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Citation

BUYSE, Tine and LIEVENS, Filip. Situational judgment tests as a new tool for dental student selection. (2011). *Journal of Dental Education*. 75, (6), 743-749. Research Collection Lee Kong Chian School Of Business.

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Situational Judgment Tests as a New Tool for Dental Student Selection

Tine Buyse, Ph.D.; Filip Lievens, Ph.D.

Abstract: Cognitive tests are used to select students into dental school, yet cognitive predictors explain only part of the variance in academic performance. Therefore, interviews and personality tests are often used to measure noncognitive (e.g., interpersonal) characteristics. Recently, situational judgment tests (SJTs) have drawn attention since there is evidence that SJTs can be valid predictors in medical admission contexts. This study examines the validity of an SJT measuring interpersonal skills for predicting academic performance of dental students. Incremental validity over cognitive tests is also examined. In this study, 796 dental students who passed the admission exam for medical and dental students in Flanders, Belgium, and enrolled in one of the two Flemish dental schools were evaluated. Grade point average (GPA) in the five years of dental studies served as the criterion. Corrected correlation between the cognitive tests of the admission exam and GPA equaled .38. Their validity dropped from .45 (year 1) to .18 (year 5). However, the validity of the SJT increased from .05 (year 1) to .20 (year 5). The SJT had incremental validity in year 5. Dental admissions committees that envision assessing a broad set of capabilities might consider using an SJT as a valuable supplement to cognitive tests. Future research needs to confirm these findings with job performance as another criterion.

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Keywords: dental education, dental school admissions, noncognitive assessment, situational judgment test

Submitted for publication 11/16/10; accepted 1/5/11

Admissions committees responsible for selecting candidates for higher education programs face an important and challenging task. This is especially the case for health professions programs such as medicine and dentistry in which the admissions process is typically very competitive. It is incumbent upon the admissions committees to select candidates from the total applicant pool who are most likely to succeed as students in the educational program. Moreover, students admitted should succeed not only in the first years but in the last years as those years have more resemblance to real job performance. Ultimately, the real test of any selection tool is how well it relates to practice. Hence, there is a clear need to use reliable and valid selection tools and to evaluate admissions processes retrospectively.¹

The literature on medical and dental school admissions clearly draws a distinction between the assessment of cognitive and noncognitive skills. Apart from cognitive ability, there is general agreement that physicians and dentists also need communication and interpersonal skills. To measure these and other noncognitive factors, most countries have relied on interviews and personality tests for dental school admissions. This study aims to examine the validity of a new type of noncognitive test—the situational judgment test (SJT)—in dental student selection. SJTs present applicants with written or video-based descriptions of hypothetical scenarios and ask them

to indicate the appropriate response from a list of alternatives.^{2,3} The context of this study is admission to dental school in the Flemish part of Belgium.

Cognitive and Noncognitive Predictors of Academic Performance

In most countries, pre-admission grade point average (GPA) and/or cognitive-oriented tests are used to select students for medical and dental schools. Research evidence has shown that pre-admission grades predict subsequent academic performance in the health disciplines.^{4,5} These results obtained in medical and dental education mirror meta-analytic findings of the validity of cognitive factors (GPA and standardized ability tests) for predicting a variety of academic performance outcomes in higher education in general.^{6,7} For example, Sackett et al.⁸ examined various large data sets and found strong relationships between standardized cognitive tests and academic performance ($r=.44$).

However, in dental education research, the relationship between GPA and academic performance has been found to be stronger in the earlier years of the educational program.¹ One study, for example, found that the Canadian Dental Aptitude Test (DAT)

was a good predictor of preclinical academic success, with prediction declining when clinical components of the program were introduced to students.⁹

This finding highlights that cognitive factors explain only part of the variance in academic performance. Hence, admission procedures should include assessment of both cognitive and noncognitive characteristics of applicants. The need to incorporate more than just cognitive factors has led to a growing interest in exploring possible supplemental predictors of academic performance, particularly those outside the cognitive domain.¹⁰ A study conducted by Hoad-Reddick and MacFarlane found that dental applicants with high interview scores on the criterion of leadership experience performed better in dental school.¹¹ Smithers et al. also suggested that an interview may be useful in identifying specific behavioral characteristics deemed important for success in dental training.⁹

