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Introduction
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Research Background

It seems that medicine is a very attractive study choice, as the number of applicants often outruns the availability of study places. Most universities have therefore introduced selection criteria for acceptance to their programs. These selection criteria are commonly based on cognitive factors, such as grade point average scores and/or scores on performance tests, information that has shown to be reliable, valid and transparent (Monroe, Quinn, Samuelson, Dunleavy, & Dowd, 2013; Searle & McHarg, 2003).

Nevertheless, although only the best performing applicants become accepted to the medical studies’ selection process, the attrition rates during the programs are on average around 10%, differing across universities (from 1.5% to 25% in the study of Lievens, Ones, & Dilchert, 2009; from 2.4% to 26.2% in the study of O’Neill, Hartvigsen, Wallstedt, Korsholm, & Eika, 2011). O’Neill et al. (2011) indicate that the rate is lower for universities with a selection procedure compared to universities without such a procedure. For example, universities in Switzerland that have selected medical students based on an ability test report higher study success rates (or lower attrition rates) than universities without a selection procedure (Bericht des Bundesrates, 2011). The same applies for Austria where university programs with admission restrictions (e.g., medical studies) have the lowest drop-out rates (Österreichische Universitätskonferenz, 2014). The selection procedure itself also seems to have an influence on the drop-out rate of medical students (Schripsema, van Trigt, Borleffs, & Cohen-Schotanus, 2014; Urlings-Strop, Stijnen, Themmen, & Splinter, 2009). Urlings-Strop et al. (2009) show that the rates of dropping out were higher for lottery-admitted students than for students who were selected based on a step-wise procedure. Although the drop-out rate at universities with an admission procedure is relatively low compared to non-selective universities; nevertheless every student who drops out is one too much.

Dropping out from a medical curriculum has considerable consequences for both the student (e.g., painful experience) and society (e.g., loss of public money), as described in the literature (Lievens et al., 2009; Maher et al., 2013; O’Neill et al., 2011; Wright, Scott, Woloschuk, & Brenneis, 2004). Moreover, since the study places in the medical studies are limited, a decrease of the attrition rate is certainly required (Maher et al., 2013).
Apart from ensuring that students successfully finish their studies, another aim of the selection process should be to guarantee that medicine graduates eventually indeed enter into the medical profession (Powis, 1994). Dropping out during a medical program clearly has undesirable effects for a country’s patient-centered care system. Too many graduates not working as physicians in the medical sector may lead to a critical shortage in the medical care workers supply. The number of medical students or graduates that aspires a career as a family doctor has steadily declined in the last decade, which may have serious consequences for the sustainability of the health care system in the future. Although recruitment problems for family doctors are not present everywhere, they certainly exist in countries like Germany (Deutsch, Höningschmid, Frese, & Sandholzer, 2013), Switzerland (Bericht des Bundesrates, 2011), U.S.A. (Osborn, 1993) and Canada (Wright et al. 2004).

