictor than is the perceptual ability test (PAT), but dental educators who believe that evidence of manual dexterity or perceptual ability must be a part of the admissions decision can find enough supporting evidence to justify doing so. When added to college GPA and the AA, information from the PAT may in fact enhance predictability. There is also evidence, however, that manual skills can be learned during routine dental curricular experiences. Overall, conventional admissions criteria at best account for about 40 percent of the variance in dental school performance, and most of this variance occurs during the early years of the curriculum. Studies are lacking for evaluating criteria that may predict success in admitting students for preferentially addressing current challenges, including achieving diversity of the workforce, ensuring access to care for all, interprofessional health care, ethics and professionalism, filling faculty positions, and conducting needed research. Schools should periodically validate all of their admissions criteria against expected performances and make corresponding adjustments.

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The U.S. Census Bureau in 2002 estimated the average career-long working income of dentists at $4.4 million, $1 million more than for persons holding a Ph.D. or other nonprofessional doctorate, and nearly $2 million more than for those with a master’s degree. Thus, if for no other reason, a dental school’s decision on whether to admit an applicant is of great economic importance to that person. But also, given the high graduation rate (a total attrition rate of only 1.3 percent was reported by dental schools in 2002-03), high eventual success rate in obtaining a license to practice, and the mission of the profession to serve the public well and safely, dental schools’ decisions are also of importance for promoting and protecting public health.

Correspondingly, a number of measures have been used to discriminate among qualifications of applicants. This article reviews reports on the value of those measures, with a view toward determining their respective utilities, identifying whether there are important gaps in knowledge about their effectiveness, and developing recommendations for the future. Although processes used for dental admissions in the two countries are not identical, we have included studies from both the United States and Canada because of their similarities in culture, geography, dental academics, and reciprocity of accreditation. And in fact, a significant number of the studies that critically assess predictors of success in dental schools were done in Canada. An occasional reference is made to studies outside of North America where they may further enlighten the issues addressed in the U.S. and Canadian studies.

All U.S. and nine of ten Canadian schools use one or more parts of the Dental Admissions (U.S.)/Dental Aptitude (Canada) Test (DAT) among their criteria for admission. Other factors used by more than two-thirds of the schools in the United States are science grade point average (GPA), non-science GPA, total GPA, interviews, and recommendations. In Canada, only total GPA and interviews in addition to the DAT are used by a majority of the schools. Fifty-five U.S. and nine Canadian schools collectively evaluated 45,775 applications for admission in 2002.
Dental Admissions/Aptitude Testing

All U.S. dental schools have required the Dental Admission Test (DAT) administered by the American Dental Association (ADA) since 1951. It includes four individual examinations: a Survey of Natural Sciences, a Quantitative Reasoning Test, a Reading Comprehension Test, and the Perceptual Ability Test. Separate scores are provided for biology, general chemistry, and organic chemistry subtests of the Survey of the Natural Sciences, as well as for the survey as a whole, quantitative reasoning, reading comprehension, and perceptual ability. An Academic Average (AA), consisting of the arithmetic mean of the quantitative reasoning, reading comprehension, biology, and general and organic chemistry scores, is also provided. In Canada, a test modeled on the ADA’s test was adopted in 1967. The major differences between the Canadian and U.S. DAT are that Canada includes a carving test (originally in chalk but now in wax) for measuring manual dexterity and does not include exams in quantitative reasoning or organic chemistry. The paper and pencil Perceptual Motor Ability Test from the ADA’s test (PMAT, with 2-D and 3-D subsections) substituted for chalk-carving from 1972 through 1974, but chalk-carving was reinstituted in Canada in 1975. Also in 1975 a formerly utilized, standardized School and College Ability Test (SCAT) was eliminated. On the basis of finding no correlation with later performance, the reading comprehension subsection of the ADA’s DAT was also dropped in Canada. So the Canadian DAT came to consist of four parts: survey of natural science (biology, chemistry), reading comprehension in the dental sciences, PMAT, and carving dexterity. The Canadian DAT also uses a calculated manual average by combining the 2-D, 3-D, and PMAT averages. For a time Canada also administered a personality factor assessment, but that was discontinued. Although numerous studies have evaluated DATs for predicting performance in dental school, the tests’ original intent was more to differentiate those who could be successful in a dental educational program from those who probably would not be successful.

