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Selection of medical students on the basis of non-academic skills: is it worth the trouble?

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In this article, we discuss the practical usefulness of selecting future medical students on the basis of increasingly popular non-academic tests (eg multiple mini-interviews, situational judgment tests) in addition to academic tests. Non-academic tests assess skills such as ethical decision making, communication and collaboration skills, or traits such as conscientiousness. Although other studies showed that performance on non-academic tests could have a positive relationship with future professional performance, we argue that this relationship should be interpreted in the context of the base rate (the proportion of suitable candidates in the applicant pool) and the selection ratio (the proportion of selected applicants from the applicant pool). We provide some numerical examples in the context of medical student selection. Finally, we suggest that optimising training in non-academic skills may be a more successful alternative than selecting students on the basis of these skills.

KEYWORDS: Selective admission, utility, validity, medical students

Introduction

There is an increasing interest in the selection of future medical students on the basis of non-academic tests in addition to, or instead of, the traditional cognition-based or knowledge-based academic tests such as the Medical College Admission Test® (MCAT). Non-academic tests measure skills such as communication skills, professional behaviour, and ethical decision making, or traits such as personality characteristics. An example of a non-academic skills admission test is the multiple mini-interview (MMI).1,2 The MMI consists of a series of short, structured interviews and tasks where potential students show their interpersonal skills and ethical standards. Another example is the use of (video-based) situational judgment tests (SJTs) that contain social doctor-patient and doctor-colleague interactions and where candidates have to say how they would respond to a particular situation.3,4 Other non-academic admissions tests, often in the form of self-report questionnaires, measure non-cognitive traits such as empathy.5 In this article, we focus on non-academic skills. However, it is not always clear whether the constructs measured by non-academic tests should be considered skills, traits, or a combination of both. SJTs, for example, are more related to cognitive abilities when knowledge instructions are used (how should one act), and more related to personality traits when behavioural instructions are used (how would you act).6

The central idea of using these measures on top of academic measures like high school grade point average (GPA) and standardised test scores (eg MCAT scores) is that these measures improve the selection procedure of future medical students. That is, through the use of non-academic tests such as MMIs or SJTs, the candidates selected will perform better as a doctor than those who were selected on the basis of academic measures only. In 2015, Harris and colleagues7 were critical about the use of ‘non-knowledge-based tests and situational judgement tests to test desirable professional attitudes, such as empathy and ethical awareness’. Their main argument was that the validity of these tests to predict academic performance was low as compared with knowledge-based tests. Instead, they advocated using knowledge-based tests to select future doctors. Indeed, non-academic tests should show predictive validity and incremental validity over and above academic tests. However, using academic performance as a criterion may not be very useful for this purpose because the aim is not to predict academic performance but doctor performance or professional performance. To show incremental validity, these tests should be reliable instruments (ie test results should be consistent across replications), should show positive relationships with relevant criteria (such as professional performance), and should not be strongly related to academic tests. Very few studies address incremental validity of non-academic tests over and above academic tests using such criteria (Lievens 8 and Adam et al9 are exceptions). However, statistically significant incremental validity is not necessarily equal to practically relevant incremental validity. In this article, we go beyond incremental validity and discuss this topic from a utility approach that originates from the personnel selection literature. The advantage of this approach is that it immediately shows the practical effect of using different selection instruments. Our main message is that in many medical student selection situations the incremental validity and utility of the use of non-academic instruments seems to be small and that the recent trend to use these instruments needs a more solid empirical basis.
Practical usefulness of additional selection instruments

The effects of additional predictors above academic tests to select students will be largest when the correlation between predictors is low. However, several studies have shown that non-academic skills and academic, cognition-based measures are not independent. For example, in a recent study on medical student selection from the Netherlands\(^5\) it was concluded that top pre-university GPA students also achieved the highest possible score in the professionalism course most often. In this course, non-academic variables such as interpersonal and communication skills, ethical decision-making, reflection and professional behaviour are assessed. The overall high performance of the top pre-university GPA group suggests that applicants who perform well academically might also have an advantage in the so-called non-academic domain.

Thus, in this course, students were judged on showing professional behaviour and their reflections on professional behaviour.

These findings are also in line with a study from the USA in which it was concluded that "the relationships between cognitive and non-cognitive subdomains of the licensing examinations reported here ranged between \(r=0.17\) and \(r=0.43\) and correlations generally increased with trainees’ seniority".\(^2\) This increase with trainees’ seniority also reflected that non-academic skills are, to a large extent, trainable. Note that the non-cognitive skills mentioned in this study are similar to what we consider non-academic skills. In a more general (non-medical) context, a meta-analysis found moderate relationships between SJT scores and cognitive ability, with a stronger relationship for tests that were based on job analysis and tests that provided knowledge instructions.\(^6\)

Thus, the studies cited above showed the same pattern; namely that academic and non-academic skills are positively correlated. However, non-academic skills may still improve predictions based on only academic scores. For example, in a Belgian study\(^3\) the additional value of a video-based SJT that measured interpersonal skills in addition to knowledge test scores was investigated. Lievens\(^3\) investigated the additional explained variance above high school GPA and knowledge test scores in a hierarchical regression analysis and found a significant effect. The SJT had significant added value for predicting four outcomes: interpersonal GPA, an interpersonal communication skills, ethical decision-making, reflection and professional behaviour.