Applicants with the highest potential to both graduate and start working as physicians should certainly be admitted to the medical studies. Wanting to become a physician is an educational decision that includes a vocational choice during one’s study (Elam, 1994). The first decision involves studying medicine and leads to a university degree, whereas the second decision demands students deciding for a particular specialty within a wide variety of job options (Borges & Savickas, 2002, 2014; Duffy & Richard, 2006). Specialty choices have far-reaching consequences for the future personal lives of students because the length and difficulty of the training vary depending on the chosen specialty (Furnham, Pendleton, & Manicom, 1981). Moreover, the consequences differ among specialties in terms of work settings (e.g., work hours; salary) and work tasks (Borges & Savickas, 2002; Iserson, 2003). While medical students form a relative homogenous group as regards their cognitive abilities (following a quite uniform curriculum), differences among them become obvious during the practical training after university graduation (Borges & Savickas, 2002). As Powis (1994) has pointed out, the academically best performing students are not always the ones who will perform the best as physicians. Therefore, we argue that the selection process should also include non-cognitive measurements which were shown to predict academic achievement of students on top of their prior performance at high school. Conscientiousness, for example, has been shown to be one of the most important personality traits for achieving study success (e.g., Lievens et al., 2009). However, the quality criteria related to the non-cognitive factors (e.g., validity) are generally too uncertain to serve as a basis for the selection of applicants (Benbassat & Baumal, 2007).
Nevertheless, the implementation of non-cognitive factors into the admission process has been increasingly proposed of late (Benbassat & Baumal, 2007; Lievens et al., 2009; Powis, 1994). It is now acknowledged that to be able to make a well-informed study decision, medical applicants should also be informed about issues such as study requirements, the most common misconceptions about the medical programs, and the advanced practical training after university graduation. The medical programs’ admission process, therefore, comprises more than merely selecting the applicants on the basis of their cognitive abilities (Kyllonen, Walters, & Kaufman, 2005; Lievens et al., 2009). For example, when choosing a study, it may be very useful to compare one’s characteristics to the characteristics of the aspired work environment. Becoming a family doctor presumably requires a different set of attitudes than becoming a scientific researcher. The former group is presumably more motivated to counsel others compared with the group who is heading for an academic career. In a matching procedure, an adequate identification of the attitudes considered to be essential for the medical program is essential. In addition, students need to be sufficiently informed about the diverse work environments within the medical field (Borges, Savickas, & Jones, 2004; Taber, Hartung, & Borges, 2011). Persons who have more insights into their personality and know more about the requirements of diverse environments are expected to make better fitting career decisions than less informed persons, that is, with regard to choosing a career that fits their personal characteristics. Furthermore, medical schools could consider implementing formal programs particularly focused on assisting medical students in making their specialty choice (Iserson, 2003). Withdrawal later on in the medical program leads to similar consequences such as early drop-out (e.g., with negative effects on one’s personal life), which in turn implies that acquired qualifications are not transferred to the work environment (O’Neill et al., 2011).

In general, the selection procedure is best thought of as a holistic process. A process that enables applicants to carefully map out their personality, needs, and work aspirations, so they can make a well-informed study decision before taking part in the selective performance test. The challenge of the admission process is to identify the best fitting applicants before selecting the best performing applicants. The admission process should therefore result in a selection of applicants who have both the appropriate vocational interests to become physicians and the cognitive abilities required to pass the program. However, in the medical domain, the identification of selection criteria for study admission
and the investigation of the influence of determinants (e.g., cognitive and non-cognitive factors) on academic success have appeared to be separate research topics (Robbins, Lauver, Le, Davis, Langley & Carlstrom, 2004). The present thesis is particularly focused on both the predictive value of non-cognitive factors (personal characteristics, vocational interests, study expectations) for academic success in the medical study as well as on the fit between these non-cognitive factors and the working environment students aspire after graduation.

The Value of Non-Cognitive Factors in Medical Studies

Non-cognitive factors have been defined to refer to the ‘typical’ behavior of an individual by explaining this individual’s preferences and/or conduct in a specific situation (Mount, Barrick, Scullen, & Rounds, 2005). As such they provide additional information on the cognitive factors, which generate knowledge about an individual’s ‘maximal’ behavior in a performance situation (Ackerman, Chamorro-Premuzic, & Furnham, 2011; Goff & Ackerman, 1992). There is consensus that cognitive factors are the best predictors of academic achievement (Furnham, Chamorro-Premuzic, & McDougall, 2003; Lievens et al., 2009; Robbins et al., 2004). Cognitive factors indicate an individual’s intellectual ability, usually measured based on scores on intelligence tests and/or past academic achievement (Ackerman et al., 2011; Furnham et al., 2003; Robbins et al., 2004). Nevertheless, recent research has frequently suggested to also integrating non-cognitive factors into the admission processes (Kyllonen et al., 2005; Lievens et al., 2009; Monroe et al., 2013; Searle & McHarg, 2003). This proposition is motivated by the argument that the impact of cognitive factors seems to decrease in higher education (due to range restriction), whereas non-cognitive factors provide useful information about students’ study behaviors throughout all educational stages (Lievens et al., 2009; Robbins et al., 2004; Trapmann, Hell, Hirn, & Schuler, 2007). Moreover, another valuable contribution of non-cognitive factors is that they are amenable to change through suitable interventions (e.g., Robbins et al., 2004). For example, students with a low degree of self-efficacy may profit from cognitive-behavioral interventions (Bresó, Schaufeli, & Salanova, 2011). In general, personal characteristics can be considered as beneficial in that they provide study-relevant information which supplements the knowledge of the individuals’ cognitive abilities. This
information concerns students’ working behavior (e.g., hard work; time spent studying) that most likely has an influence on students at risk for performance difficulties.