Internal reliability of the ADA’s DAT is good, with ranges of reliability coefficients (Kuder-Richardson Formula 20) of 0.85 to 0.92 for its four parts. Predictive validity is determined by relating scores to performance in dental school and scores on the National Board Dental Examination. Scores on the DAT do tend to improve on repeat taking, indicating that learning to do better on the test through experience does take place. However, the ADA points out that, on the average, individuals who repeat the test score lower than first-time takers.

The DATs are weighted very heavily in dental admissions decisions. Five of its component scores—academic average, science, perceptual ability, reading comprehension, and biology—were each rated more important by U.S. schools than any other factor. On a scale of 1 (least important) to 9 (most important), the academic average was rated (median score) 9, science 8, perceptual ability 7, and the rest of the component scores 6 or below as respective individual criteria of importance in the admissions decision. Quantitative reasoning score was ranked least important among the DAT’s component scores with a median of 2.

Predictors of Performance

While acknowledging, at least to a certain extent, the need to achieve diversity of workforce, dental education has principally sought to determine the most highly academically qualified among the applicant pool in making its admissions decisions. To support that objective, studies have been conducted in attempts to relate a number of potentially qualifying factors to performance in a dental curriculum or parts thereof. These primarily have included preparatory academic performance and the DAT and its components. Additionally, a number of tests of manual dexterity or perceptual ability other than those in the DAT, personality assessments, interviews, and demographic characteristics have been studied as predictors. Outcome variables in the studies principally have included dental school overall and individual year GPA, performance in technique, preclinical or clinical courses, performance on Parts I and II of the examination given by the National Board of Dental Examiners, attrition, and delays in graduation.

Two general limitations on high correlations between predictors and outcomes have been identified: 1) range restriction in those admitted as compared to those in the total applicant pool, and 2) the generally unknown reliability of dental school grades included in studies. The restricted range problem consists of variance being greater among applicants...
than among students because the latter are a restricted sample of the applicant pool; thus, correlation coefficients between predictors and outcome variables may be lower for students than would have been the case if the entire pool had been admitted. Some studies have attempted to control for one or both of these potential limitations. Considerable variation in results year to year and across schools as well is an additional problem to interpretation of the meaning of relationships between admissions testing and performance in dental school.

Prior Academic Performance

In a number of relatively early studies, predental college grade point average (GPA) was significantly related to academic performance in dental school. Several investigators held undergraduate GPA to be the strongest predictor of success, and a higher median correlation coefficient with first-year GPA among the dental schools was reported for GPA than for any of the DAT scores. There was also indication that liberal arts majors did as well as science majors, perhaps even better with respect to national board examinations. Correlation coefficients between college GPA and dental school performance were positive and significant in the various studies, but they fell in the wide range of $r=0.19$ to 0.61 and thus explained from less than 5 percent to nearly 40 percent of the variation.

Variations in the magnitude of range restriction and grade reliability problems may provide at least a partial explanation for the low and variable correlations. However, there were also findings of individual components to dental school GPA—namely, basic science, dental science, and manual skills—that were independent of each other and therefore could correlate differentially with different predictors, although the highest correlations were still between basic science or overall college GPA and dental school overall or science GPA in the early years. Students withdrawing from dental school for academic reasons were reported to have lower college science GPAs than those who withdrew for personal reasons. In a more recent study, Sadow et al. also found undergraduate science GPA to be a relatively strong predictor of yearly ($r=0.29-0.41$) and final ($r=0.43$) dental school GPA. Non-science college GPA was not as strongly correlated, but was still a significant predictor. Another study found that predental GPA and the DAT academic average correlated positively with dental school GPA but not with technical performance grades. Yet other evidence suggests that the best predictor of performance in the first two years of dental school is prior academic performance combined with parts of the DAT.