Besides interviews, the use of personality inventories in selecting students for dental education has also been explored. Results from a personality measure used by Chamberlain et al. indicated that Conscientiousness and Neuroticism, and to a lesser extent Agreeableness, were significant predictors of both first-year academic performance of dental students and the professional behavior of dental practitioners.¹² Cariago-Lo et al. concluded that the California Psychological Inventory could discriminate among medical students who performed well and those who did not.¹³ Smithers et al. found that Openness to Experience was significantly related to aspects of clinical education, although contrary to expectations, this relationship was negative.⁹ Their study concluded that the facets of Openness and Ideas, together with Positive Emotions, which is a facet of Extraversion, improved prediction of performance in clinical studies beyond that provided by the Canadian DAT and the interview. Poole et al. suggested that a combination of scores from the Canadian DAT, a valid measure of personality, and a well-designed structured interview provided the best prediction of those applicants who will do well in both the academic and clinical aspects of dental school.¹⁴

In recent years, there has been a surge of research in the SJT, another noncognitive test. In employment settings, three meta-analyses have indicated that SJTs are related to important job performance criteria. McDaniel et al. reported a mean corrected correlation between SJTs and job performance of .34.¹⁵ A second meta-analysis by McDaniel et al.

reported a mean corrected validity of .26.¹⁶ In terms of incremental validity, SJTs accounted for additional variance (varying from 1 to 2 percent) over both cognitive ability and personality. In addition, Christian et al. found validity coefficients ranging from .19 to .43.¹⁷

In light of these promising results for SJTs in employment selection settings, it is understandable that there is also increasing interest in using SJTs in educational admissions. Evidence that SJTs are valid in medical admission settings has been provided by Lievens et al.,¹⁸ who explored the use of an interpersonal SJT in the Belgian medical college admissions context. This SJT predicted GPA in interpersonal skills courses and had incremental validity over cognitive tests for predicting such interpersonal GPA. Patterson et al. also studied the use of an SJT for selection of students for postgraduate general practitioner training in the United Kingdom.¹⁹ This SJT focused on three nonclinical selection criteria: empathy, integrity, and coping with pressure. The SJT was the best single predictor of performance in a selection center that used work-relevant simulations to target both clinical and nonclinical domains.

Situational Judgment Tests and Admission to Dental School

Although SJTs have been found to be valid predictors of noncognitive skills in medical education, to our knowledge there has been no research on the validity of SJTs in dental education. It can be hypothesized that the positive results regarding validity of SJTs found in medical selection will translate to dental selection. One can assume that candidates who get selected for medical and dental education should be capable learners, open-minded and communicative, and socially competent. Physicians and dentists, of whatever specialty, need specialist medical knowledge and a complementary palette of skills and personality traits if they are to be professionally competent.²⁰ Hence, using an interpersonal SJT in a dental selection context is worth considering.

However, there are also arguments that the positive results of SJTs in medical settings cannot be extrapolated to dental settings. In fact, medical and dental students have been found to differ on various characteristics. For example, Lindemann et al. noted differences between dental and medical students

with regard to learning approaches, especially upon entrance to professional school, which suggests that students enter with different academic studying experience and strategies.²¹ Other researchers have found that dental students were significantly more likely to be motivated by factors relating to status, security, and the nature of their occupation (e.g., regular working hours, self-employment, and independence); by contrast, medical students were significantly more likely to be motivated by factors relating to career opportunities, patient care, working with people, use of personal skills, and interest in science.²²

Our study had two main research objectives. First, we examined the validity of an SJT measuring interpersonal skills for predicting academic performance of dental students. In most medical and dental schools (as with the ones in this study) earlier courses focus on the acquisition of knowledge, whereas later courses place more emphasis on communication with patients and internships, which have activities that involve significant interpersonal interactions. Hence, grades in the clinical years of dental school may be better predicted by interpersonal skills as measured by SJTs than grades in the first years. Second, as SJTs claim to measure skills other than cognitive abilities, we examined whether an SJT will explain incremental variance over cognitive tests for predicting academic performance.

Methods

This study was conducted in the context of admissions to medical and dental studies in Belgium. The admissions exam was institutionalized in 1997. Each year, this exam, which lasts for an entire day, is centrally administered in a large hall in Brussels.

