THE CAREER CHOICE OF STEM STUDENTS: A PROFESSIONAL IDENTITY APPROACH

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1 Introduction

In the Netherlands, the technical sector is responsible for one fifth of all employment and two third of all export (Volkerink, Berkhout, Bisschop, & Heyma, 2013). Therefore, highly educated science, technology, engineering and mathematics (STEM) students build the foundation for economic success. Hence, it is important for the Netherlands to continuously develop technical talents to survive on the global market. In recent years, the number of university students that graduated in technical programs increased. Nevertheless, recent reports show that about 50% of highly educated graduates from STEM study programs end up working outside the technical sector (Berkhout, Bisschop, & Volkerink, 2013; Chen, 2013). This is quite remarkable considering that unemployment rates are very low in the technical sector (Rijksoverheid, 2014). Thus, there are many opportunities for graduates from STEM study programs to find a job in the technical sector, but still relatively few of them are interested in these vacancies. Reasons for the high percentage of engineers who do not opt for a career in the technical sector are thus far unclear.

Professional identity (PI) describes individuals' perception of their relevant traits with regard to their occupation (Beijaard, Meijer, & Verloop, 2004) and has been shown to directly influence people's career choices (J. Y. Hong, 2010). For example, research among teachers suggests that a well-established and strong PI decreases the chances of them leaving their sector (Canrinus, Helms-Lorenz, Beijaard, Buitink, & Hofman, 2012). Similarly, J. Y. Hong (2010) shows that teachers who leave their profession score significantly lower on all facets of PI than their peers in the profession.

Therefore, the question rises what makes that STEM students, who chose for a technical study program after high school, decide to continue on a career path outside the technical sector after graduation? When deciding upon a career it is important that students identify sufficiently with their future profession. Students compare themselves to others in their field of work and search for similarities and differences to determine the degree of fit between their traits and that of others in the profession. It is for that reason that stereotypes - the image of traits that are widely perceived to be typical for members of a profession - have a big influence on the sense of belonging students feel in a profession. Prevailing stereotypes about people in the technical sector concern their gender (mostly male; e.g. Good, Rattan, & Dweck, 2012), race (mostly White or Asian; Carlone & Johnson, 2007), personality (being a loner; Rommes, Van Gorp, Delwel, & Emons, 2010), interests, (computers and gaming; Kendall, 2011), and intelligence (i.e. high levels of intelligence; e.g. Hong & Lin-Siegler, 2012) and research indicates that students who do not identify with the stereotypical features of their future profession are less likely to enter a career path in the technical field (e.g. Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). However, providing students with role models that do not fit typical stereotypes about professionals in the technical sector increases students' sense of belonging in and self-efficacy of succeeding in a technical study program (Shin, Levy, & London, 2016). Likewise, interaction of female STEM students with female role models has been shown to improve students' performance in class, identification with the STEM field and intention to pursue a career in STEM after graduation (Stout, Dasgupta, Hunsinger, & McManus, 2011). Thus, a broader image of what a career in STEM entails and who these professionals in the STEM field are (their PI) might encourage more students to enter a career in a technical field.

Unfortunately, as of yet, little is known about the PI of STEM students and professionals. While there is much research on professionals in the medical or educational field, such as doctors (e.g. Beaulieu, Rioux, Rocher, Samson & Boucher, 2008; Pratt, Rockmann & Kaufmann, 2006) and teachers (e.g. Hong, 2010; O'Connor, 2008), the PI of STEM is relatively under-researched.

Therefore, the goal of this study is to explore the variations in STEM students' PI and how this is related to their career choices.

1.1 Professional identity

Professional identity (PI) has been defined as a persons' self-concept with regards to their profession (Ibarra, 1999) and gives answer to the question "Who am I as a professional?". Within research on PI, different scholars disagree to which extent PI is personal, social or both. Those focusing on social aspects, define PI as "*the degree to which employees identify themselves with the profession that they practice and its typical characteristics*" (Bartels, Peters, de Jong, Pruyn & van der Molen, 2010, p.211). A focus on what professionals have in common as a group often results in the development of stereotypes, a combined view people hold about typical traits and behaviors of a profession. For example, when defining professional identity as a social entity, one might argue that a STEM student is typically a quiet person who gets very excited about natural sciences. Supporters of the social view on PI argue, in line with social identity theory, that the development of a PI is an ongoing socialization process throughout which professionals are introduced to and integrate stereotypical traits of their profession into their PI.

Others, who focus on PI as an individual entity, define PI as "*the relatively stable and enduring constellation of attributes, beliefs, values, motives and experiences in terms of which people define themselves in a professional role*" (Ibarra, 1999 p. 1). They argue that PI is the individual's view about their skills, beliefs and motives, unrelated to how others see them and their profession. Thus, taking a view that is more in line with the understanding of identity as a personal construct, such as Erikson (1950 in Schwartz, Luyckx, & Vignoles, 2011). Taken together, PI can be described as the identity of a person regarding their job or their career. Integrating prior theories on identity, a professional identity contains both a developmental aspect, as it is not stable but changes over time as one moves further in the career, a social aspect, as it is shaped in part by the people surrounding an individual and an educational aspect, as its development already starts in school (Crocetti, Avanzi, Hawk, Fraccaroli, & Meeus, 2014). Thus in this research PI will be defined as an ongoing process of integrating various identities regarding the roles a person takes on in a profession.

Yet, no matter whether PI is viewed as more social, more personal, or both, researchers agree that PI consists of two dimensions, namely *identity content* and *identity strength* (Schwartz et al., 2011). *Identity content* includes all the components (i.e., characteristics, behaviors, norms) that make up an individual's PI. In general, the content of PI has been thought to be made up of a persons' interests, values and abilities in their occupation (Kielfhofner, 2007, in Schwartz et al., 2011). In line with that, Ashforth, Harrison & Corley's (2008) framework on identity also indicates values, goals and abilities as important constituents of identity content, but adds a persons' beliefs and personality traits to that. For example, the prototypical content of the PI of an engineer may be "work on technical problems", "design machines" and "work autonomously". Identity strength refers to the degree to which individuals commit to these components (Ellemers, Kortekaas, & Ouwerkerk, 1999). In other words, identity strength describes the degree to which they perceive being an engineer as an important aspect of their self-concept.

While there is quite some literature on the strength of identification (e.g. Adams, Hean, Sturgis, & Clark, 2006; Kunnen, 2009), to date the content of PI, and the interrelatedness between content and strength has largely been ignored in research (Schwartz et al., 2011). Although in the framework of Ashforth et al's (2008) the interrelatedness is acknowledge, this has not yet been empirically tested. Therefore, in this research, a combination of two frameworks (Ashforth et al., 2008; Kielhofner, 2007 in Schwartz et al., 2011)) is used, whereby the content of PI is made up by four domains (interests, competences, values and goals, and personality), to systematically investigate various dimensions in the content and strength of STEM students' PI (see Figure 1).