Dental Admission/Aptitude Tests

In addition to college GPA, the DAT has been found to be one of the most consistent predictors of performance in the early part of dental curricula. Estimates of correlation between its academic average (AA) and academic performance in the first year or first two years are in the range of 0.19-0.55, statistically significant in a positive direction and accounting for 4 to 30 percent of the variances in students' performance. Graham and Boyd reported that use of the DAT in Canada decreased attrition rate from a former level of 10-18 percent to 3 percent, and they found reliability of the various parts of the Canadian DAT in 1977 to be from 0.81 to 0.88. Kramer in the United States reported in 1999 that predental GPA plus all DAT scores predicted 40 percent (range 25-60 percent) of the variance in first- and second-year dental school grades. Just like GPA as a predictor, the DAT AA was higher among persons who withdrew from dental school for personal reasons than was the case for those who withdrew for academic reasons.

The ADA studies annually the degree to which its DAT measures correlate with selected performance measures in each U.S. dental school (first-year GPA, grades in histology, biochemistry, preclinical operative technique, technique courses average). As an example of such study, Kramer reported in 1999 that positive correlations were found between GPA and the DAT AA at 95 percent of the schools and with the DAT total score at 89 percent of them. The median correlation coefficients with overall first year GPA were 0.40 to 0.44, and thus accounted for 16-19 percent of the variance. No indication of consistently lower correlation was found for any racial group, although the methodology would not have revealed any potentially selective exclusion of minority groups from admission. And for the outcome of overall GPA, the data appeared to indicate that the DAT's AA or total score predicted it less well for Hispanics than for other groups.

In 2000-01, 42 percent (for DAT Perceptual Ability) to 80 percent (for Academic Average) of the schools had significant ($p\leq.05$) correlations between
the various DAT scores and first-year GPA, with corresponding median correlation coefficients of 0.188 to 0.377. Males scored slightly higher than females. No statistical comparisons were made among ethnic groups. There was a clear trend toward higher mean scores for all sections over time, 1988 to 2000.9

Sandow et al. found that the DAT AA correlated positively with academic measures in the first two years of dental school, but not always in the last two years, and had a 0.317 correlation coefficient with final GPA. These authors confirmed some of the earlier indications that the DAT academic average was second only to college science GPA as the best correlate of performance in school. With multivariate analysis they found that all admissions criteria together accounted for 30-40 percent of the variation in dental school GPA. Interestingly, in the Sandow study, students who withdrew in good standing had higher scores on admissions criteria than students who stayed in school.29

In a recent study in Canada, the DAT AA was found to relate positively, albeit weakly (r=.24) to performance in year one of dental school, but the other DAT measures did not. Hierarchical regression analysis indicated that age, among the variables considered, was actually the best predictor of year 1 performance in this study (younger students did better) and the DAT added just 5 percent of the variance.11

The ADA reported that DAT scores had a higher correlation than did predental GPA with performance on Parts I and II of the examinations given by the National Board of Dental Examiners.5,34 But others also recently reported that all admissions criteria together, using multivariate regression models, accounted for only one-quarter to one-third of the variation in scores on the National Board Examination.29

Not all studies are consistent with the predominant findings on correlations between the DAT and dental school grades. In Canada, for example, Wood found the DAT total science score, biology subsection, and the AA to correlate weakly with grades in some dental school basic science courses, and there was no significant correlation for the reading comprehension subsection.10 Also in Canada, performance in year one plus the particular school contributed the most (25 percent) to the variance in performance in year two, and the DAT score added only another 9 percent.11

The preponderance of findings over the past several decades supports the relatively early findings18,29 that the DAT AA is a significant predictor of performance in years one and two, but it is not as effective in predicting performance in later years of the curriculum. For example, a recent study in a Canadian dental school found that performance in years one and two of that curriculum were better predictors of performance in the upper class years than were the predmission DAT scores.11

