

CHAPTER 1

General introduction

Medical schools are responsible for delivering professionals who perform well and are able to cope with challenges and changes in healthcare¹. If the medical profession reflects the patient population, the best possible healthcare for every individual can be provided². Therefore, medical schools should strive to generate a student population that reflects society³. Because the places for the medical study are limited, medical schools are also responsible for admitting the students they consider able to successfully complete the medical study and ultimately become excellent healthcare professionals. Motivation is a crucial factor for student learning, performance and well-being⁴⁻⁶. This thesis aims to investigate the effects of selection on the motivation of the student population as well as the applicant pool. Factors such as student performance and engagement are also considered. This general introduction provides an overview of the literature with regard to the use of selection and the contextual and theoretical background for the research described in this thesis.

Medical school selection

The number of applicants for medical school globally exceeds the number of available places. Therefore, medical schools have the responsibility to select students from a wide range of applicants in a fair and transparent manner^{7,8}. Acceptance rates vary from 6% to 30%, which makes medical school admissions highly competitive⁹. A great variety of tools is used to determine which applicants are admitted. With this, medical schools attempt to enhance the quality of the student population and ultimately the medical profession^{7,8,10}. In the early years of medical education, knowledge was considered the most important feature of doctors, and the focus in selection was on academic abilities. Till date, previous academic performance shows to be the strongest predictor of future academic performance^{8,11-18}. Throughout the years, the demands of society have changed and patients increasingly place value on skills and characteristics such as communication and empathy alongside cognitive ability. From the 1970 onwards this has led to the incorporation of the so-called “non-academic criteria” in selection^{7,12}. However, assessment of such features proves to be challenging. The added value of many non-academic assessment tools is considered questionable, due to reliability and validity issues^{12,16}. The few tools that show considerable reliability and validity tend to be costly¹³. Table 1 provides an overview of frequently used academic and non-academic selection tools, evidence for their reliability and validity and the main concerns.

Table 1 Overview of tools used in medical school selection

Selection tool		Evidence for reliability and validity	Main concerns
Academic	<i>Previous academic performance</i>	High reliability and validity ^{8;11-17}	May introduce a socioeconomic class bias ^{8;13}
	<i>Aptitude tests</i>	Mixed evidence ^{8;11-13;15-17}	May be susceptible to coaching ¹³ ; may induce bias ⁸
Non-academic	<i>Personal statements</i>	Limited validity, lacks reliability ^{7;8;12-17}	Susceptible to “faking good behaviour” ^{8;13} ; difficult to score objectively ¹³ ; susceptible to input from third parties ^{7;13} ; concerns about socioeconomic class bias ¹³
	<i>Traditional interview</i>	Varying, but mainly low validity and reliability ^{7;8;11-13;16;17}	Susceptible to interviewer bias ¹²⁻¹⁴
	<i>Multiple Mini-interview</i>	Satisfactory validity and reliability ^{8;13;15;17}	
	<i>Letters of Reference</i>	Evidence for poor validity and reliability ^{8;13;14;16;17}	Concerns about socioeconomic class bias ¹³
	<i>Situational Judgement test</i>	Valid and reliable if properly constructed ^{8;13}	May be susceptible to coaching ^{8;13}
	<i>Personality</i>	Moderate validity ^{8;12-14;17}	Selection based on personality contradicts widening access ethos ¹³ ; may be susceptible to coaching ¹³ ; susceptible to “faking good behaviour” ¹³
	<i>Emotional intelligence</i>	Poor validity ^{8;13;17}	May be susceptible to coaching ¹³ ; susceptible to “faking good behaviour” ¹³

Medical school selection and equity

The medical study should be equally accessible to students from different social, ethnic and economic backgrounds. A diverse student population results in a student population which is well-prepared to meet the needs of a diverse society¹⁹. Moreover, research has shown clear benefits of a diverse physician workforce, which pertain to the improvement of healthcare access, a decline in healthcare disparities and an increase in