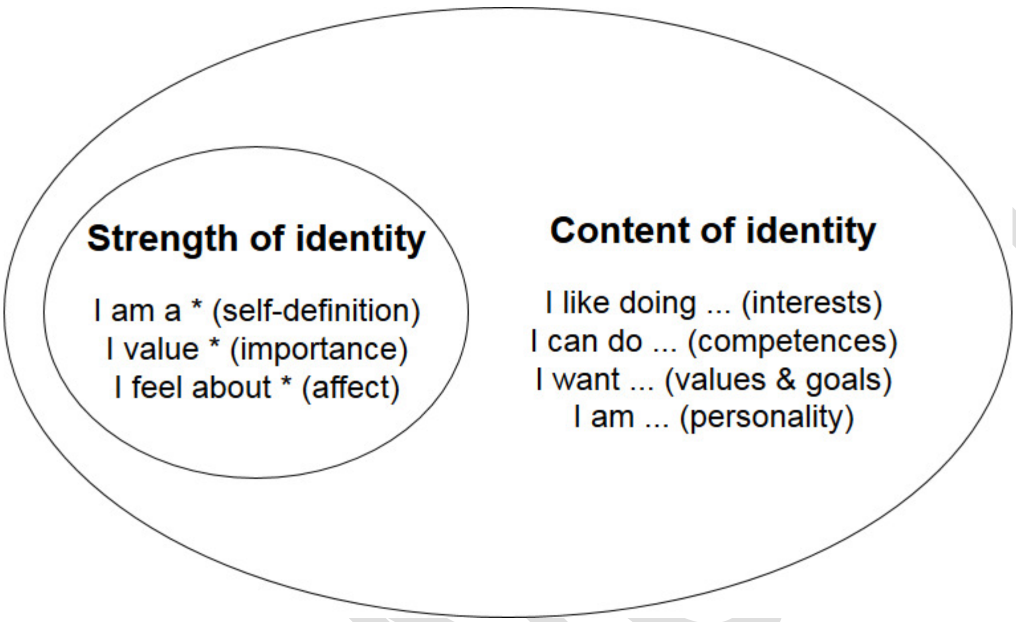

Figure 1: Model of identity adapted from Ashforth et al. (2008)

1.2 The Importance of PI for Career Choices

In recent years, research has shown that a clear and stable PI positively impacts personal, study, and career outcomes. For example, literature studies have shown that PI influences a persons' mental well-being (e.g. Schwartz et al., 2011). Moreover, empirical research shows that PI influences employees' self-efficacy, motivation, career choices and intention to leave a profession in various disciplines, from teachers (Canrinus et al., 2012), to IT specialists (Khapova, Arthur, Wilderom, & Svensson, 2007), and nurses (Sabanciogullari & Dogan, 2015). However, research on who leaves the technical sector often focuses on groups divided by gender or race (e.g.

Griffith, 2010) and little is known about how the content of PI influences STEM students' career choice.

The closer the match between a person's PI and the image they have of a profession or organization, the bigger the likelihood that they will commit and choose that profession or remain in it (Price, 2009). The same holds true for students, as research with high school students shows that a strong and stable PI, which is in line with perceived characteristics of a future profession, increases students' motivation to learn and the quality of their career choices (Meijers, Kuijpers, & Gundy, 2013). However, even students who do not share stereotypical attributes of STEM students (i.e., nerd, introverted) might still be well-suited to succeed in this field, because of other personal attributes (i.e., creativity, communication skills). Yet, as these more atypical students see little commonality between their PI and their future profession they decide not to enter the technical sector (Cheryan et al., 2011) or to leave the field (Beasley & Fischer, 2012). Therefore, our hypothesis is that the commitment or strength of identification will explain the relation between STEM students' professional identity content and their career choices.

Career choices are often not made over night. According to Marcia's (1966) widely acknowledged framework on identity development, besides committing to aspects of a person's identity, also *career exploration* is vital. Career exploration also has been shown to influence students' decision to pursue a career in the technical sector. Perez, Cromley, and Kaplan (2014) showed that students who score high on commitment, but low on exploration (i.e. students who do not have a well-informed definition of being an engineer) are more likely to quit their studies than their better-informed colleagues. On the other hand, exploration can also help to get committed to the future profession. Perez et al. showed that students who reflected more on their work values and interests and explored their career options more extensively prior to taking a STEM class felt higher levels of motivation to study, and valued their STEM major more than their less well informed colleagues. We therefore expect that especially for student with a less prototypical professional identity profile, career exploration will help them to get committed to their future profession (for example by finding alternative role models) or at least to get more clarity about a possible alternative career path. More prototypical STEM-students might easily commit themselves to the profession as they can identify strongly with the stereotypical profile, resulting in a clear image of their future career. We therefore also expect career exploration to mediating the relation between the content of the professional identity and the career clarity of STEM students.

1.3 Background characteristics influencing PI and career choices

Based on prior studies, we can assume that not only professional identity influences students' career choices, but also students' background characteristics. We will discuss the two most important ones here: gender and focus of the study program.

While women and men have been shown to have the same intrinsic aptitude for STEM studies (Spelke, 2005), gender has been shown to significantly influence students' decision to stay in a STEM class or higher education course. In addition, women have been shown to be six times more likely to leave the technical field compared to men (Mau, 2003 in Sadler, Sonnert, Hazari, & Tai, 2012). As discussed earlier, stereotypes and role models influence the degree to which students can identify with their future profession. As women are still underrepresented in the technical sector and especially in the Netherlands there are strong stereotypes regarding the gender of professionals in the technical sector as being predominantly male, it is expected that female STEM students will exhibit lower levels of strength of PI and more often opt for a career outside the technical sector. However, as of yet, no research investigates whether differences between genders with regard to the content of their PI exists and it is unknown whether female and male students have different profiles of PI content and to what extent this explains also gender differences in career choices of STEM students.

Besides gender, students also differ in the type of study program they follow. In the Netherlands, the level of education determines the breadth of jobs available to STEM students after graduation. While university of applied science (HBO) students are typically prepared for one specific job, university students (WO) are prepared for a broad range of functions in a field of technology. In addition, students at the university of applied science also have more opportunities to explore different career options as they have multiple internships during their study program, giving them the chance to develop a clear image of their future career. Also within these levels, the focus of STEM study programs differs. The Dutch education system distinguishes two types of technical study programs: Cluster I and Cluster II study programs. In cluster I study at least 75% of the courses are STEM-related courses, highlighting the main focus of these study programs on STEM. Cluster II study programs use science and technology to focus on topics outside the technical sector (Volkerink, Berkhout, & de Graaf, 2010) resulting in only 50-75% of the courses having a focus on STEM . For instance, the study program *electrical engineering* is a classical cluster I type of study program with mainly technical classes. On the other hand *industrial engineering and management*, as a cluster II study program, also contains a majority of technical classes, but non-technical topics problems form the basis for the courses (e.g. improving supply chain management with mathematical algorithms). Assuming that more focus in a study program leads to higher levels of career clarity and less career exploration, it is expected that Cluster II

STEM students have a clearer view on their career and explore their career opportunities less than their peers enrolled in a Cluster I study program.