The value of non-cognitive factors within the admission process depends on at least two conditions. First, they have to correlate with the desirable outcome variables. In higher education, there are traditionally two indicators of academic achievement, namely grades and highest level of educational attainment (Ackerman et al., 2011). Prior research has indicated that personal characteristics are significantly related to students’ study success (Lievens et al., 2009; Robbins et al., 2004; Trapmann et al., 2007). For example, students’ self-efficacy (e.g., confidence in their abilities) as well as their conscientiousness have been meaningful success predictors (Robbins et al., 2004; Trapmann et al., 2007). Second, it is argued that non-cognitive factors provide information in addition to that supplied by cognitive factors in predicting study success. Again, this seems to be the case. Prior research has shown that personality characteristics explain an additional amount of variance in students’ study success on top of the impact of the cognitive factors (Ferguson, James, O’Hehir, & Sanders, 2003; Robbins et al., 2004; Trapmann et al., 2007). The following Big Five personality traits have been identified: extraversion, neuroticism or emotional stability, agreeableness, conscientiousness, and openness, which are commonly agreed upon as the basic constructs for characterizing people (DeRaad & Schouwenburg, 1996; Kyllonen et al., 2005; Richardson, Bond, & Abraham, 2012). These traits consist of six facets that measure personality on a more specific level than the broader trait factors (McCrae & Costa, 1997). Research on the stability of the personality traits have shown that personality is a relative stable construct roughly until young adulthood (e.g., Caspi, Roberts, & Shiner, 2005; Conley, 1984; Costa, McCrae, & Holland, 1984). For example, Pullmann, Raudsepp and Allik (2006) reported in a longitudinal study that the individual-level of the personality traits does not differ remarkably between adolescents and young adults. Another important finding in this respect is that the link between personality traits and achievement measurements stays significant after controlling for ability differences (Caspi et al., 2005). This taken together with findings that personality characteristics correlate with achievement measurements makes it feasible to use personality characteristics as predictors for study success. As already indicated, although the predictive validity of cognitive factors for academic achievement has been well confirmed (explained amount of variance around 25% within a university setting), there is still an additional amount of variance that needs to be
explained (Robbins et al., 2004; Trapmann et al., 2007). One of the most promising personality factors to explain this variance has been shown to be conscientiousness (Robbins et al., 2004; Trapmann et al., 2007). The contribution of conscientiousness has often been discussed in terms of factors such as motivation, the will to achieve, and self-control, which seem to become more important in higher education (Busato, Prins, Elshout, & Hamaker, 2000; O’Connor & Paunonen, 2007).

As aforementioned, the decision to study medicine involves the vocational choice of a certain work environment. However, studies have shown that applicants are not being informed adequately enough about this issue before the study of their choice starts (Marley & Carman, 1999). And this situation does not seem to improve much during the course of the study, since a substantial number of medical students (around 20%) have remained undecided about their further careers during their programs (Guntern, Korpershoek, & van der Werf, 2015; Kassebaum & Szenas, 1995). This may be caused by the fact that these students did not sufficiently think through their study choice prior to the admission process. Major reasons for wanting to study medicine are the wish to help others and the intellectual challenge (Farrokhi-Khajeh-Pasha, Nedjat, Mohammadi, Rad, & Majdzadeh, 2014; McHugh, Corrigan, Sheikh, Lehane, Broe, & Hill, 2011). In addition, applicants have mentioned promising career perspectives (e.g., earning a lot of money, low risk of unemployment), the encouragement of significant others (family member, relatives and close friends) and having received good high school grades (Draper & Louw, 2007; Farrokhi-Khajeh-Pasha et al., 2014; Marley & Carman, 1999). It is therefore essential that applicants are provided with objective and reliable information about the work environments of physicians already at the time of their study choice.