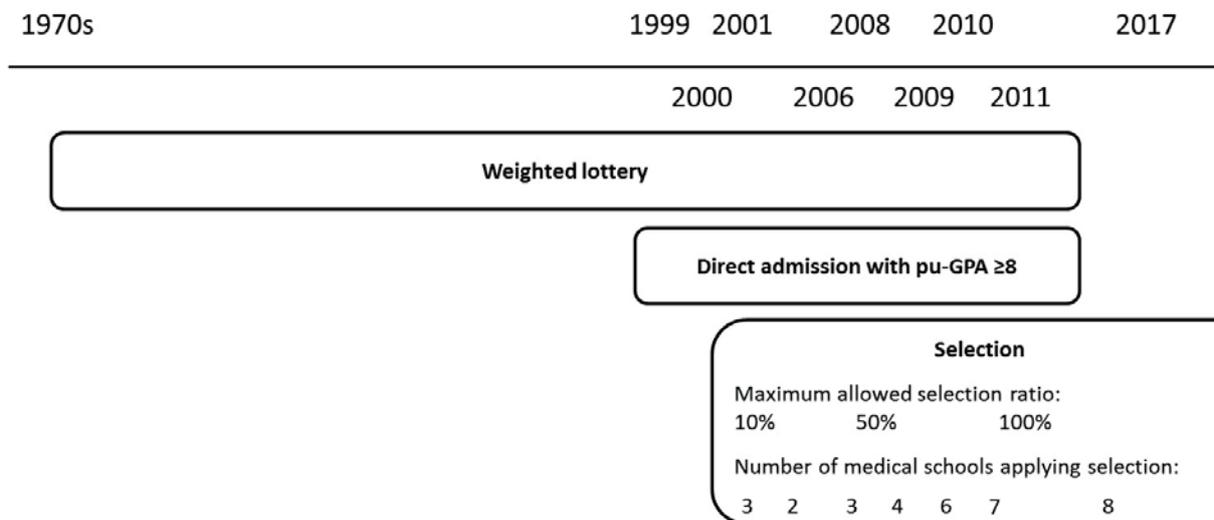
patient satisfaction². However, in the past years concerns have arisen that the desired student diversity may be compromised due to selection. In particular, students from ethnic minority backgrounds^{20;21}, students without a medical family background²²⁻²⁴, lower socioeconomic status (SES) students^{21;23;25}, and students who are first in family to go to university^{23;26;27} are underrepresented in medical education. A first explanation pertains to biased selection procedures^{13;28-30}. For example, A levels, used in the UK, are biased in favour of higher SES students and generally, non-White students and students from lower SES are disadvantaged^{13;31;32}. Furthermore, self-selection among those students has been suggested as a possible cause for their underrepresentation. Widening participation efforts are enacted to remove barriers, compensate for disadvantages and encourage underrepresented students into higher education. Such efforts, however, vary in the extent to which they are successful^{13;33}. To address inequality issues, insight into how motivation for the medical study is formed can be used to design interventions aimed at encouraging students into medical education. Negative reactions from family and peers in an environment in which academic excellence is looked down upon^{20;34} may cause a decline in applicants' motivation which in turn can lead them to refrain from applying to the medical study^{18;35}. Motivation may also decline due to a lack of access to preparatory activities for medical school selection, such as gathering information about the medical study or gaining healthcare experience^{20;36}. While medical schools do not have a direct influence on applicants' social environments, they can work towards designing a selection procedure for which preparatory activities are equally accessible to all applicants³⁷. For this, it is important to gain insight into which inequalities prospective applicants experience during their orientation process.

Medical school admissions in the Netherlands

In the Netherlands, all high school students who graduate from 6-year pre-university education with science subjects, i.e. physics, biology, chemistry and mathematics, are eligible for entry to the medical study. For a long time, admission into the medical study was regulated in a unique way (see the timeline in Figure 1). In the 1970s a national weighted lottery was implemented, in which chances of admission were based on applicants' pre-university grade point average (pu-GPA)³⁸. Four categories were distinguished. The admission ratio for students with a pu-GPA 7.5 - 7.9, 7.0 - 7.4, 6.5 - 6.9, and < 6.5 (on a scale from 1 to 10) was 9 : 6 : 4 : 3. A large amount of criticism following three unsuccessful attempts in the lottery of a top scoring applicant, led to amendment of regulations and from 1999, applicants with a pu-GPA of ≥ 8 were granted

direct admission to the medical study. Because only a small proportion of pre-university students obtains this high level of achievement, the majority of applicants enrolled in the lottery. From 2000 medical schools were allowed to admit a small proportion of students based on selection. The proportion of students medical schools were allowed to select gradually increased to 100% in the following years. Findings reported by one Dutch medical school, indicating that selection yielded a better performing student population, with less drop-out, compared to lottery^{35;39;40}, led the government to impose a law which dictated that from 2017 admissions would be based only on selection. These changes in the admissions policy allowed for unique research designs. Usually, rejected applicants cannot be recruited for research purposes as they are not admitted to the medical study. In the Dutch system, rejected students could still get admitted through lottery and can therefore serve as a control group. The co-existence of the admission routes also allowed for investigation of the effect of the gradual increase in the use of selection.

Figure 1 Flowchart of Dutch admissions throughout the years and the number of medical schools applying selection



The Dutch system further differs from those used in other countries with regard to the number of medical schools applicants can apply to. While applicants in the UK can apply to up to four medical schools, and in the US to as many medical schools as they want, applicants in the Netherlands are allowed to apply to only one of the eight medical schools per year. Each medical school in the Netherlands designs their own procedure to select the students they consider most suitable for their curriculum. When admission is only through selection, the motivation to get admitted to the medical study may override applicants' motivation to find the medical school that fits their educational preferences best, resulting