1.4 The current study

While there is an abundant amount of empirical evidence showing the positive effects of a strongly developed PI on a person's career, researchers are less unified in *how* to investigate it. As PI is such a multifaceted concept, researchers are divided on how to measure PI in all its complexity (Schwartz et al. , 2011). The strength and content of PI are usually investigated in separate studies, with the strength mostly being measured in a quantitative manner (e.g. Ellemers et al., 1999), while the content is mainly measured in a qualitative manner (Izadinia, 2013). This makes it difficult to compare various studies, which in turn impedes developing a holistic framework for STEM students' PI. It is for that reason that this research aims at both developing a quantitative manner to measure STEM students' PI content and to combine that with measuring the strength with which they identify with their future profession. The current research aims at gaining new insights into STEM students' PI, both strength and content, and the relation between STEM students' personal characteristics, their PI and the career choices they are aiming for. Therefore, the aim of the research is to answer the following research questions:

RQ 1: How can variety in the PI of STEM students be described?

RQ 2: How is STEM students' content of PI related to their career choices and to what extent is this effect mediated by PI strength and career exploration?

RQ 3: What is the impact of STEM students' background characteristics (gender, level of education, and type of study) on their PI content, strength and career choices?

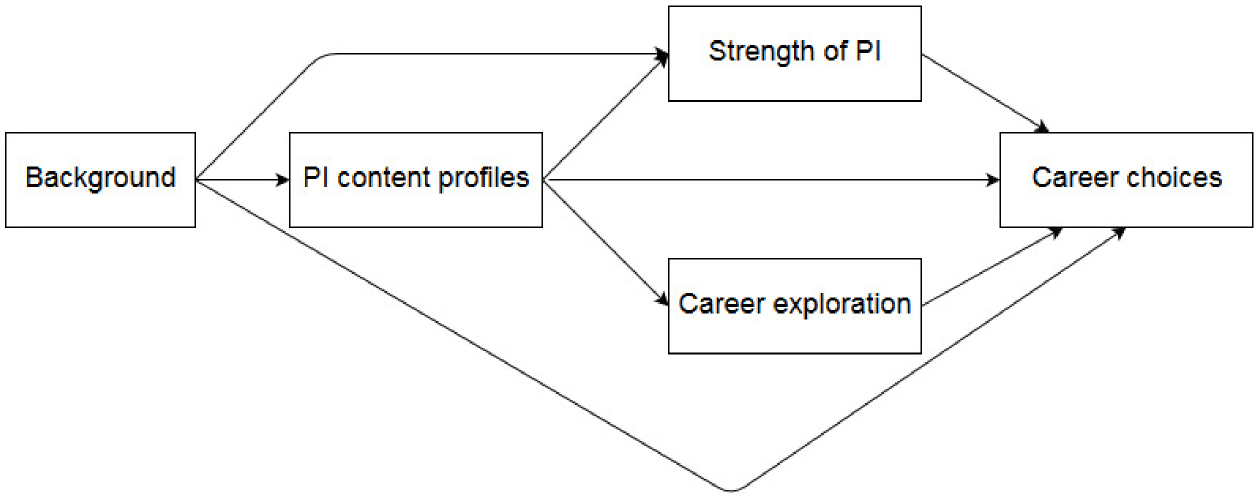

Figure 2. Research model

2 Method

2.1 Participants

Students from all technical study programs of two Dutch higher education institution, one university, one university of applied sciences, were invited to take part in the study. About 3500 students received an invitation via email by study advisor, including information about the option to participate in a draw for 10 vouchers with a total value of 200 euros upon completion of the survey. Based on these invitations, 816 students started to fill in the questionnaire (response rate of 23.3%). Students with more than 10% missing answers, as well as students who indicated they were enrolled in a non-technical study program were excluded from the data analysis. This resulted in the data of 743 students being included in the current study, however, due to the inclusion of students who had less than 10% of the questions left unanswered, the number of participants varies for each analysis. Of the participants, 34.2% were female and 59.0% male (6.9% did not indicate their gender). The average age was 22.66 years old (*SD* = 2.78). Of the participants, 367 (49.4%) attended a university, while 338 (45.5%) attended a university of applied sciences. Due to a technical difficulty, the level of education was not saved for 38 (5.1%) participants.

2.2 Measures

2.2.1 Professional identity content

To our knowledge, no instrument to measure the professional identity of STEM students was available at the beginning of the study. Therefore a new instrument, called the "Career Compass", was developed. Within the Career Compass preexisting, validated scales were used to measure the four dimensions of professional identity: interests (Hansen & Scullard, 2002), competences (Male, Bush, & Chapman, 2011; Passow, 2007), values and goals (Lyons, Higgins, & Duxbury, 2010; Roberts & Robins, 2000; Ros, Schwartz, & Surkiss, 1999; Sheldon, Elliot, Kim, & Kasser, 2001), and personality (Ashton & Lee, 2009; Ashton et al., 2004). To shorten the time it took participants to fill in the entire questionnaire, items were adapted in a way that they had a fixed part for the entire dimension and a flexible part which was unique per item. For example, all questions on the *interest* dimension of PI started with the fixed part "*I am interested in…*" and were followed by the flexible parts of items, such as "*partying*" or "*community involvement*". All items were measured via a 7 point Likert scale.

Scales were checked for overlap and items occurring on multiple scales were removed. Hereby the item was removed from the domain with a lower level of abstraction, assuming that the item with a higher level of abstraction would cover the item of the other domain. For example, the item *honesty* was removed from the value scale, as it was also a part of the personality scale and it was assumed that *honesty* as a personality trait would also cover *honesty* as a value of a person. This resulted in 178 items that were presented to the participants. Exploratory and confirmatory factor analysis were performed to ensure the quality of the developed instrument. After item reduction, the final questionnaire contained 92 items across 27 factors within the four dimensions of PI. Confirmatory factor analysis revealed sufficient model fit to indicate a reliable and valid questionnaire to measure PI content of STEM students.

Next to the professional identity content measures, additional scales and questions were added to the questionnaire to measure participants' demographics, strength of professional identity and intended career choice.

2.2.2 Strength of PI

The degree with which students identified with their future profession was measured with six items adapted from Ellemers et al. (1999), an example item being "*I feel good about becoming an engineer*" measured on a 7 point Likert scale.