Nonetheless, choosing a medical specialty after university graduation is known to be demanding. And the fact that there is little information available to distinguish among the different work environments does not make it any easier. Iserson (2003) has argued that medicine offers “more options for its practitioners than any other profession” (as cited in Stratton, Witzke, Elam, & Cheever, 2005, p. 36). So far, however, previous research (Borges & Savickas, 2002; Borges et al., 2004; Elam, 1994; Taber et al., 2011) has mainly focused on the description of patient-oriented (e.g., family medicine) versus technique-oriented specialties (e.g., surgery). Patient-oriented specialties involve the interaction with patients, while more technique-oriented specialties concentrate on particular areas of the
body and the use of technical skills and instruments (Yufit, Pollock, & Wasserman, 1969). In this context, it was found that physicians working in more patient-oriented specialties have higher scores on social aspects, whereas the physicians in technique-oriented specialties are more interested in realistic aspects (Borges et al., 2004). A third type of work environment for physicians is research, which involves non-clinical activities such as teaching and administration (Yufit et al., 1969). Not having enough information available to be able to distinguish among all of these options at the time of the study decision may well explain the inadequate insight that graduates have into their actual career preferences.

**Research Topics**

The overall goal of this thesis has been to explore the relevance of non-cognitive factors (personal characteristics, vocational interests, study expectations) within the medical program. Obviously, applicants should be supported in their study decision whether the program of their choice is the ‘right’ one for them. In this light, additional knowledge about the impact of personality characteristics and self-efficacy on the academic achievement of students on top of their prior performance is crucial. As previously mentioned, the added value of non-cognitive factors in the admission procedure depends on the associations between the non-cognitive factors with the desirable outcome variables and the amount of additional information provided by these factors on top of cognitive factors. Additionally, during their medical program, students have to choose between a particular specialty and a non-clinical profession. This decision seems to be one of the most difficult decisions after entering medical school (Kassamali, Gill, Murphy, Cheetham, & Ali, 2013). Therefore, more research is needed to better understand factors influencing medical students’ further career decisions and to be better able to advise them in this respect (Kassamali et al., 2013). So far, relatively little is known about the association between students’ vocational interests and their aspired career choices. Although there is a large amount of medical specialties and subspecialties, for research purposes the work settings investigated are usually based on the classification of patient-oriented versus technique-oriented specialties (Borges et al., 2004; Taber et al., 2011). The contribution of this thesis to the prior research is that it presents a finer-tuned approach to taking the clinical specialties (family doctor, specialist working in a private practice, and specialist working in a hospital), the non-clinical professions
(scientific researcher) and a medically related job (dentist) into account. Furthermore, the present thesis has aimed to characterize the pool of medical applicants by focusing on both their scores on interest variables and personal characteristics. Another focus has been to examine if applicants’ study expectations match the medical students’ actual perceptions of the study environment.

The thesis research is based on five samples from Switzerland and Austria, two containing medical applicants (Sample 1: $N = 5607$ with 63% female and 37% male applicants; Sample 2: $N = 1899$ with 63% female and 37% male applicants) and three containing medical students in their pre-clinical years (Sample 1: 863 with 54% female and 46% male; Sample 2: 788 with 55% female and 45% male; Sample 3: 347 with 56% female and 44% male). The admission procedures in these countries were as follows: 1. High school graduates applied for the medical program, 2. Applicants were informed about the self-administrated assessment (participation on voluntary basis), 3. Applicants received feedback about their non-cognitive measurement scores and 4. Applicants had to participate in a selective ability test in order to get study permission. A broad range of variables were taken into account to address the research topics. The scales included in the personality assessment were self-discipline, emotional stability and social activity (based on the Five Factor Model of Personality) with the addition of self-efficacy; social, investigative, artistic, realistic, enterprising and conventional interests for the interests assessment (based on the RIASEC model of Holland, 1996, 1997), and the addition of prestige associated with the various work environments (referred to as prestige); practical focus of the studies, workload, learning strategies and study demands for the expectation questionnaire.