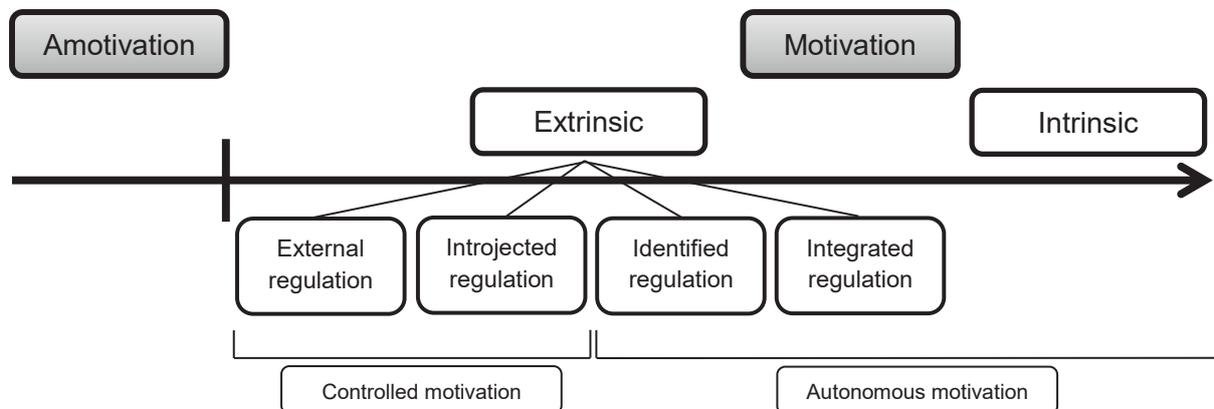
in strategies to determine where they have the maximal chances of being admitted.

Outcomes of selection

Student motivation

Motivation is crucial for medical students' learning, performance and well-being, as well as for patient outcomes⁴¹⁻⁴⁹. Motivation entails the reasons people act in certain ways. In this thesis, Self-determination theory is used as theoretical framework. This theory finds its origin in Psychology and is gaining ground in the domain of medical education^{41;48;50;51}. SDT stresses the importance of the quality of motivation and describes intrinsic and extrinsic motivation on a continuum, together with a lack of motivation (amotivation) (see Figure 2)^{4;5}. It assumes that people have a natural curiosity and a tendency to grow and develop themselves, which is referred to as intrinsic motivation. However, motivation is dynamic and can change between the different types, depending on feelings of autonomy (making one's own decisions), competence (feeling capable of doing something) and relatedness (sense of belonging to others). When pressure is experienced, either from the self or from others, behaviour is driven by extrinsic motivation. Self-determination, referred to as the experience of having a choice, is crucial for motivation. This is prominent in the case of intrinsic motivation, but also in some cases of extrinsic motivation. Different forms of extrinsic motivation are described, which are defined based on the extent to which they are self-determined. Identified regulation is seen when a person acknowledges the value or importance of certain behaviour. The most self-determined type of extrinsic motivation is integrated regulation. This occurs when identified regulations are fully internalized and assimilated with the self. Intrinsic motivation together with identified regulation and integrated regulation forms what is called autonomous motivation. The other two types of extrinsic motivation, i.e. introjected regulation (internal pressure) and external regulation (extrinsic pressure or rewards) together form what is called controlled motivation. If students are autonomously, and especially intrinsically, motivated learners, this benefits their educational experience. Autonomous motivation has showed good associations with learning and performance. It fosters deep learning (contrary to surface learning), better study behaviour and academic achievement, including lower dropout and continuation in a study^{41;42;45;47;50}. In addition to educational outcomes, autonomous motivation is associated with positive well-being of students⁴¹. The least desirable learning outcomes have been found among amotivated students and students with a combination of high controlled and low autonomous motivation^{43;49}.

Figure 2 The Self-determination continuum of motivation (adapted from Ryan & Deci, 2000⁵)



Because medical schools aim to admit motivated students, motivation is often one of the selection criteria for the medical study^{52;53}. However, research that addresses both student selection and motivation is scarce and studies investigating motivation in this respect have mainly focused on the quantity of motivation, rather than the quality of motivation. There are indications that selection results in a student population with higher strength^{54;55} and more autonomous type of motivation⁵⁰, but more evidence is needed (see Table 2). As described previously, motivation is dynamic and can be influenced by the educational environment. In an autonomy-supportive learning environment, as opposed to a controlling environment, the autonomous motivation of students thrives⁵⁶. It has also been suggested that the experience of being selected may have a positive influence on student motivation, due to fulfilment of students' needs for competence and relatedness^{41;51;54;57-59}.

Medical schools invest substantial time and money in selection, including the assessment of motivation^{13;52;53;60}. Motivation is usually measured by using personal statements or some sort of interview^{7;60;61}. Assessment of motivation in high stakes selection situations can be difficult, however. Because applicants' futures depend on how they portray their motivation for the medical study, they may be inclined to provide socially desirable answers instead of true reflections of their motivation⁶². This behaviour, also referred to as "faking good" behaviour⁶³, poses a risk to the validity of motivation assessments for the selection of students.