2.2.3 Career choice

Career choice was measured in two ways: Intended career choice and career clarity. In order to determine students' intended career choice students were asked to name an organization they would like to work for in the future, in an open question in order to identify their intention to stay on or leave the technical sector. Their answers were coded as either technical or non-technical by two independent coders. Interrater reliability was tested and, with a Cohen's kappa of 0.684, found to be sufficient. Next to STEM students' intended career choice, it was analyzed to which degree students had a clear view of their future career (i.e. what type of work they wanted to do after graduation). This was assessed via four items adapted from Gupta, Chong, and Leong (2014) measured on a 7 point Likert scale. An example item is "*It is clear to me what I want to do for a living after I graduate*". Cronbach's alpha indicated sufficient scale reliability ($\alpha = 0.840$).

2.2.4 Career exploration

Whether students were actively exploring their career and opportunities was measured with three items, based on Meeus, Iedema, Helsen, and Vollebergh (1999). An example item is "*I often talk with other people about my career plans*". All items were measured on a 7 point Likert scale. Cronbach's alpha indicated sufficient scale reliability (α = 0.801).

2.2.5 Demographics

Students were asked about their gender, current level of education (university degree or university of applied sciences degree) and the name of their current study program. The latter was then categorized as a cluster I or cluster II study program, based on the information of study programs on the focus of courses in the study program as being predominantly technical or not.

2.3 Data analysis

2.3.1 Professional identity content profiles

In order to identify profiles of STEM students based on the content of their professional identity content, latent profile analysis (LPA) was performed. Latent profile analysis (LPA), also known as finite mixture modeling, is an analysis method to identify underlying clusters of individuals, based on continuous data. As such it is a person-centered approach, focusing on differences between people, rather than a variable-centered approach, such as factor analysis (Pastor, Barron, Miller, & Davis, 2007). This focus on communalities and differences between individuals is especially suited for the current research, as it identifies subgroups within a certain population and it is the goal to identify profiles of STEM students, based on the content of their PI. Thus LPA aims to detect patterns between STEM students' interests, competences, values and goals, and personality that result in a holistic view of PI profiles which could not be achieved by a variable-centered approach (Wang & Hanges, 2011). Within LPA, a differentiation between *level* and *shape* profiles can be made (Morin & Marsh, 2015). Level profiles describe the overall scoring pattern of an individual, as high, medium, or low on all measured indicators. These type of profiles are particularly suited to e.g. performance appraisal where the overall scoring tendency is of importance. Contrary, shape profiles show whether an individual scores high, medium, or low on singular indicators, thus giving a more detailed description of differences in STEM students' PI content. It is for that reason that in the current research the focus lies on shape profiles.

For the LPA, Mplus version 7.11 was used (Muthén & Muthén, 2012). LPA was performed with the standardized mean scores of the 27 factors established in the exploratory factor analyses Initially, LPA was performed for k=2 to k=6 clusters with maximum likelihood (ML) as estimator. Several model fit indices were analyzed to judge the quality of the models. First, two log-likelihood based model fit indices, the Lo-Mendell-Rubin likelihood test (LMR) and the bootstrapped likelihood ratio test (BLRT), were used. Both fit indices have been shown by Nylund, Asparouhov, and Muthén (2007) to very reliably compare the model fits of different numbers of clusters across various sample sizes. However, one drawback of these two model fit indices is their inability to make comparisons between models with different parameters (Pastor et al., 2007). Therefore, two Bayesian based model fit indices were chosen in addition: the Bayesian Information Criterion (BIC) and the adjusted Bayesian Information Criterion (adjBIC). Initial analysis of the k=2 to k=6 models delivered contradicting results. Model fit indices suggested conflicting best solutions, with the LMR suggesting a k=3 model solution and the Bayesian based model fit indices and the BLRT suggesting solutions with a much larger number of clusters (even larger than ten on further inspection). Upon further inspection of the k=3 model, the profiles distinguished between high, medium, and low scoring patterns of STEM students on all indicators, thus resulting in a *level* profile (Morin & Marsh, 2015). However, as discussed earlier, this research aims to identify *shape* PI content profiles. It was therefore decided that even though the LMR suggested a k=3 model, to continue research with the k=4 to k=6 models.

Due to the close relation of the four dimensions of PI, covariance was allowed between factors, to give a better representation of reality. Modification indices were analyzed for all models and for a set of variables with the average highest adjusted E.P.C. values across all clusters in a specific model, the covariance was not fixed to zero (Muthen & Muthen, 2012. Covariance between variables was freed one by one. As the log-likelohood based model fit indices were incapable of comparing models with different model parameters, in the subsequent model analyses, only the two selected Bayesian Information Criterion based model fit indices were used to determine the model fit.

Subsequently from each base model k=4 to k=6 the model with the lowest BIC and adjBIC scores were selected for further inspection and interpreted to develop meaningful PI content profiles. For that the mean z-scores per cluster were compared on all 27 variables that made up the PI content. The final model was chosen based on how well the data could be interpreted and to which degree the model was parsimonious, as a more parsimonious model is preferable to a less parsimonious model (Marsh, Lüdtke, Trautwein, & Morin, 2009).

2.3.2 Influence demographics on strength and content of PI and on career choice

In order to determine the degree to which gender, level of education and type of study program influenced STEM students' PI content profiles and their intended career choice, Pearson's chi-square analysis was performed. If significant, means analysis was used to further investigate differences between the PI content profiles, based on gender, level of education, and type of study program.

The influence of background characteristics of STEM students of the strength pf their PI, career clarity and career exploration was analyzed a series of one way independent analysis of variance (ANOVA). If significant differences in means between groups of STEM students were analyzed.

2.3.3 Influence PI content profiles on strength of identification with future profession

Univariate ANOVA was used to determine the degree to which the PI content profiles influence STEM students' identification with their future profession. Means were analyzed to determine differences between groups of STEM students with various PI content profiles.

2.3.4 Influence PI content profiles on intended career choice

In order to determine the degree to which gender, level of education and type of study program influenced STEM students' PI content profiles, Pearson's chi-square analysis was performed. Means analysis was used to further investigate how STEM students intended career choice differed based on their PI content profile.

2.3.5 Mediating effect of career clarity and career exploration on the relationship between content of PI and the strength of PI

To test the relationship between PI content profiles and either career clarity or career exploration and the mediating effect of STEM students' strength of PI in that relationship, a mediation analysis was performed. As the STEM students content of PI is a multicategorical variable, Heyes and Preacher's (2014) approach to multicategorical mediation analysis was applied. For that, k-1 dummie variables are constructed with the remaining variable being the base line for comparison. In this research, the PI content profile of the loner is used as the contrast variable. Relative indirect, relative direct and direct effects are then calculated for all dummie variables, relative to the contrast variable. The analysis was performed using the syntax provided by Preacher and Hayes (2014) for mediation analysis with a multicategorical variable using SPSS with the PROCESS. To test the mediating effect, regression analysis was performed.