As a result of the interplay between base rate, selection ratio, and (multiple) correlation between predictor scores and criterion scores, we can determine the success ratio. The question is what the difference in the success ratio is when we use an academic test and a non-academic test, in contrast with using an academic test alone. In Table 1, we show these percentages for three hypothetical base rates: 0.70, 0.80, and 0.90, and four hypothetical selection ratios: 0.60, 0.30, 0.10, and 0.05. These selection ratios represent roughly the Dutch context: strict selection, like in France, where after the first year of medical school, approximately 20% of the students are selected for the second year, and very strict selection as often found in the USA and the UK. For this illustration we used the results from the Belgian study\(^3\) since it was the only study that reported incremental validity of a non-academic test over and above academic tests, and used suitable criterion measures.

In that study,\(^3\) knowledge-based tests showed a correlation of \(r=0.07\) with doctor performance. Adding an SJT resulted in an

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Belgian study, the definition of ‘doctor performance’ was the more heterogeneous criterion of doctor performance as over the first 3 years. The low correlation is probably due to for a selection ratio of 0.30, an increase in versus 3.1%). For a base rate of 0.90 this percentage is around ratio of 0.60 the percentage of successful students increases can see in Table 1 that for a selection ratio of 0.60 and a selection test only provides A counterargument is that, although there may be few future medical students who are unsuited for the medical profession, it is still very important to detect these few students because they may bring serious harm to patients and to the medical institution. This is true, but we should show how well instruments like non-academic tests meet this goal based on analyses as shown earlier. Following our example, let us assume that 20% of the medical school applicants are not suitable to be doctors. Using an SJT in addition to an academic test would reduce the number of unsuitable doctors by between 1.8% and 4.8%, depending on the selection ratio. There are two other arguments why institutions, in our view, should take calculations like the ones given above into account in selecting students on the basis of non-academic skills. The first is that the environment also determines professional behaviour. The second argument is that many (or at least some) non-academic skills are trainable and that experience is very important. As Henry Marsh recently remarked: ‘surgery is a practical craft, and you learn it largely by doing it – simulators and training courses can take you only part of the distance’. In fact, a reasonable question is: what is more effective? Selecting students based on non-academic skills, or improving the curriculum and working conditions with respect to teaching and developing these skills?

**Discussion**

Medical school admissions need not be based on predicted school performance or even in improved medical job performance, defined more broadly. Medical schools can opt to select future medical students on the basis of particular talents (eg leadership, wanting to work in third world countries, etc) or on the basis of school diversity. For example, some schools use standardised test scores as diagnostic tools to predict which students need extra help in their studies. However, it is important to realise that when predictors are chosen on the basis of the strength of the relationship with a criterion, base rate and selection ratio play a crucial role when we determine the practical outcome. Because instruments like SJTs and MMIs are psychometrically more complex, expensive to develop
and administer, and sometimes less reliable than academic instruments, the added value may be modest and the costs high. We illustrated this in the context of medical selection but this does not show a general result in terms of the utility of non-academic tests. It is true that selection ratio and base rate may differ across medical schools and across countries. So there may be situations where it pays off to add non-academic skills tests to academic tests. Besides utility models that show increments in success ratios, there are utility models that can be used to estimate the economic consequences of implementing selection instruments. However, it is not easy to illustrate these models given the uncertainty of how to estimate some parameters in these models, such as the standard deviation of economic gain from increased performance (Holling provides some solutions). In addition, the costs of educating a student who is unsuitable for medical practice is also difficult to determine and will vary considerably across countries and universities. A utility analysis is complex and beyond the scope of this review, but we encourage decision makers to explore the applications of these models in their particular selection context. Another argument for selecting future students based on non-academic skills is that it may result in self-selection of future students, leading to applicants who perhaps fit the profile of a future successful doctor better. If this would be the case, then the base rate would change as a result of the selection procedure. This is not taken into account in the Taylor-Russell model discussed previously and this hypothesis deserves future research.

We would like to stress that we are not against the selection of future medical students on the basis of non-academic skills, but we would argue for future research that is aimed at the incremental validity and utility of these instruments in the context of base rates and selection ratio. As we showed, statistically significant incremental validity is not necessarily practically relevant. In future research, much more attention should be given to the criterion variables. Doctor performance is a complex variable that is not taken into account in many studies or is not operationalised clearly. For example, in the Belgian study, students following a career in general practice were studied. It may be the case that non-academic skills like social skills are more important for this specialty than for other medical specialties.

Conflicts of interest
The authors declare no conflicts of interest.

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