Student performance

Selection research predominantly focuses on predicting performance during the medical study and have found that many selection tools correlate only moderately with medical

Table 2 Overview of research on admissions groups and motivation

Authors	Findings
Hulsman et al. (2007)⁵⁴	Higher strength of motivation among selected students in comparison to top pu-GPA and lottery-admitted students
Kusurkar et al. (2010)⁵⁵	Higher strength of motivation among selected students in comparison to lottery-admitted students
Kusurkar et al. (2013)⁵⁰	Higher autonomous motivation among selected students in comparison to lottery-admitted students
Nieuwhof et al. (2004)⁶⁴	No differences were found with regards to the strength of motivation of selected and lottery-admitted students

school performance¹³. These studies are generally limited by the fact that a single admissions process is used at a medical. The Dutch situation allows for comparison of different admissions processes at one medical school. Studies comparing the different admissions groups, too, mostly concern performance outcomes. Top performers in pre-university education consistently outperform selected and lottery-admitted students in medical school, in both the pre-clinical and the clinical phases^{54;57;59}. For differences between selected and lottery-admitted students, however, the evidence is less clear. A great variety of performance outcomes is considered in these studies. While better professional behaviour and clerkship performance have been reported^{40;59}, no difference were found for year-1 course completion and Year-3 OSCEs^{18;57;65} and findings regarding other performance outcomes are mixed^{18;35;39;54;57;59;65} (see Table 3). Overall, the differences found are usually small and do not always reach statistical significance. The practical relevance of a 0.1 higher GPA on a scale from 1 to 10, for example, is questionable. Because the lottery-admitted group consists of students who had participated in selection, but were rejected, and students who only applied to lottery, this differentiation has also been taken into account.

Student engagement

Engagement is also an important factor in student's learning, performance, well-being and patient outcomes⁶⁶⁻⁷⁰. It is defined as a positive state of work-related (or study-related) well-being and is considered the positive counterpart of burnout. Engagement involved three dimensions, being vigour, dedication and absorption^{69;71}. Vigour refers to high levels of energy, mental resilience while studying, and the willingness to invest

effort. Dedication is characterized by enthusiasm, pride and challenge. Absorption pertains to being happily and fully immersed in one's study, whereby time passes quickly. While its importance in the educational context has been acknowledged, engagement has gained little attention in medical education and has not been studied in relation with selection before.

Clinical practice is highly demanding, leaving medical students and professionals at risk for burnout. The prevalence of burnout among medical students is reported to range between 45 and 71 percent⁷² and 15% of Dutch residents have been found to meet the criteria for burnout⁷³. Burnout of medical practitioners is a threat to patient safety⁷⁴. Therefore the well-being of medical students requires attention. Motivation and engagement may play an important role in the prevention of burnout among medical students. As both factors are associated with positive well-being of students and have negative relationships with burnout and exhaustion^{43;71}, motivated and engaged students may build up more resilience to cope with high demands of medicine, which serves as protection against burnout.

In conclusion, high stakes are involved in selection. Applicants' futures depend on their ability to be successful in selection, whereas for medical schools the stakes are multi-factorial. Selection is costly, should result in a good quality student population, and has to be designed in a way that is acceptable to the society. Much importance is placed on medical school selection, resulting in an increase in the costs and the time invested by medical schools. This stresses the need for research into the effects of selection. This thesis addresses the effects of selection from the perspective of motivation and discusses whether the outcomes justify these investments.

General problem definition, aim and research questions

While selection is widely applied for the admission of students, there is a paucity of evidence for its use compared to other admissions strategies. Moreover, motivation as a factor in selection has been understudied. Therefore, the following general research question was formulated:

What are the effects of selection on the motivation of the student population and the applicant pool?

In this thesis, the effects of selection are explored in the student population and the applicant pool, with a focus on motivation. The specific main research questions for the research studies conducted in this thesis are as follows:

1. What is the association between selection and motivation in medical school? (*Chapter 2*)
2. Are different medical school admission groups associated with differences in motivation, engagement and performance? (*Chapter 3*)
3. Is participation in medical school selection associated with differences in motivation, engagement and performance? (*Chapter 3*)
4. Are different medical school selection procedures associated with differences in motivation, engagement and performance? (*Chapter 3*)
5. What are students' main reasons for applying to a particular medical school and are these reasons related with student characteristics and motivation? (*Chapter 4*)
6. Is a statement on motivation a valid tool as a part of the medical school selection procedure? (*Chapter 5*)
7. How is motivation for medical study formed and what is the role of selection in it? (*Chapter 6*)