At least part of the reason for low predictability of the DAT for later dental school years could relate to the heterogeneity of skills reflected in dental school grades (as mentioned earlier).35 Success in didactic coursework that traditionally has been more heavily weighted in years one and two is not predicted by the same predmission measures as is clinical or technical performance. Among such findings were those of Smithers et al., where in contrast to year one when the academic average was the only significant predictor among the DAT components, they found its PAT and reading comprehension sections also reached significance in year two where a greater proportion of the curriculum was comprised by technique courses.11

Perceptual Ability and Manual Dexterity Tests

Because perceptual abilities and manual skills are so important in the practice of dentistry, mechanical aptitude or dexterity testing of some sort has been used at least as far back as 1937.36 Such testing is, in fact, relatively overrepresented in the available literature on dental admissions testing. Correspondingly, it occupies a large portion of this article’s attempt to be comprehensive in review. Tests of perception or skill have been wide-ranging in format, including chalk carving,16 fabrication of wax teeth,37 wire bending,38 and cavity preparation,39 as well as a number of other tests of perception or dexterity.40-45

A chalk-carving test was part of the DAT for a substantial period. However, Chen et al. did not find it to be a measure of dexterity nor to predict performance in dental school and argued that the chalk carving tested temperament as much or more than manual skill.25 Graham noted that it had good reliability but also discussed the possibility that it measured past experience rather than potential, was not further improvable as a test, carried some image concerns for dentistry as a profession, and was very costly and difficult to administer.46 Correspondingly,
the paper and pencil Perceptual Motor Ability Test (PMAT) was developed, found in simultaneous administration to have the same relationship to preclinical technique grades as chalk carving, and replaced the chalk-carving test for evaluating manual dexterity in the U.S. DAT from 1972 forward.7

Although Canadian dental schools also abandoned the chalk-carving test in 1972, they reinstated it in 1975.7 Investigators there continued to study the issue and concluded that the carving test accounted for most of the variation attributable to the DAT for predicting grades in operative and fixed prosthodontics technique courses.16 Earlier, one of the same investigators had found the PMAT, 2D, and 3D subsections of the PAT not very helpful, but the chalk-carving test correlated positively with a number of course grades including some of the basic sciences, preclinical restorative dentistry, and third-year restorative dentistry, with r=0.2 to 0.4.10 Whether curricular differences or potential unequal grade reliability between the U.S. and Canadian schools were also factors is not clear, but the statistically significant positive correlations in Canada were low, indicating the relationship between chalk-carving scores and course grades to be relatively weak. There also were some false negatives in the chalk-carving results, but Wood argued that schools could afford to ignore them if applicant numbers were high.10 Scores from the carving test in Canada since 1999 have been reported as ability-referenced standardized scores rather than being normalized.47

Over the years, whether a perceptual ability test or a manual dexterity test might be preferable, or whether there is significant value in either, has remained controversial, and results of studies have been mixed. But regardless of which type of “non-cognitive” test was studied, they generally have been less predictive of performance in dental school than were the academic sections of the DATs or predental GPA, and perceptual or dexterity tests have not correlated well with final class standing.6,24,28,30,33

Some strongly believed the chalk-carving test to be superior to spatial relations tests.49 Arguments in favor of manual dexterity testing included that it was never intended to predict grades but rather to exclude applicants who “had five thumbs”49 and suggestions that chalk carving and the paper and pencil PMAT measured different things.50 Some suggested that the low correlations of the carving test with grades were due to the range restriction problem after admission.49 Others found a waxing test to predict scores on practical exams better than did the DAT or GPA, but it still accounted for less than 25 percent of the variation.37 Wong et al. tested a pilot self-instructional course consisting of an exercise in Ivorine blocks to develop defined shapes. A high inter-rater reliability (r=0.88) was established, and the pilot was marginally better correlated with laboratory examinations on amalgams than were college GPA, DAT AA, or PMAT. Again, however, it accounted for less than 20 percent of the variability.51