3 Results

3.1 Professional identity content profiles

In order to identify subgroups of STEM students, based on the content of their professional identity, latent profile analysis (LPA) was performed. The three final models that were analyzed were models 4C, 5C, and 6C with each three covariates freed (for more information on the model selection process see method section). Means plots for all three models were analyzed to identify the most parsimonious model that could best be interpreted in the formation of meaningful profiles. The model that was deemed most suitable to reflect STEM students' PI content was model 5C. Looking at the mean z-scores of the different profiles, the following five profiles of STEM students, based on the content of their PI were identified: the *loner* (n = 68, 9.2%), the *security seeker* (n = 102, 13.7%), the *researcher* (n = 274, 36.9%) , the *all-rounder* (n = 151, 20.3%), and the *status seeker* (n = 148, 19.9%). *Loners* score relatively high on the personality traits of being open-minded, emotional and honest and humble, but low on extraversion and conscientiousness. They show little interests in activities other than gaming, particularly on social, community involvement, and fashion related activities. Looking at the values and goals, *loners* score low on almost all factors, with the exception of slightly above average z-scores for purpose and comfort. They score particularly low on power, physical health, family, money and benevolence. Finally, *loners* judge themselves below average on all competencies, scoring especially low on management, team, self-management and international orientation related competences. The second profile established are *security seekers*. These STEM students are highly emotional and disagreeable. They are very interested in fashion and beauty activities, show relative to their peers, very low interest in gaming and community involvement. *Security seekers* value routine and structure, family, and having a purpose, but are less invested in intellectual stimulation than their peers. They do not judge themselves to above average competencies, and score particularly low on research and analytical related competences. The third profile, called *researchers*, distinguish themselves by scoring low on being open-minded , extraversion and conscientiousness. Their only interest above average lies in gaming activities, while they score low on fashion and social activities. They score around or below average for all values and goals factors, with particularly low scores on autonomy, purpose and power. Looking at the competences, *researcher* STEM students score above average on only one competence, namely research and score low on competences such as management, international orientation skills, and self-management. The fourth type of profile established are *all-rounders*. Students in this profile score above average on all factor that were used to measure the content of PI. They score particularly high on being open-minded, emotional, agreeable and conscientious. They are mostly interested in fashion, but also in outdoors, community involvement and social activities. *All-rounders* especially value purpose, benevolence, family, autonomy, physical health, and intellectual stimulation. With regards to competences they indicate especially high levels for design, teamwork, and management. The final profile established is termed the *status seekers*. STEM students in this profile are very extravert, but score low on emotionality, honesty-humility, and agreeableness. *Status seekers* are above average interested in social and community involvement activities. With regards to their values and goals, they score highest on power and status, intellectual stimulation and money, but lowest on routine and structure, family, a purpose in life, and comfort. They judge themselves to be very competent in managing, having an international orientation, being analytical and working in teams. See Figure 3 for more information on the PI content of STEM students.

3.2 Influence of demographics on professional identity

Pearson's Chi-square analysis revealed a significant influence of all three of STEM students' demographical characteristics on their PI content profile: gender ($X^2(4)= 169.591$, $p=0.000$), level of education ($X^2(4)= 100.670$, $p=0.000$), and type of study ($X^2(4)= 63.349$, $p=0.000$). Looking at the distribution of profiles by gender, men are more likely than women to fit in the *researcher* or *status seeker* profile, while women were more likely to be a *security seeker*, *all-rounder* or *loner*. Comparing university with university of applied sciences students, university students were more likely to be *researcher* or *status seeker*, while their peers from a university of applied sciences were more likely to be *loners*, *security seekers* or *all-rounders*. Finally, comparing students in a cluster I study program with those enrolled in a cluster II study program, cluster I STEM students are more likely to be in a *researcher* profile, while cluster II STEM students are more likely to fit a *security seeker* or *all-rounder* profile (little difference for *loners* and *status seekers*). For more details see Table 1.

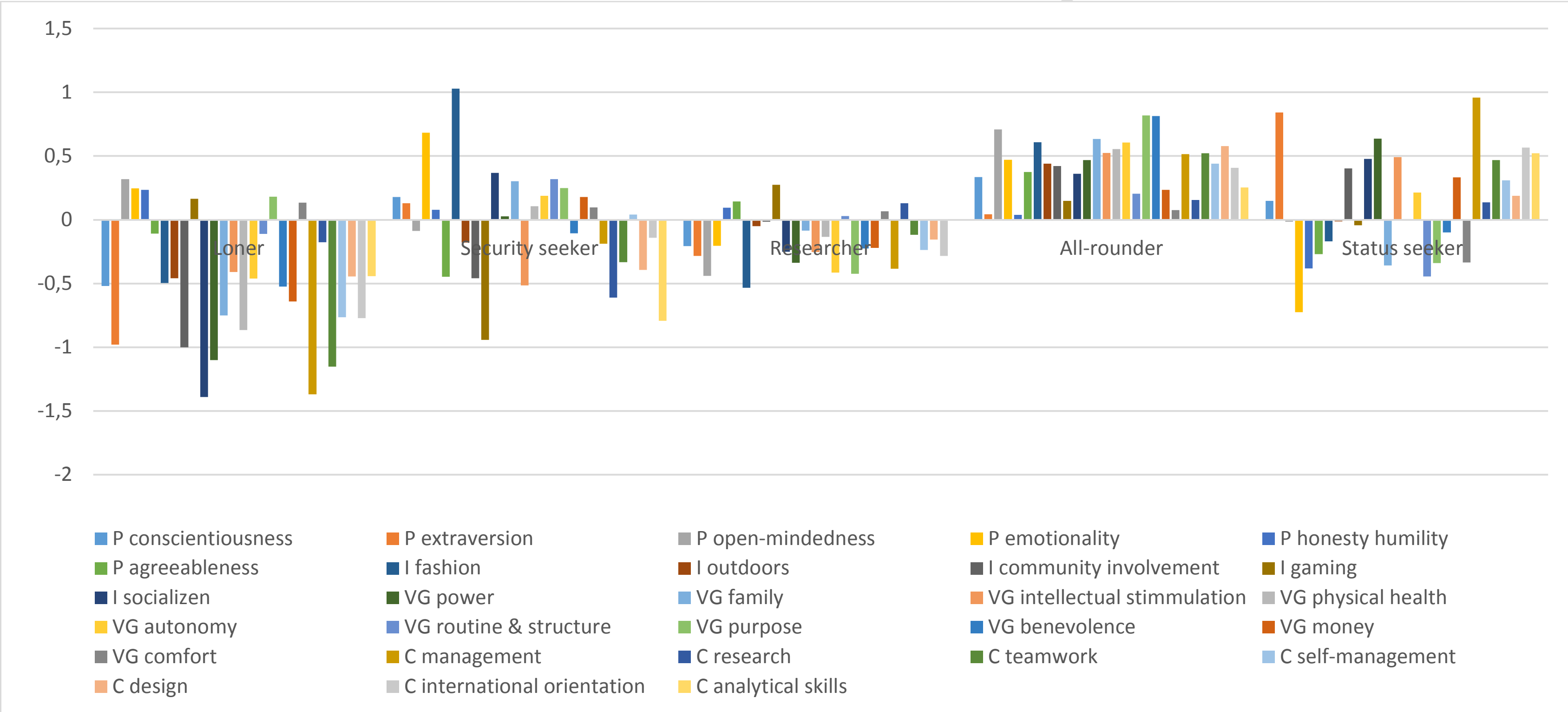

Figure 3: Z-scores of PI content profiles.