Table 3 Overview of research on admission groups and performance

Authors	Outcome measures	Findings
Hulsman et al. (2007) ⁵⁴	Year-1 GPA	<i>GPA</i> : top pu-GPA > selected and lottery-admitted
	Year-1 examinations	<i>Pass all exams</i> : top pu-GPA > selected and lottery-admitted
Urlings-Strop et al. (2009) ³⁹	Dropout 60 course credits per year	<i>Dropout</i> : selected < lottery-admitted <i>Course credits</i> : no differences, except in the second year for 1 out of 4 cohorts (selected > lottery-admitted; this did not remain after stratification for year of entrance and lottery category)
	Year-1 GPA	<i>GPA</i> : no differences, except in the first year for 1 out of 4 cohorts (selected > lottery-admitted)
Urlings-Strop et al. (2011) ⁴⁰	Clerkship dropout Clerkship GPA	<i>Dropout</i> : selected < lottery-admitted <i>GPA</i> : selected > lottery-admitted
Urlings-Strop et al. (2013) ³⁵	Dropout	<i>Dropout</i> : no differences between participants and non-participants; selected > rejected lottery-admitted
	Clerkship GPA	<i>GPA</i> : no differences between participants and non-participants; selected > rejected lottery-admitted
Schripsema et al. (2014) ⁵⁹	Year-1 GPA	<i>GPA</i> : top pu-GPA > selected > lottery-admitted
	Course credits	<i>Credits in Year-1</i> : top pu-GPA > selected and rejected lottery-admitted > lottery-admitted <i>Credits in Year-2</i> : top pu-GPA, selected and rejected lottery-admitted > lottery-admitted <i>Credits in Year-3</i> : no differences
	Good professionalism score	<i>Professionalism</i> : top pu-GPA > selected > rejected lottery-admitted and lottery-admitted
	Dropout	<i>Dropout</i> : no differences
Lucieer et al. (2015) ⁶⁵	Dropout	<i>Dropout</i> : cognitive selected < lottery-admitted
	Year-1 GPA	<i>GPA</i> : no differences
	Course credits at 52 weeks	<i>Course credits</i> : cognitive-selected > lottery-admitted
	Year-3 OSCE Bachelor completion in three years	<i>Passing OSCE</i> : no differences <i>Completion</i> : no differences

Authors	Outcome measures	Findings
Stegers-Jager et al. (2015) ¹⁸	Year-1 course completion within one year	<i>Year-1</i> : selected > non-selected (top pu-GPA and lottery-admitted; after including early medical school performance, this did not remain)
	Pre-clinical course completion within 4 years Clerkship performance	<i>Pre-clinical course completion</i> : no differences <i>Clerkships</i> : no differences
De Visser et al. (2016) ⁵⁷	Year-1 Course credits (obtaining ≥ 42 out of 60; obtaining all 60 credits)	≥ 42 <i>course credits</i> : selected > lottery-admitted; no differences between selected, top pu-GPA and 60 credits: top pu-GPA > selected > lottery-admitted and rejected lottery-admitted (adjusted for GPA, only selected > lottery-admitted remained)
	Year-1 Dropout	<i>Dropout</i> : selected < lottery-admitted
	Year-1 GPA	<i>GPA</i> : top pu-GPA > selected > lottery-admitted and rejected lottery-admitted (adjusted for pu-GPA, only selected > lottery-admitted and rejected lottery-admitted remained)
	Year-1 nursing attachment	<i>Nursing attachment</i> : no differences between groups
	Bachelor completion in three years	<i>Completion</i> : selected > lottery-admitted (adjusted for pu-GPA, no differences remained)
	Year-2 and 3 GPA (theoretical exams)	<i>GPA</i> : top pu-GPA > selected > lottery-admitted and rejected lottery-admitted (adjusted for pu-GPA, only selected > rejected lottery-admitted remained)
Year-3 grade (clinical course)	<i>Clinical course</i> : top pu-GPA > selected > lottery-admitted (adjusted for pu-GPA, only selected > lottery-admitted remained)	

Outline of this thesis

In this thesis the effects of selection will be addressed with regards to the medical student population and the applicant pool. The effects of selection will be viewed from the perspective of motivation, while using SDT as a theoretical framework. Both quantitative and qualitative research methods are used to gain insight into the effects of selection.

Chapter 2 reports on a first exploration of the association between motivation and selection at one medical school. This study aimed to investigate whether differences in motivation could explain performance differences between different admission groups.

Furthermore, it tested the hypothesis that selection has a positive effect on motivation. The research described in this chapter entails the comparison of the motivation of students who had been admitted based on selection and students who had been admitted based on the other admission routes, as well as the comparison of the motivation of recently selected students and students who were selected years before or admitted based on the other admission routes. The mechanism was further explored using open questions to ask students about the possible effects of selection on their motivation.

In *Chapter 3*, the research was extended to two other Dutch medical schools to test if earlier findings with regard to the motivation of the different admissions groups could be generalised across medical schools. The performances of students in the pre-clinical and clinical phases of the medical study and student engagement were included as additional outcome measures. The multisite character of the study described in *Chapter 2* allowed for comparisons between different selection procedures. Selection procedures are demanding in nature and applicants have to put considerable effort in their preparations. Therefore, this study also entailed comparisons between students who had opted to participate in a voluntary selection procedure and students who refrained from it and entered through weighted lottery.

In *Chapter 4*, the effect of selection on applicants' behaviour, more specifically their medical school choice strategy, was studied. Moreover, it was investigated how different reasons for applying to a particular medical school were associated with student motivation in the medical study. The proportion of students medical schools were allowed to admit through selection increased throughout the years. In this chapter, the possible effect of this increase on the behaviour of applicants is addressed.

In *Chapter 5*, the validity and suitability of a written statement on motivation as a selection tool is addressed. Medical schools try to ensure that motivated students are selected and assessment of motivation is often part of the selection procedure. The content of applicants' statements and the discriminative ability of such statements were investigated.