In a somewhat similar vein, Deubert et al. devised a trainability test consisting of an instruction period followed by a test cavity preparation in a plastic tooth. They found correlations in the 0.4 to 0.6 range between the number of errors on the test and operative dentistry grades. They also found that students who had fewer errors than three on the test were more likely to pass the operative course than fail it, whereas those who had more than sixteen errors were more likely to fail than pass. Those investigators also studied three written tests, assessing mechanical aptitude, space relations, and intelligence. The first two correlated significantly with operative dentistry grades (r=0.47 to 0.58 for mechanical aptitude, 0.2 to 0.3 space relations), but intelligence did not. Based on their results, the authors suggested a trainability test after first using a written mechanical aptitude test as a screening mechanism.39 Problems with interpretation of that work are the undetermined reliability of those who did the grading and the fact that those who graded the training exercise were also involved in grading the course.

Kao et al. compared scores on a wire bending exercise (after demonstration), GPA, and DAT scores as predictors for laboratory examination scores on wax carving exercises and single and multiple tooth preparations and restorations of various types. They found the wire bending scores correlated positively with the examination scores (r=.30 to .48) while DAT scores did not. Their analysis also indicated that the wire bending scores improved prediction by DAT when added to it.38 Interpretation of that work is complicated by the fact that students already admitted to school were the only ones contributing to the wire bending results while the entire applicant pool influenced the DAT scores.

Luck et al. in Germany tested motor skills of dental and medical students with several devices, once early and again later in the respective educational programs. The dental students improved significantly from first to second testing, and the medi-
Medical students did not, even though the medical students scored better initially. That work, as well as others, indicated that studying dentistry improved manual skills. Similarly, retaking the test improved performance on the PAT as well as it did for the AA. Second scores also correlated better with performance in school than did first scores. Indeed, questions have been raised about the legitimacy of using a practical test for admissions decisions because of the varying amounts of practice the candidates bring to the test.

In testing the PAT for replacing a mechanical dexterity test, Graham concluded the two do equally well in predicting technical performance. Bellanti et al. also found the PMAT to correlate with grades in fixed prosthodontics technique at \( r = 0.37 \). Testing a random sample, \( N = 1,163 \) from 150 testing centers, Graham concluded in 1974 that there were five or six independent factors within the PMAT. Sandow et al. found positive correlations for PMAT with most academic measures, and a low PMAT score was significantly associated with dismissal. Similar to other studies reported in this review, the correlations with performance were positive but the degree of association was not very strong.

Thompson et al. found chalk carving and PMAT scores to correlate with each other (\( r = 0.36 \)), and to a lesser but similar extent (\( r = 0.13 \) to 0.21), each correlated with preclinical grades in dental school. However, when the two were considered together they found better correlation with preclinical performance at \( r = 0.51 \). Wood and Boyd found correlations in the 0.31 to 0.39 range for both chalk carving and the manual average of the DAT (but not its individual components) with second-year grades in operative and fixed prosthodontics technique. Since their school did not exclude applicants for low manual dexterity scores, the correlations did not suffer from range restriction as was the case for some studies. Gansky et al. found a block-carving test for manual dexterity did not add information to the admission criteria nor predict the students who fell in the bottom 10 percent of the class in preclinical lab courses, while the PAT did modestly correlate with percentile class rank (\( r = 0.34 \)).

Based on pilot results indicating that a paper and pencil Space Relations (SR) test was a preferred approach for assessing the basic components of motor skills without much effect from training, Smith tested the SR as a predictor of grades in four dental school classes. In a similar manner, DeRevere had earlier found correlations (\( r = 0.37 \) to .39) between both chalk-carving and a written spatial relations test with operative dentistry technique grades. The SR was a subtest of a Differential Aptitude Test battery consisting of multiple choice questions based on visualization of a 3-D object formed by folding and manipulating a 2-D pattern. Smith found a poor relationship between the SR and grades in the four classes, but he also found that two-thirds of those who scored less than 50 on the SR failed to graduate on time or at all. Beck et al. administered the SR to dental hygiene students at the beginning of their second year and again in the last month of their third year. They found the SR added virtually nothing to dental anatomy and dental laboratory grades for predicting clinical performance. Although that study was conducted with dental hygiene rather than dental students, the principles are likely the same.