One difference from admission practices in the United States is that the process in Belgium is centralized and government-run. All students interested in medical and dental studies take a battery of examinations. Those who pass receive a certificate that permits entry into any of the six medical schools in Belgium. Individual medical schools are not involved in the screening of candidates, which also means that the level of selectivity in Belgium is generally less strict than the level of selectivity in some U.S. medical schools. A second difference is that students enter medical and dental studies at a younger age (about nineteen years of age) rather than upon completion of an undergraduate degree as is more typical in the United States.

This study included twelve cohorts of entering dental students in Belgium. The total applicant pool consisted of 22,498 students (36.7 percent male, 63.3 percent female; average age eighteen years and nine months; 99.5 percent Caucasian) who completed the Medical and Dental Studies Admission Exam in Belgium between 1997 and 2008. On average, the passing rate of the exam was about 30 percent. Note that both medical and dental students were selected with the same exam.¹⁸ Students were required to indicate their choice of education (medicine or dentistry) only after passing the exam. While the total applicant pool was used for purposes of range restriction corrections to estimate validity in the applicant pool, our study focused on the 796 candidates who passed the exam and undertook dental studies at one of the two dental schools in Flanders.

These twelve cohorts had between twenty-five and 109 students per year. Only participants who passed the admission exam, started dental studies, and had continued their studies were included. In total, we were able to obtain the first-year GPA of 781 students, the second-year GPA of 489 students, the third-year GPA of 411 students, the fourth-year GPA of 343 students, and the fifth-year GPA of 274 students. Student attrition due to failure (especially in the first academic year) is one reason for the reduction in sample sizes later in the curriculum. However, the main reason for the sample size reduction across the academic years is the availability of criterion data at the time of this study. In fact, whereas criterion data related to the 1997–2004 exams were available for all five academic years, data for four academic years were available for the 2005 exam, data for three academic years were available for the 2006 exam, data for two academic years were available for the 2007 exam, and data for only one year were available for the 2008 exam.

Predictor Measures

The Flemish admissions exam assesses various characteristics that contribute to learning or performance in medical and dental school. In particular, the exam measures knowledge in sciences and general cognitive ability. Besides these cognitive predictors, the exam consists of two additional tests: a silent reading protocol and a situational judgment test. These two tests are work samples because they present candidates with tasks they will encounter in their studies (reading and understanding texts with a medical subject) and in the profession (patient in-

teractions). The following describes the development and content of the tests used in this study.

Cognitive portion of exam. The cognitive portion of the exam consists of two main tests. The first part is designed to evaluate applicants' mastery of four basic science-related subjects (mathematics, physics, chemistry, and biology). Ten multiple-choice questions per subject are asked. Every question has four possible answers, of which only one is correct. Second, there is a cognitive ability test, which consists of fifty multiple-choice questions with five response alternatives each. The problems in this general mental ability test are formulated in verbal, numerical, or figural terms. Prior research has demonstrated good reliability and predictive validity of this reasoning test for medical and dental students.²³ In particular, that study reported an internal consistency of .84 and a validity coefficient of .36 for predicting the final scores obtained in the first year of medical and dental studies. (In light of test security, the source of this cognitive ability test cannot be mentioned. For the same reason, sample items are not presented. Interested researchers may contact the authors to obtain more information.)

The silent reading protocol is a written text developed specifically for the admissions exam each year. The underlying rationale is to ask candidates to read and understand an article with a medical content (diabetes, lower back pain, etc.). Each text is about ten pages long and includes tables and figures but no statistics. All difficult medical words are explained in an endnote. Candidates have fifty minutes to read the text and answer thirty questions. All questions are multiple-choice with four possible answers each. Each year, the same procedure is used to develop the text and accompanying questions, starting with an existing medical text in a popular journal or handbook. Next, a professor in medicine develops a more elaborate version of the original; then, two professors in medicine assist in developing a list of relevant questions and response options. Due to test security issues, pilot testing was not possible, and dropping questions after receiving applicant data was forbidden. Across the exams, the average internal consistency coefficient of this test was .74.