Relating STEM students' background statistics with their strength of identification with their future profession via a series of independent ANOVAs revealed significant differences between STEM students, depending on their gender ($F(1, 690) = 22.014$, $p = 0.00$), level of education ($F(1, 703) = 29.383$, $p = 0.00$) and type of study program ($F(1, 728) = 33.888$, $p = 0.00$). Looking at the means revealed that female STEM students showed lower levels of identification ($M = 4.454$, $SD = 1.147$) than their male peers ($M = 4.851$, $SD = 1.028$), university students ($M = 4.906$, $SD = 0.998$) scored higher than university of applied science students ($M = 4.468$, $SD = 1.145$), and students enrolled in a Cluster I study program ($M = 4.994$, $SD = 0.958$) scored higher than their peers enrolled in a Cluster II study program ($M = 4.533$, $SD = 1.108$).

3.3 Influence PI content profiles on strength of identification with future profession

Univariate analysis of variance shows a significant effect of STEM students' PI content profiles on the strength with which they identify with their future profession. $F(4, 738)=16.33$, $p=0.00$. Analysis of means reveals that STEM students in the *researcher* profile have the highest level of identification with their profession ($M = 4.975$, $SD = 0.936$), followed by *all-rounders* ($M = 4.863$, $SD = 1.060$) and *status seekers* ($M = 4.688$, $SD = 1.086$). STEM students that are identified as *security seekers* ($M = 4.145$, $SD = 1.087$) or *loners* ($M = 4.194$, $SD = 1.231$) show much lower levels of identification.

3.4 Professional identity in relation to intended career choice

Pearson’s Chi-square analysis revealed a significant influence of PI content profiles on STEM students’ intended career choice ($X^2(4)= 51.468$, $p=0.000$). Comparing the intended career choice of STEM students between the various profiles showed that STEM students in the *researcher* profile were most likely to aim for a career within the technical sector (64.4%), while students in either the *loner*, *status seeker* or *all-rounder* profiles were nearly equally intent on pursuing a career within as outside the technical sector (56.1%, 52.0%, and 45.7% respectively indicating an intention to work in the technical sector). STEM students least likely to pursue a career in a technical organization were *security seekers* as only 19.8% intended to work for a technical organization. See Table 2 for an overview of the results.

Table 1

Background characteristics and PI content profiles

	Overall	Gender		Level of education		Type of study program	
Profiles		Men	Women	University	University of applied sciences	Cluster I	Cluster II
Loner	68 (9.2%)	39 (8.9%)	26 (10.2%)	28 (7.6%)	39 (11.5%)	26 (8.9%)	40 (9.2%)
Security seeker	102 (13.7%)	13 (3.0%)	85 (33.5%)	19 (5.2%)	82 (24.3%)	16 (5.5%)	86 (19.7%)
Researcher	274 (36.9%)	205 (46.8%)	45 (17.7%)	176 (48.0%)	76 (22.5%)	153 (52.2%)	116 (26.6%)
All-rounder	151 (20.3%)	73 (16.7%)	71 (28.0%)	55 (15.0%)	92 (27.2%)	42 (14.3%)	106 (24.3%)
Status seeker	148 (19.9%)	108 (24.7%)	27 (10.6%)	89 (24.3%)	49 (14.5%)	56 (19.1%)	88 (20.2%)
Total	**743 (100%)**	**438 (100%)**	**254 (100%)**	**367 (100%)**	**338 (100%)**	**293 (100%)**	**436 (100%)**

3.5 Professional identity in relation to career clarity

Looking at how STEM students differ in the degree to which they have a clear image of their career, demographics and PI content profile influence STEM students career clarity.

Results of a series of ANOVAs revealed no significant differences between male and female STEM students with regards to the clarity of their intended career ($F(1,690) = 1.006$, $p = 0.316$). However, comparing STEM students enrolled at a university or a university of applied sciences, significant differences were found with $F(1, 698) = 25.898$, $p = 0.00$. Finally, ANOVA revealed significant differences between the career clarity of STEM students enrolled in a Cluster I and in a Cluster II study program ($F(1,722) = 11.878$, $p = 0.001$). For more information see Table 2.

Table 2

PI content profiles and intended career choice

PI content profile	Intended career choice: inside technical sector	Intended career choice: outside technical sector	Total
Loner	23 (56.1%)	18 (43.9%)	41 (100%)
Security seeker	17 (19.8%)	69 (80.2%)	86 (100%)
Researcher	143 (64.4%)	79 (35.6%)	222 (100%)
All-rounder	58 (45.7%)	69 (54.3%)	127 (100%)
Status seeker	66 (52.0%)	61 (48.0%)	127 (100%)
Total	307 (50.9%)	296 (49.1%)	603 (100%)

In order to test how the PI content of STEM students influence their career clarity and to what degree that relationship is influenced by STEM students' strength of PI, mediation analyses was performed, based on Preacher and Hayes' (2014) approach to mediation analysis with a multicategorical independent variable (see Figure 4).