Suddick et al. tested dental students with two field dependence-independence tests (FDI) (embedded figures and inverted tracing) and found that the FDI tests predicted dental school performance better than did DAT scores. However, as the DATs were preadmission and the FDI tests were in dental school, the results could be questioned on the basis of learning that may have taken place prior to the FDI tests being administered. Ireland et al. tested stereoscopic vision in one class and concluded that it did not correlate with scores on preparing and restoring teeth in a manikin, but at the same time found that the 3-D subsection of the PAT did, at \( r = 0.42 \).

Kramer held that the DAT subscale scores contributed unique information for predicting performance in the first two years of dental school, and Dworkin found the manual average subtest to relate positively to first-year technique courses. Kramer’s report concluded that linear combinations of the PAT subtest scores were more predictive of first-year technique performance than was the total PAT score. Wood in Canada found that the DAT manual average correlated with preclinical and clinical restorative dentistry, occlusion, and biochemistry grades (correlation coefficients between 0.3 and 0.4), but the PMAT subscore correlated negatively with grades for five courses and positively only with preclinical restorative dentistry and fourth-year biology. Oudshoorn, also in Canada but more than twenty years later, compared technical grades for a year one operative dentistry course to preadmission chalk-carving scores (CD) and perceptual aptitude scores (PA). He found weak but positive correlations indi-
cating that the CD and PA scores accounted at best for 7 percent to 10 percent of the variation in operative technique grades, generally consistent with other reports.\textsuperscript{10,13,20,24,31,48,59,62} Range restriction as an explanation for the low correlation was ruled out in the Oudshoorn study by comparing preadmission CD and PA scores for students to those of the total applicant pool. Neither the CD nor the PA scores predicted failures in operative technique. Again similar to earlier studies,\textsuperscript{16,54} \textsuperscript{a}wide variation in predictability for student outcomes was found, and the carving test accounted for a large amount of the variation. While the students who had scored highest on the CD and PA tests tended to outperform those who had scored lowest, the overlap in operative technique performance between those two groups was very large.

Gray and Deem\textsuperscript{63} concluded that a group with high PAT scores (\textgtrq;19) did better in technique courses than a group with low PAT scores (\textltnq;16). The same study reported a higher correlation coefficient between preclinical technique grades and the PAT (\textgtrless=0.496) than between those grades and the DAT AA or the college GPA (\textgtrless\textless;0.2). Whether or not practice would obliterate that effect over time was not determined. Looking at later years of the curriculum, Gray et al.\textsuperscript{64} found that the PAT did not significantly predict grades in years three and four.\textsuperscript{64} In a longer-term study, Coy et al.\textsuperscript{64} found significant correlations between PAT scores and preclinical operative practical examination scores over eight years, although the correlation coefficients were only in the 0.228 to 0.307 range. They also found a gender bias in the PAT favoring males and recommended against using the PAT in admissions decisions beyond gross screening of applicants.\textsuperscript{62}

In recent years, new simulation technology has been introduced for teaching and evaluating dental students in operative dentistry.\textsuperscript{65,66} Gray et al.\textsuperscript{67} tested first-time use of such simulators as an outcome variable for predictor variables in admissions data. They expected to find a correlation between performance with the simulator and PAT scores but did not, although there was a significant correlation between the simulator score and the DAT academic average. So first performance on the simulator did not significantly predict performance for preclinical technique courses, but perhaps somewhat surprisingly, the simulator was a better predictor of general cognitive ability than of psychomotor ability.