The SJT. In the context of the admissions exam, an SJT with situations about interactions with patients was developed. The general aim of the SJT used in the admissions exam was to measure interpersonal and communication skills. We used an approach analogous to another study²⁴ for developing a video-based SJT. First, we collected realistic critical

incidents regarding interactions between physicians/dentists and patients from experienced physicians/dentists and professors in general medicine. Second, vignettes that nested the critical interpersonal incidents were written. Two professors (who teach courses related to consulting practices) tested these vignettes for realism. Similarly, questions and response options were derived. Third, semiprofessional actors were hired and videotaped in a recording studio. Finally, a panel of experts (experienced physicians/dentists and professors) developed a scoring key. Agreement among the experts was generally satisfactory (Cohen's kappa's >.70), and discrepancies were resolved upon discussion, leading to the scoring rule. The scoring key indicated which response alternative was correct for a given item (+1 point). It was forbidden by law to use different scoring rules (e.g., penalizing for choosing an incorrect answer by assigning -1 point).

In its final form, the SJT consisted of short videotaped vignettes of key interpersonal situations that physicians/dentists are likely to encounter with patients. A narrator introduced each vignette. After each critical incident, the scene froze, and candidates were allowed twenty-five seconds to answer the question "What is the most effective response?" related to the scene. No prior medical or dental knowledge was required as the items dealt with basic interpersonal situations. In total, the SJT consisted of thirty questions of the multiple-choice type, with four response alternatives each. The alternate form reliability of the SJTs was .66,¹⁸ which is in line with a prior study.²⁵

Total decision score. To make the actual admission decision, a weighted sum of all predictors was computed. Next, a minimal cut-off was determined on this operational composite. Weights and cut-off scores were determined by law, with the cognitive tests receiving the most weight.

Criterion Measure

The criterion consisted of GPA in each of the five years of dental training at the only two dental schools in Flanders. This GPA was a composite (average) measure derived from course grades. These courses covered topics such as preventive dentistry, chemistry, preclinical exercises, manual dexterity, internships, and dermatology. In the last year of the curriculum (year 5) there was an internship. Only overall GPA was made available to us.

As this study is longitudinal, students will have contributed data for several years. Not all students

contributed data for their entire academic career as some students have only recently entered dental school. Hence, the performance of student cohorts was tracked over a one-, two-, three-, four-, or five-year period, depending upon their year in the dental program, and was correlated with their admission exam scores. As can be seen in Table 1, first-year data were available for 781 students, dropping to 489 for the second year, 411 for the third year, 343 for the fourth year, and 274 for the fifth year.

Note too that analyses were conducted only for cohorts for which criterion data for the full academic curriculum (five years) were available. As those results were identical to the ones presented in the tables, we present results for all available cohorts because the sample sizes are then larger.

Study participants are a more homogeneous group than the pool of applicants from which they were selected. The increase in homogeneity has the effect of underestimating the true size of a correlation coefficient in the applicant population. Therefore, we corrected the correlations for multivariate range restriction. To this end, we applied the multivariate range restriction formulas of Ree et al. to the uncorrected correlation matrix.²⁶ As suggested by Sackett and Yang, statistical significance was determined prior to correcting the correlations.²⁷

Results

Table 1 shows that the validity of the SJT increased from year 1 (uncorrected $r=-.01$, corrected

$r=.05$) to year 5 (uncorrected $r=.17$, corrected $r=.20$). The uncorrected correlation between the SJT and overall GPA was $.04$ (corrected $.14$).

The corrected correlation between the cognitive composite and overall GPA was $.38$. The validity of the cognitive composite was significant in the first three years of dental education, but it dropped from $.45$ (year 1) to $.18$ (year 5). In the last two years, the correlation of the cognitive composite with GPA was not significant. This is possibly due to the fact that other components of the program are introduced into the curriculum in these last two years (e.g., clinical internships). Results shown in Table 1 also demonstrate that the total admission exam is a good predictor of preclinical and clinical academic success. The silent reading protocol is not a significant predictor in any of the five years of dental education as none of the correlations between the silent reading protocol and GPA are significant prior to correcting the correlations for multivariate range restriction (correlations above the diagonal in Table 1).

Next, we examined whether the SJT had incremental validity over cognitive tests for predicting GPA in dental education. To this end, we conducted hierarchical regression analyses. The cognitive composite was entered as a first block. Next, we entered the silent reading text. Finally, the SJT was entered. The results of these hierarchical regression analyses are presented in Table 2. The SJT had incremental validity over the cognitive composite and the reading text only in year 5 of dental education. Again, the inclusion of internships in that particular year might explain this finding.