Chapter 6 reports on a study that aimed at exploring the mechanisms through which high school students form different types of motivation for the medical study. Concerns exist about underrepresentation of certain groups of students in medical education, such as ethnic minority students and lower SES students, due to biased selection procedures and

Chapter 1

self-selection. An explanation for this issue was sought by investigating the motivation of students who considered applying to medical school. This study especially focused on the effect of selection on their motivation.

Chapter 7 opens up the discussion about whether selection should be replaced by lottery and considers the issue from the angle of student outcomes, as well as the diversity of the medical student population.

Finally, in *Chapter 8*, the findings with regard to the effects of selection on the student population and the applicant pool are considered in light of the existing body of literature. It further included a reflection on the strengths and limitations of the thesis. Practical implications are described as well as suggestions for areas of future research.

As this thesis consists of papers published in or submitted to peer-reviewed journals, some repetitiveness across various chapters was inevitable.

References

- 1 Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *The lancet* 2010; 376(9756):1923-1958.
- 2 Morgan HK, Haggins A, Lypson ML, Ross P. The Importance of the Premedical Experience in Diversifying the Health Care Workforce. *Academic Medicine* 2016.
- 3 General Medical Council. Tomorrow's Doctors: Outcomes and standards for undergraduate medical education. *Manchester, UK: General Medical Council* 2009.
- 4 Deci EL, Ryan R. Intrinsic motivation and self-determination in human behavior. *New York and London: Plenum* 1985.
- 5 Ryan RM, Deci EL. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology* 2000; 25(1):54-67.
- 6 Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 2000; 55(1):68-78.
- 7 Albanese MA, Snow MH, Skochelak SE, Huggett KN, Farrell PM. Assessing Personal Qualities in Medical School Admissions. *Academic Medicine* 2003; 78(3).
- 8 Patterson F, Knight A, Dowell J, Nicholson S, Cousans F, Cleland J. How effective are selection methods in medical education? A systematic review. *Medical Education* 2016; 50(1):36-60.
- 9 Razack S, Hodges B, Steinert Y, Maguire M. Seeking inclusion in an exclusive process: discourses of medical school student selection. *Medical Education* 2015; 49(1):36-47.
- 10 Kulatunga Moruzi C, Norman GR. Validity of admissions measures in predicting performance outcomes: the contribution of cognitive and non-cognitive dimensions. *Teaching and learning in medicine* 2002; 14(1):34-42.
- 11 Shulruf B, Poole P, Wang G, Rudland J, Wilkinson T. How well do selection tools predict performance later in a medical programme? *Advances in Health Sciences Education* 2012; 17(5):615-626.

Chapter 1

- 12 Benbassat J, Baomal R. Uncertainties in the selection of applicants for medical school. *Advances in Health Sciences Education* 2007; 12(4):509-521.
- 13 Cleland J, Dowell J, McLachlan J, Nicholson S, Patterson F. Identifying best practice in the selection of medical students. *GMC Res Report* 2012.
- 14 Eamonn F, David J, Laura M. Factors associated with success in medical school: systematic review of the literature. *BMJ* 2002; 324.
- 15 Prideaux D, Roberts C, Eva K, Centeno A, Mccrorie P, Mcmanus C et al. Assessment for selection for the health care professions and specialty training: Consensus statement and recommendations from the Ottawa 2010 Conference. *Medical Teacher* 2011; 33(3):215-223.
- 16 Salvatori P. Reliability and Validity of Admissions Tools Used to Select Students for the Health Professions. *Advances in Health Sciences Education Theory and Practice* 2001; 6(2):159-175.
- 17 Siu E, Reiter H. Overview: what's worked and what hasn't as a guide towards predictive admissions tool development. *Advances in Health Sciences Education* 2009; 14(5):759-775.
- 18 Stegers-Jager KM, Themmen APN, Cohen-Schotanus J, Steyerberg EW. Predicting performance: relative importance of students' background and past performance. *Medical Education* 2015; 49(9):933-945.
- 19 Saha S, Guiton G, Wimmers PF, Wilkerson L. Student body racial and ethnic composition and diversity-related outcomes in US medical schools. *JAMA* 2008; 300(10):1135-1145.
- 20 Rao V, Flores G. Why aren't there more African-American physicians? A qualitative study and exploratory inquiry of African-American students' perspectives on careers in medicine. *Journal of the National Medical Association* 2007; 99(9):986.
- 21 Young ME, Razack S, Hanson MD, Slade S, Varpio L, Dore KL et al. Calling for a broader conceptualization of diversity: Surface and deep diversity in four Canadian medical schools. *Academic Medicine* 2012; 87(11):1501-1510.
- 22 Simmenroth-Nayda A, Görlich Y. Medical school admission test: advantages for students whose parents are medical doctors? *BMC Medical Education* 2015; 15(1):81.