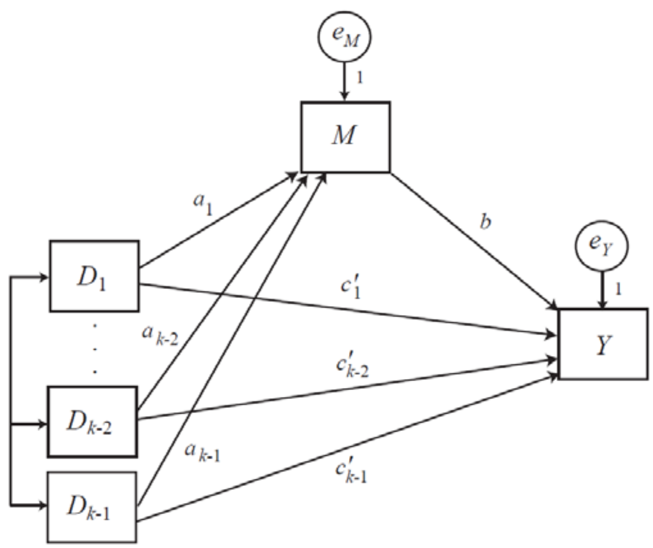

Figure 4: Multicategorical mediation model (Hayes & Preacher, 2014)

Results show that the relationship between STEM students PI content profiles and their career clarity is mediated to some extent by STEM students' strength of PI (b = 0.178, $t(733)$ = 3.981, p = 0.000). Looking at the results of the individual PI content profiles and applying Zhao, Lynch, and Chen's (2010) categorization mediation effects, differences between the mediation of strength of PI for the various PI content profiles become clear. First, relative to the control PI content profile of the *loner*, there is a direct only mediation from the *security seeker* profile to career clarity, as a_1 * b is significant and c is non-significant. Second, indirect only mediation from the *researcher* profile to career clarity is indicated, as a_2 * b is non-significant and c is significant. Finally, complementary mediation is established for both the *all-rounder* and the *status seeker* profiles on career clarity as both $a_{3/4}$ * b is significant and c is significant with all effects being positive (see Table 3).

Table 3

Mediation effect of strength of PI on the relationship of PI content and career clarity

	M		Y			
	Coefficiant (SE)		Coefficiant (SE)		Coefficiant (SE)	
Constant	i_1	4.194**	i_3	3.646**	i_2	2.898**
D_1 security seeker	a_1	-0.047	c_1	0.708**	c'_1	0.717**
D_2 researcher	a_2	0.769**	c_2	0.360*	c'_2	0.223
D_3 all-rounder	a_3	0.688**	c_3	0.998**	c'_3	0.875**
D_4 status seeker	a_4	0.489*	c_4	0.975**	c'_4	0.888**
b	0.178**					
t	3.981					
R2	0.067					
F	13.878					

*p < .05, ** p<.001

Similarly, it was tested to what degree career exploration mediates the relationship of STEM students' PI content profiles on their career clarity. Results revealed a mediating effect of career exploration (b = 0.356, t(732) = 9.104, p = 0.000). Looking at the individual PI content profiles, the mediating effect of career exploration can be categorized based on Zhao et al. (2010) as indirect only mediation for the security seeker and researcher profiles and complementary mediation for the all-rounder and status seeker profiles (see Table 4).

Table 4

Mediation effect of career exploration on the relationship of PI content and career clarity

	M		Y			
	Coefficient (SE)		Coefficient (SE)		Coefficient (SE)	
Constant	i_1	3.746**	i_3	3.646**	i_2	2.312**
D_1 security seeker	a_1	1.399**	c_1	0.708**	c'_1	0.211
D_2 researcher	a_2	0.505*	c_2	0.360*	c'_2	0.180
D_3 all-rounder	a_3	1.520**	c_3	0.998**	c'_3	0.457*
D_4 status seeker	a_4	1.646**	c_4	0.975**	c'_4	0.389*
b		0.356**				
t		9.104				
R2		0.162				
F		28.244				

$^*p < .05$, ** p<.001

4 Discussion

The current research focused on three main topics related to the PI of STEM students and their career choice. The first focus of the research was to analyze the content of STEM students' PI and distinguish between various profiles of STEM students. Second, these profiles were linked to STEM students' career choices and it was analyzed whether strength of PI or career exploration influenced that relationship. Finally, background characteristics of STEM students were linked to their PI and career choice. In the following sections, conclusions will be drawn to discuss the results presented earlier.

4.1 STEM students' PI content profiles

The first aim of the study was to identify different profiles of STEM students, based on the content of their PI. Through latent profile analysis, the research succeeded in identifying five unique PI content profiles of STEM students: *loners*, *security seekers*, *researchers*, *all-rounders*, and *status seekers*. *Loners* are characterized by their need for solitude. They are very introvert and show very little interest in social activities. And while they judge themselves lower than average on all competences, they exhibit particularly low self-efficacy in management and teamwork. *Security seekers* distinguish themselves from other STEM students by their need for security and stability. They value routine and structure and show little interest in intellectual stimulation. Additionally, they are highly emotional and evaluate themselves to have particular low analytical and research skills. *Researcher* STEM students are less extrovert than their peers and score only on one competence above average, namely research. Their main interest is gaming and they score particularly low on social and fashion interests. *All-rounder* STEM students are characterized by their high scores on nearly all parts of PI. They are interested in nearly all activities with the exception of gaming and find many values and goals important, particularly having a purpose in life and being benevolent. They judge themselves to be above average in all competences, especially with regard to design and management. Finally, *status seekers* distinguish themselves from other STEM students by their high interest in power and status. They are highly extrovert and very social. Next to power and money, they value intellectual stimulation. Additionally, they show high levels of self-efficacy in all competences, but especially in management, analytical skills and having an international orientation.

Two of the identified PI content profiles, *loners* and *researchers*, can be considered to be more stereotypical for STEM students than the other three, as. Both loners and researchers score relatively low on extraversion and on social interests. With regards to interest, both score relatively high on gaming. Yet, while loner score themselves very low on all competences compared to their peers, researchers also judge their skills low on most competences, but score themselves above average on research skills. These aspects of loner's and researcher's PI are in line with some commonly perceived stereotypical trait of people in the technical field: less interest in and abilities for social interactions (Rommes et al., 2010), interest in gaming and computer related activities (Kendall, 2011), and highly developed cognitive skills (Cheryan et al., 2011). While researchers and loners have much in common with regards to the content of PI, their levels of identification with their future profession, i.e. their strength of PI, varies much. STEM students in the researcher profile exhibit on average the highest levels of identification, while loner STEM students have the second lowest strength of PI from all PI content profiles. One explanation for the lower levels of identification with their future profession of loners compared to researchers might be the perceived lower competences of loners. Loners self-efficacy with regards to their skills was below average for all competences. As self-efficacy influences STEM students' perception of belonging in the technical sector (Good et al., 2012) this perceived inability might lead to a perceived misfit and thus lower level of identification with the profession.

Next to the loner and the researcher, three profiles have been found that fit less well to the common perception of who stereotypical people in the technical sector are, namely *security seekers*, *all-rounders* and *status seekers*. STEM students from these profiles varied in the degree to which they identified with their future profession. *All-rounders* and status seekers score on average higher than security seekers. For *all-rounders* the higher levels of identification might be explained by *all-rounders'* high interest and valuation in general. STEM students with this profile seem to be enthusiastic and confident in many aspects of PI and it can be hypothesized that this enthusiasm translates to many professions and therefore also to a career in the technical sector. However, research is needed to test this hypothesis. Status seeker show high levels of identification with their future profession as well. An explanation for that might be the combination of the intellectual stimulation, status, and money that are typically linked to a career in the technical sector and that are highly valued by status seekers. Finally, *security seekers* exhibit the lowest levels of identification with their future profession. This is in line with expectations, as STEM students in this profile share characteristics that are least in line with stereotypes in the technical sector. *Security seekers*, scoring high on social and fashion related interest and low on cognitive abilities, who are also often female, do not fit the stereotype of the typically male, introvert gamer that persists as the stereotype of a STEM student (Cheryan et al., 2011; Good et al., 2012; Rommes et al., 2010). This perceived misfit with other STEM students might explain the lower levels of strength of PI of *security seekers*.