In the next section, the theory of vocational choice will be briefly explained (Holland, 1959). Holland’s theory, which states that individuals typically search for environments that allow them to satisfy their interests, has been well investigated and often used in the analysis of individuals’ work choices (Gottfredson, 1999; Holland, 1959, 1996, 1997). Holland’s theory has also provided a useful framework for the investigation of this thesis’ research topics, in particular for the exploration of students’ aspired work environments. Subsequently, the aims and the research questions of this thesis are explained in further detail.
Holland’s Theory of Vocational Choice

The theoretical background of this thesis is based on Holland’s theory of vocational choice (Holland, 1959). This theory provides a theoretical framework for counseling individuals in their vocational choices and predicting their work performance and satisfaction once they have chosen a certain work environment. The theory assumes that individuals are the product of the interaction with their environment, including peers, parents and significant others. While interacting with others, an individual “develops a hierarchy of habitual or preferred methods for dealing with environmental tasks” (Holland, 1959, p. 35). Furthermore, an individual searches for an occupational environment that enables him/her to satisfy his/her hierarchy of orientations. According to the theory, individuals and environments can be described via six orientations or (personality) types (Holland, 1996, 1997). These orientations include the individuals’ interests and values as well as their styles of interaction, such as preferences in these respects or tendencies to avoid interaction with others. At the same time, the professional occupations can be also categorized based on these orientations. Next, we present a short description of the categories (of individuals), often referred to as the RIASEC types (Holland, 1996, 1997). A more comprehensive description of these types is provided in the subsequent Chapters.

- **Realistic type**: works in a realistic environment, likes to manipulate things. This individual tends to avoid the interaction with others.
- **Investigative type**: enjoys to explore and understand scientific phenomena. This individual does not like to sale his/her activities. He/she is more interested in developing new knowledge.
- **Artistic type**: has a dominant artistic orientation with a high interest in creative activities. He/she is more open-minded than the other types and dislikes routines.
- **Social type**: is strongly motivated to help, teach and counsel other people. This type considers itself as empathic and having interpersonal skills. This individual is not interested in mechanical and technical activities.
- **Enterprising type**: likes to persuade others and tends to avoid scientific topics.
- **Conventional type**: tries to establish and maintain routines. This individual dislikes ambiguous and unstructured activities.
Holland (1959, 1996, 1997) outlined several assumptions regarding the interaction among individuals and their vocational choice. In general, the theory assumes that individuals with accurate self-knowledge are more capable of making adequate vocational choices than people with less self-knowledge. “Self-knowledge is defined as a person’s ability to make discriminations among potentials environments in terms of this own attributes” (Holland, 1959, p. 40). Thus, individuals with better knowledge of the different environments are better able to opt for a setting that is in line with their (personality) type. According to Holland’s theory, an individual’s career is more stable if he/she works in an environment that suits his/her personality type. Furthermore, if this is the case, this individual is assumed to perform better and be more satisfied with his/her career choices. More information about the theory of Holland and the study results on the congruence between the characterization of individuals and occupational environments are presented in the corresponding Chapters.

**Aims of This Thesis**

The first aim of this thesis has been to find out more about the composition of the pool of applicants for the medical studies with regard to applicants’ vocational interests (social, investigative, artistic, conventional, enterprising, realistic), their interest in prestigious professions and their personal characteristics (self-discipline, self-efficacy, social activity). Due to the fact that the medical programs offer a broad spectrum of education, combining the acquirement of a scientific knowledge base with the practical application of this knowledge, our initial pool of applicants was supposed to be relatively heterogeneous (Stratton et al., 2005). Nevertheless, in Switzerland and Austria a substantial number of applicants withdrew early in the admission process without participating in the selective performance test. The quality of the selection process, however, depends for a considerable part on a sufficiently motivated pool of applicants (Benbassat & Baumal, 2007). Apart from motivation, another aspect that has an influence on applicants’ prospective study behavior is study expectation (Draper & Louw, 2007; Pike, 2006). If the expectations regarding the study are not accurate, students may become disappointed and, in the worst case, drop-out of their medical program. Therefore, we argued that broadening our knowledge of the initial group of applicants may, in a subsequent step, enable medical programs to prevent
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potentially suitable applicants from dropping out early in the admission process. The specific research questions related to this first objective are the following:

1. To what extent can subgroups of medical applicants be distinguished based upon their personal characteristics, vocational interests and level of prestige?
2. To what extent do medical applicants’ study expectations differ from medical students’ study experiences?