**Interviews**

Interviews are commonly used for admissions purposes in various educational programs.\textsuperscript{68} Interviews can help to verify information found elsewhere in the application dossier, but at the same time can be suspect for validity and reliability, especially if unstructured.\textsuperscript{11,69} Interviews have the best validity when highly structured,\textsuperscript{70-72} and validity of interviews generally increases when interview questions are related directly to the content of what is being applied for.\textsuperscript{73} In Canada, reliability of highly structured interviews for dental admissions was reported to reach 0.83 to 0.87.\textsuperscript{74} However, Smithers et al.\textsuperscript{11} found that standardized interviews did not predict performance in the first two years of dental school. They did add information beyond the DAT for predicting third-year performance.\textsuperscript{11}

A study in Sweden indicated that an individualized process that included interviews yielded dental students who did better than those selected by a standardized system consisting of secondary school grades plus a university standard aptitude test.\textsuperscript{75} In a U.S. study by Sandow et al., interview scores were weakly but positively related to overall dental school GPA, but less so than to college GPA or DAT AA.\textsuperscript{29} Additional study would be needed before a conclusion might be drawn about the efficacy of interviews for predicting performance in U.S. dental schools.

**Personality Profiles**

Dental students may characteristically reflect personalities different from those of students in other professional schools.\textsuperscript{76} Personality profiles such as the Meyers-Briggs Type Indicator (MBTI), the Minnesota Multiphasic Personality Inventory (MMPI), and the California Personality Inventory (CPI) have been tested in dental student and/or applicant population samples. Those high in extroversion in MBTI results were reported to have less difficulty with clinical activities while those high in introversion did better in academic components of the curriculum and those high in “judging” and “sensing” had a higher class rank than those with other MBTI types.\textsuperscript{77} However, with wider testing in other fields, the MBTI has demonstrated relatively low reliability and has not proven to be a good predictor of job performance.\textsuperscript{78,79} Kalis et al. found no relationship of MMPI or CPI test scores to academic performance in dental school, and they did not differ between students...
who were dismissed and those who remained in school or between accepted and rejected applicants for admission. They concluded that those personality tests did not provide meaningful additions to existing admissions criteria.

Canadian schools assessed personality factors (16PF) between 1974 and 1977. They were not purportedly used for admissions decisions, but nonetheless the personality ratings were more favorable in the accepted group than in the rejected group. Smithers et al. tested another personality instrument, the Five Factor Model of Personality (FFM), which was said to be a good predictor of job performance. They found that the “Openness to Experience” component added significantly to the DAT and interviews for predicting performance in years two and three, but the relationship was negative because those candidates who scored lower on the “Openness to Experience” scale were the ones who did better in dental school. So in that study, personality did assist in predicting clinical performance, but indicated that those students who were less imaginative and not as intellectually curious were the ones who did better. Perhaps along with the earlier cited failure to find a correlation between intelligence and operative dentistry grades, it’s better not to speculate on what that result may mean for dental education.

Comment

Notwithstanding the significant variation among studies and less than complete prediction of performance that is available from admissions testing and other criteria, our review indicates to us that dental schools in the United States and Canada, by considering college GPA and DAT scores as well as interviews if they are highly structured and content-relevant, have defensible methods for attempting to admit those students most likely to succeed academically and for claiming objectivity in the process. The academic average of the DAT seems better at predicting overall success than the PAT or its components, but only consistently for the early part of conventional dental curricula, and those who believe that consideration of perceptual ability or evidence of manual dexterity must be a part of the decision for admission can find enough supporting evidence to justify doing so. When added to college GPA and the DAT AA, such information may in fact add something to our ability to predict dental school performance. On the other hand, there is also evidence that those manual skills can be learned during current dental educational processes or even by retakes of the tests designed to measure them. Overall, however, even using multivariate stepwise regression with multiple predictors, it seems that the best that one can do with conventional admissions criteria is to account for about 40 percent of the variance in dental school performance in the early years of the curriculum. Among tested predictor variables, certain DAT scores correlate best with performance on National Board examinations, which could be important for those schools that include passing those examinations as a graduation requirement.