Table 1. Correlations among predictors and overall criteria in study

	1	2	3	4	5	6	7	8	9	10
Predictors (N=796)										
1. Cognitive portion		-.01	-.03	.77**	.17**	.12**	.10*	.09	.04	.16**
2. Silent reading protocol	.23		.03	.25**	.02	.01	.06	-.02	.05	-.00
3. SJT	.08	.18		.17**	-.01	.04	.09	.10	.17**	.04
4. Total decision score	.85	.42	.20		.18**	.16**	.16**	.13*	.16*	.19**
Criteria										
5. GPA year 1 (781)	.45	.18	.05	.47		.70**	.59**	.51**	.36**	.92**
6. GPA year 2 (489)	.39	.11	.08	.45	.78		.68**	.59**	.38**	.88**
7. GPA year 3 (411)	.33	.10	.15	.39	.61	.69		.74**	.47**	.87**
8. GPA year 4 (343)	.25	.04	.10	.28	.53	.60	.75		.63**	.86**
9. GPA year 5 (274)	.18	.20	.20	.26	.41	.42	.52	.64		.72**
10. GPA overall (781)	.38	.13	.14	.45	.79	.85	.87	.86	.74	

Note: Uncorrected correlations are above the diagonal, corrected correlations below the diagonal. Correlations were corrected for multivariate range restriction.

* $p<.05$; ** $p<.01$

Table 2. Summary of hierarchical regression analyses of predictors on GPA

Model predictors	Criteria														
	GPA Year 1			GPA Year 2			GPA Year 3			GPA Year 4			GPA Year 5		
	Beta	R ²	ΔR ²	Beta	R ²	ΔR ²	Beta	R ²	ΔR ²	Beta	R ²	ΔR ²	Beta	R ²	ΔR ²
1. Cognitive portion	.17**	.03	.03**	.12**	.01	.01**	.10*	.01	.01*	.09	.01	.01	.04	.00	.00
2. Silent reading protocol	.02	.03	.00	.01	.01	.00	.05	.01	.00	-.03	.01	.00	.03	.00	.00
3. SJT	-.00	.03	.00	.04	.02	.00	.09	.02	.01	.10	.02	.01	.16**	.03	.03**

*p<.05; **p<.01

Discussion

The task of selecting the best medical and dental applicants out of an extremely competitive applicant pool is a problem faced annually by medical and dental schools worldwide. Furthermore, there is a responsibility for admissions committees to seek evidence that the selection instruments used deliver appropriate outcomes. Therefore, this study examined the validity of the dental admissions procedure in Flanders for predicting GPA during the dental curriculum. A unique aspect of this procedure is the use of an SJT in the selection of dental students.

First, the results of this study confirm the finding that cognitive predictors are valuable and necessary tools in the selection of students for dental education. The cognitive composite was a significantly valid predictor of GPA in three of the five years of dental education, although the validity decreased in the clinical years. This result was expected, as the later years of dental education focus on internships and practice and no longer purely on the acquisition of new knowledge.

Second, this study extends the positive predictive validity results of SJTs found in medical education to dental education. That is, an SJT that measures interpersonal capacities has incremental validity over cognitive tests. This result applies to year 5 only, which is explained by the fact that most courses in the year 5 curriculum involve interaction with real patients as compared to earlier years in which mostly manual dexterity is taught. It should be noted that we are not positing that alternative measures such as SJTs should be used to replace cognitive measures. Instead, we suggest that they can be valuable additions to extant cognitive measures. Future research should examine whether our results

can be confirmed when actual job performance as a dentist serves as a criterion.

A major limitation in this study is the limited sample size in year 5 of the dental curriculum. Therefore, results in this year should be carefully interpreted. Small sample sizes are, however, inherent to a longitudinal approach. All twelve cohorts available since the use of the admission exam were used in this study.

This study describes a single selection procedure in a specific setting. Hence, no claims concerning generalizability can be made. However, we do believe that our results are interesting for admissions systems in other countries. In any country, dentists of the future face many challenges. They should be good and fast at acquiring manual skills. They should also be open-minded and tolerant, communicative, and socially competent. To reach these objectives in the future, committees conceptualizing admissions procedures for dental education should design selection procedures that assess both cognitive and noncognitive skills. Along these lines, the SJT might be a useful supplement to cognitive tests.

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