The second aim of this thesis has been to examine the impact of personality characteristics and self-efficacy as predictors of students’ academic achievement on top of their prior performance. Earlier prediction models are typically focused on the personality variables as derived from the Five Factory Model of Personality (Ferguson et al., 2003; Lievens, Coetsier, De Fruyt, & Maeseneer, 2002; Lievens et al., 2009). The current thesis expands these earlier models by including self-efficacy as additional predictor for students’ academic achievement. The inclusion of self-efficacy rendered it possible to take students’ belief in their own abilities into account. As Bandura (1982) has argued, “perceived self-efficacy is concerned with judgements of how well one can execute courses of action required to deal with prospective situation” (p. 122). Furthermore, self-efficacy was shown to be valuable in helping students with performance difficulties (Bresó et al., 2011). Another expansion of earlier prediction models has been to include students’ pre-university performance to obtain information on the additional amount of variance explained by the personal characteristics. The research question in this context is:

3. Do personality characteristics and self-efficacy explain an additional amount of variance in medical students’ academic achievement on top of prior performance?

The third aim of this thesis has been to investigate the relative impact of students’ vocational interests and their views regarding prestige on their aspired work environments. We added to Holland’s model by including prestige as predictor variable into the RIASEC scales. The rationale behind this inclusion is that prestige has been considered as an influential factor in individuals’ career decision-making process (Gottfredson, 1996). Moreover, medical professions have been regarded to be highly prestigious (Furnham et al.,
1981; Rosoff & Leone, 1991), whereas medical specialties differ with respect to the connected levels of prestige (Creed, Searle, & Rogers, 2010; Taber et al., 2011). More specifically, we formulated the following research question:

4. Within the medical discipline, to what extent are students’ vocational interests and their preference for a prestigious career related to their aspired work environment?

**Outline of This Thesis**

Including the introduction, this thesis contains six Chapters.

Chapter two explores the pool of medical applicants. Personal characteristics, vocational interests and level of prestige are used to identify medical applicant subgroups. Subsequently, the identified subgroups are related to the applicants’ high school performance, study choice certainty and aspired work environment to gain more insight into their career conceptions.

The intention of Chapter three was to find out more about the applicants’ study expectations. Based on qualitative online interviews with medical students, lecturers and physicians the following topics were mentioned as possible areas of misconception: the practical focus of the studies, the workload, the learning strategies and the study demands. The link to the theory of Holland (1959, 1996, 1997) is such that expectations, which are based on an individual’s prior experiences, may have an influence on the work environment selected.

Chapter four and five investigate the medical student samples. Chapter four studies the impact of students’ self-discipline, social activity, emotional stability and self-efficacy on their academic achievements in addition to the influence of their pre-university performance. Selection of the personal characteristics was based on prior studies which have shown the impact of these variables (Lievens et al., 2009; Robbins et al., 2004; Trapmann et al., 2007). Here the benefits of the selected non-cognitive factors over students’ cognitive abilities are discussed in terms of support programs for students with performing difficulties.

Finally, Chapter five examines the relative impact of vocational interests and the level of prestige on students’ aspired work environments. These work environments include the options family doctor, specialist working in a private practice, specialist working in a
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hospital, scientific researcher, and dentist. In addition, a category for undecided students was added. Among other benefits, this study provides information about the perceived value of prestige within the medical context in general, and in the different medical work environments in particular.

The last Chapter presents a summary of the main results and offers an overall conclusion. Next, suggestions for further research and implications for theory development are made. The thesis ends with implications for practice such as the development of a self-administered assessment.