Additionally, as long as the principal objective is to admit students who will do the best in the curriculum of a particular school, it would be wise for the school to consider the advice of Boyd and Teteruck and conduct local validation studies to determine exactly how the various admissions criteria relate to performance in that specific curriculum and culture. Of course, the validation would need to be updated from time to time as either of those outcome variables changes, and it would further be wise to consider institutional mission and objectives in the mix. Staat and Yancey, for example, found that their “Admissions Index”—comprised of an academic component from college overall GPA (15 points), science GPA (30 points), DAT AA (8 points), and PAT (7 points) scores and a personal component derived from interviews and recommendations (cultural awareness 12 points, academic development 8 points, extracurricular development, social factors, and disadvantaged background 5 points each)—correlated better (r=0.67) with first-year GPA than did any single preadmission datum. Interestingly, although letters of recommendation are very frequently gathered and used in the admissions process, we could identify no studies in the dental literature that investigated their reliability or predictive validity.

At the same time, what does not seem to be adequately considered in relevant literature is how well the admissions process looks beyond performance in dental school to performance issues after graduation, and this appears to be an important gap in our knowledge. Very few such studies exist, but Simon and Chambers found that a battery of aptitude measures did not distinguish practicing dentists from the general population. They concluded that a wide range of aptitudes could be consistent with graduating from dental school and maintaining a pri-
private practice. Their conclusion supports other conclusions that correlations between predictors and performance in school, never overwhelming in amount of variation explained, fade to near insignificance as curricula progress to their later years and that requisite abilities can be learned from a variety of backgrounds. Perhaps more importantly, there is very little to indicate how well admissions testing or other analyses for selection of students may predict a predilection for differentially addressing particular needs of society. The Futures Project: Policy for Higher Education in a Changing World makes compelling arguments that standardized tests are not capable of providing that information and that conventional concepts of quality in higher education together with competition for the same students, faculty, and resources are in fact widening the gap between the performance of institutions of higher education and the satisfaction of public need. Additionally, they argue, conventional higher education strategies are particularly deficient in helping to solve issues of attainment for those from the least advantaged backgrounds including those with low income and persons of color.84

Perhaps one reason for not extending analysis of predictors to service in the clinical practice of dentistry is that, as for medicine,85,86 it has been difficult to find a universally accepted list of criteria by which the competence of dental practitioners can be judged. But the fact remains that we could not find studies that attempted to relate admissions criteria to success in practice, however that might be defined, or to serving populations of particular need, leadership positions, academic positions, or other needed service to society. It also is apparent that the dental profession and those it serves face a number of current and future challenges. Arguably, admissions processes could contribute to meeting those challenges more successfully by choosing the right people who would preferentially work on them after completion of their professional educational program, but evidence is needed to support that hypothesis. If it is supportable, evidence is also needed for which characteristics in applicants will be most predictive of the ability to successfully address the challenges. Included among the challenges are achieving diversity within the profession to meet the oral health care needs of our diverse population with the requisite cultural sensitivity,14 access to care for all underserved Americans,87 developing and implementing interprofessional approaches to health care,88,89 meeting the needs for future faculty,90 conducting the research needed for continuous improvement of the profession and its service capabilities,91 and ensuring high standards of ethics and professionalism.92

**Recommendations**

Based on the literature cited in this review we make the following conclusions and recommendations:

1. College GPA and DAT academic average scores can reasonably be used as predictors for early academic performance in dental school.
2. Perceptual ability or manual dexterity tests are best viewed as screening rather than predictive tools and could be used to set baseline scores below which further consideration would not be given to a candidate.
3. There seems little to be gained from more analysis or new tests of perceptual abilities or manual dexterity as predictors of dental school performance.
4. Interviews should be highly structured and then validated against expected performance attributes if they are to be used as part of admissions decisions.
5. Each school periodically should validate all the criteria used in its admissions decisions against subsequent performance objectives and adjust criteria accordingly.
6. Information should be generated and validated on applicant criteria that can be used to address important societal needs in addition to preparing practitioners for private practice, including access to care and academic and research careers.
7. Schools should consider those validated criteria for meeting societal needs in relation to their individual missions, goals, and objectives.

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**REFERENCES**