- 23 Heath C, Stoddart C, Green H. Parental backgrounds of Otago medical students. *The New Zealand Medical Journal (Online)* 2002; 115(1165).
- 24 McManus IC, Richards P. Audit of admission to medical school: I--Acceptances and rejects. *British Medical Journal (Clin Res Ed)* 1984; 289(6453):1201-1204.
- 25 Ferguson E, James D, Yates J, Lawrence C. Predicting who applies to study medicine: Implication for diversity in UK medical schools. *Medical Teacher* 2012; 34(5):382-391.
- 26 Vaglum, Wiers J, Ekeberg. Motivation for medical school: the relationship to gender and specialty preferences in a nationwide sample. *Medical Education* 1999; 33(4):236-242.
- 27 Gąsiorowski J, Rudowicz E, Safranow K. Motivation towards medical career choice and future career plans of Polish medical students. *Advances in Health Sciences Education* 2014;1-17.
- 28 McManus IC, Richards P, Winder BC, Sproston KA, Styles V. Medical school applicants from ethnic minority groups: identifying if and when they are disadvantaged. *BMJ* 1995; 310(6978):496-500.
- 29 Humphrey-Murto S, Leddy JJ, Wood TJ, Puddester D, Moineau Gv. Does Emotional Intelligence at Medical School Admission Predict Future Academic Performance? *Academic Medicine* 2014; 89(4):634-643.
- 30 Puddey IB, Mercer A, Carr SE, Loudon W. Potential influence of selection criteria on the demographic composition of students in an Australian medical school. *BMC Medical Education* 2011; 11(1):1.
- 31 Mathers J, Sitch A, Parry J. Population-based longitudinal analyses of offer likelihood in UK medical schools: 1996-2012. *Medical Education* 2016; 50(6):612-623.
- 32 Griffin B, Hu W. The interaction of socio-economic status and gender in widening participation in medicine. *Medical Education* 2015; 49(1):103-113.
- 33 Grafton-Clarke C. Is it too difficult for disadvantaged applicants to get into medical school? *Medical Teacher* 2016;1.
- 34 Greenhalgh T, Seyan K, Boynton P. "Not a university type": focus group study of social class, ethnic, and sex differences in school pupils' perceptions about medical school. *BMJ* 2004; 328.

Chapter 1

- 35 Urlings-Strop LC, Stegers-Jager KM, Stijnen T, Themmen APN. Academic and non-academic selection criteria in predicting medical school performance. *Medical Teacher* 2013;1-6.
- 36 Wright S. Medical school personal statements: a measure of motivation or proxy for cultural privilege? *Advances in Health Sciences Education* 2014;1-17.
- 37 Laurence CO, Zajac IT, Lorimer M, Turnbull DA, Sumner KE. The impact of preparatory activities on medical school selection outcomes: a cross-sectional survey of applicants to the university of Adelaide medical school in 2007. *BMC Medical Education* 2013; 13(1):159.
- 38 Ten Cate TJ. Medical education in the Netherlands. *Medical Teacher* 2007; 29(8):752-757.
- 39 Urlings-Strop LC, Stijnen T, Themmen APN, Splinter TAW. Selection of medical students: a controlled experiment. *Medical Education* 2009; 43(2):175-183.
- 40 Urlings-Strop LC, Themmen APN, Stijnen T, Splinter TAW. Selected medical students achieve better than lottery-admitted students during clerkships. *Medical Education* 2011; 45(10):1032-1040.
- 41 Kusurkar RA, Ten Cate TJ, Van Asperen M, Croiset G. Motivation as an independent and a dependent variable in medical education: A review of the literature. *Medical Teacher* 2011; 33(5):e242-e262.
- 42 Artino AR, La Rochelle JS, Durning SJ. Second-year medical students's motivational beliefs, emotions, and achievement. *Medical Education* 2010; 44(12):1203-1212.
- 43 Kusurkar RA, Croiset G, Galindo-Garre F, Ten Cate TJ. Motivational profiles of medical students: Association with study effort, academic performance and exhaustion. *BMC Medical Education* 2013; 13(1):87.
- 44 Moolaert V, Verwijnen MG, Rikers R, Scherpbier AJ. The effects of deliberate practice in undergraduate medical education. *Medical Education* 2004; 38(10):1044-1052.
- 45 Sobral DT. What kind of motivation drives medical students' learning quests? *Medical Education* 2004; 38(9):950-957.
- 46 Stegers-Jager KM, Cohen-Schotanus J, Themmen APN. Motivation, learning strategies, participation and medical school performance. *Medical Education* 2012; 46(7):678-688.

- 47 Vansteenkiste M, Zhou M, Lens W, Soenens B. Experiences of autonomy and control among Chinese learners: Vitalizing or immobilizing? *Journal of Educational Psychology* 2005; 97(3):468.
- 48 Williams GC, Saizow RB, Ryan RM. The importance of self-determination theory for medical education. *Academic Medicine* 1999; 74(9).
- 49 Vansteenkiste M, Sierens E, Soenens B, Luyckx K, Lens W. Motivational profiles from a self-determination perspective: The quality of motivation matters. *Journal of Educational Psychology* 2009; 101(3):671.
- 50 Kusurkar RA, Ten Cate TJ, Vos CMP, Westers P, Croiset G. How motivation affects academic performance: a structural equation modelling analysis. *Advances in Health Sciences Education* 2013; 18(1):57-69.
- 51 Ten Cate TJ, Kusurkar RA, Williams GC. How self-determination theory can assist our understanding of the teaching and learning processes in medical education. AMEE guide No. 59. *Medical Teacher* 2011; 33(12):961-973.
- 52 Turner R, Nicholson S. Reasons selectors give for accepting and rejecting medical applicants before interview. *Medical Education* 2011; 45(3):298-307.
- 53 Breland H, Maxey J, Gernand R, Cumming T, Trapani C. Trends in College Admission 2000. *A Report of a Survey of Undergraduate Admissions Policies, Practices, and Procedures* 2001.
- 54 Hulsman RL, Van Der Ende JSJ, Oort FJ, Michels RPJ, Casteelen G, Griffioen FMM. Effectiveness of selection in medical school admissions: evaluation of the outcomes among freshmen. *Medical Education* 2007; 41(4):369-377.
- 55 Kusurkar RA, Kruitwagen C, Ten Cate TJ, Croiset G. Effects of age, gender and educational background on strength of motivation for medical school. *Advances in Health Sciences Education* 2010; 15(3):303-313.
- 56 Reeve J. Self-determination theory applied to educational settings. 2002.
- 57 de Visser M, Fluit C, Fransen J, Latijnhouwers M, Cohen-Schotanus J, Laan R. The effect of curriculum sample selection for medical school. *Advances in Health Sciences Education* 2016;1-14.

Chapter 1

- 58 Kusurkar RA, Ten Cate TJ. AM Last Page: Education Is Not Filling a Bucket, but Lighting a Fire: Self-Determination Theory and Motivation in Medical Students. *Academic Medicine* 2013; 88(6):904.
- 59 Schripsema NR, Trigt AM, Borleffs JC, Cohen-Schotanus J. Selection and study performance: comparing three admission processes within one medical school. *Medical Education* 2014; 48(12):1201-1210.
- 60 Dowell J, Lynch B, Till H, Kumwenda B, Husbands A. The multiple mini-interview in the UK context: 3 years of experience at Dundee. *Medical Teacher* 2012; 34(4):297-304.
- 61 Guyaux J, oude Egbrink MGA, Heeneman S, Houben AJHM, Willekes C, Schuwirth LWT et al. Selectie op een combinatie van cognitieve en noncognitieve eigenschappen. Keuzes en ervaringen in de onderzoeksmaster Arts-Klinisch Onderzoeker (A-KO) te Maastricht. *Tijdschrift voor Medisch Onderwijs* 2011;1-9.
- 62 White J, Brownell K, Lemay JF, Lockyer J. "What Do They Want Me To Say?" The hidden curriculum at work in the medical school selection process: a qualitative study. *BMC Medical Education* 2012; 12(1):17.
- 63 Griffin B, Wilson IG. Faking good: self-enhancement in medical school applicants. *Medical Education* 2012; 46(5):485-490.
- 64 Nieuwhof MG, Ten Cate TJ, Oosterveld P, Soethout M. Measuring strength of motivation for medical school. *Medical Education Online* 2004; 9.
- 65 Lucieer SM, Stegers-Jager KM, Rikers RM, Themmen AP. Non-cognitive selected students do not outperform lottery-admitted students in the pre-clinical stage of medical school. *Advances in Health Sciences Education* 2015;1-11.
- 66 Svanum S, Bigatti SM. Academic course engagement during one semester forecasts college success: Engaged students are more likely to earn a degree, do it faster, and do it better. *Journal of College Student Development* 2009; 50(1):120-132.
- 67 Carini RM, Kuh GD, Klein SP. Student engagement and student learning: Testing the linkages*. *Research in higher education* 2006; 47(1):1-32.

- 68 Casuso-Holgado MJ, Cuesta-Vargas AI, Moreno-Morales N, Labajos-Manzanares MT, Barón-López FJ, Vega-Cuesta M. The association between academic engagement and achievement in health sciences students. *BMC Medical Education* 2013; 13(1):1-7.
- 69 Schaufeli WB, Martinez IM, Pinto AM, Salanova M, Bakker AB. Burnout and engagement in university students a cross-national study. *Journal of cross-cultural psychology* 2002; 33(5):464-481.
- 70 Prins JT, Van Der Heijden FMMA, Hoekstra-Weebers JEHM, Bakker AB, Van de Wiel HBM, Jacobs B et al. Burnout, engagement and resident physicians' self-reported errors. *Psychology, health & medicine* 2009; 14(6):654-666.
- 71 Schaufeli WB, Salanova M, González-Romá V, Bakker AB. The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness studies* 2002; 3(1):71-92.
- 72 IsHak W, Nikraves R, Lederer S, Perry R, Ogunyemi D, Bernstein C. Burnout in medical students: a systematic review. *The clinical teacher* 2013; 10(4):242-245.
- 73 De Jonge Specialist. Rapport Nationale AIOS Enquete 2015. De werkomstandigheden van aios in beeld. 2015.
- 74 Dyrbye L, Shanafelt T. A narrative review on burnout experienced by medical students and residents. *Medical Education* 2016; 50(1):132-149.