In conclusion, it can be said that the developed profiles of STEM students' PI content highlight the diversity in the population of STEM students, a population that is often only analyzed and perceived as one group of students. These differences become even more apparent and informative when linking the PI content profiles of STEM students to the strength of PI and subsequent career choice.

4.2 The career choices of STEM students

In this research, career choice has been measured in two ways. First students were asked to name an organization they would like to work for after graduation. In this way, STEM students intended career choice was determined. Second, the degree to which STEM students had already developed a clear image of their career was measured. When looking at STEM students' intended career choices, similar results can be found as with the level of identification with their future profession. *Researcher* STEM students show the highest likelihood of choosing a profession in the technical sector, while *security seekers* are least inclined to aim for a career in a technical organization with only one fifth of students naming a technical organization as their preferred future employee. Interestingly, *loner* students who score relatively low on strength of identification with their future profession are more likely to aim for a profession in the technical sector than status seekers or all-rounders, while both *status seeker* and *all-rounder* profiles showed higher levels of identification with their future profession than loner STEM students. This incongruity of *loners* between their low levels of identification with others in a technical profession and the simultaneously high percentage of *loners* who aim for a career in the technical field might be explained by the *loners'* PI. Loners are characterized by relative low scores on all social aspects of PI, suggesting high levels of individualism. This independence of others might account for *loners'* low levels of identification with their future profession, as they might not identify much with others in general. This would resolve why many *loners* opt for a career in the technical field, while at the same time exhibiting low levels of identification with professionals in the technical field.

STEM students' PI content profiles were also related to the clarity of their career and the influence of both strength of PI and career exploration on that process were determined. In order to do so, it was analyzed how STEM students with various PI content profiles differ in career clarity. As the loner was assumed to be a stereotypical PI content profile, STEM students from that profile were used as base line and the career clarity, strength of PI, and career exploration of students in all other profiles were compared to them.

It was hypothesized that STEM students with more prototypical PI content profiles would have higher levels of career clarity and that this effect would be mediated by both STEM students' strength of PI and career exploration. Our results partly support these findings. A mediating effect of both strength of PI and career exploration on this relationship was found. Hereby clear differences between the PI content profiles were observed. With regard to the mediating effect of STEM students' strength of PI, complementary mediation is established for *all-rounder* and *status seeker* STEM students. This is to say that for these two PI content profiles, increased PI strength results in higher levels of career clarity which is in line with our expectations. For *researcher* STEM students, their career clarity is fully explained by the strength with which they identify with their future profession, meaning that the higher researcher STEM students identify with their future profession, the more clear their image of their preferred career. On the other hand, for the *security seeker*, the degree to which students in that profile have a clear vision on their intended career is not at all influenced by the extent to which they identify with their future profession. This indifference of strength of PI on the clarity of career might be explained by the *security seekers'* perceived misfit with the profession. Many of the characteristics of *security seekers* differ from what is usually perceived as stereotypical for STEM students and only about 20% of STEM students seek a career in the technical sector. Thus *security seekers* might have a clear image of a career outside the technical sector independent of their level of identification with their profession.

Next to the mediating effect of strength of PI, career exploration was hypothesized to influence the degree to which STEM students have a clear view of their career depending on their PI. Results support this hypothesis and, as with strength of PI, findings differ for the various PI content profiles. It was hypothesized that STEM students who engage in more activities to explore their career opportunities would develop a clearer view on their intended career. Findings suggest this to be true for all STEM student profiles. However, looking more closely at the results, a distinction has to be made between all-rounders and status seekers on the one hand and researchers and security seekers on the other. For *all-rounder* and *status seeker* students career exploration mediates the relationship of PI content on career clarity only partially. For security seekers and researchers, there is only an indirect effect of the PI content profile on career clarity via career exploration. Thus, security seekers and researchers differ from loners with regards to career clarity, however, that effect can be explained by differences in career exploration.

4.3 Limitations

The current research gives insight into the PI of STEM students and its effect on career choice. However, there are several limitations to the study.

First, latent profile analysis (LPA) was used to determine the PI content profiles of STEM students. One advantage of LPA is its ability to not only cluster individuals into clusters, but also to give a probability score that a person belongs to a certain cluster. Especially in line with an attempt to develop a more diversified view of STEM students and their PI, this continuous view of PI content profiles, opposite to a categorical view, would have had added value, to highlight that STEM students do not fit in a box. However, as there is little research on how to work with the results of LPA as a continuous variable, it was not possible to apply this added value of LPA in the current research yet.

The second limitation regards STEM students' career choice, which has only been measured as intended career choice. As it was not possible in the scope of the current research to do longitudinal research and identify STEM students' actual career choice, only their intentions were measured and it is unknown whether these intentions match STEM students actual career choice after graduation. Moreover, it was not possible to analyze the mediating effects of strength of PI and career exploration on the relationship between PI content profiles and career choice, as, to the authors' knowledge, there is no way to measure a mediation effect between to categorical variables.

5 Conclusion

The research at hand set out to analyze differences between STEM students' PI and how these differences influence career choice. The research succeeded in identifying five individual profiles of STEM students, named the loner, security seeker, researcher, all-rounder, and status seeker. The profiles were successfully linked to STEM students career choices and differences between the profiles were highlighted.

References

Adams, K., Hean, S., Sturgis, P., & Clark, J. M. (2006). Investigating the factors influencing professional identity of first-year health and social care students. *Learning in Health and Social Care, 5*(2), 55-68.

Ashforth, B. E., Harrison, S. H., & Corley, K. G. (2008). Identification in organizations: An examination of four fundamental questions. *Journal of management, 34*(3), 325-374.

Ashton, M. C., & Lee, K. (2009). The HEXACO–60: A short measure of the major dimensions of personality. *Journal of personality assessment, 91*(4), 340-345.

Ashton, M. C., Lee, K., Perugini, M., Szarota, P., De Vries, R. E., Di Blas, L., . . . De Raad, B. (2004). A six-factor structure of personality-descriptive adjectives: solutions from psycholexical studies in seven languages. *Journal of personality and social psychology, 86*(2), 356-366.

Bartels, J., Peters, O., de Jong, M., Pruyn, A., & van der Molen, M. (2010). Horizontal and vertical communication as determinants of professional and organisational identification. *Personnel Review, 39*(2), 210-226. doi:10.1108/00483481011017426

Beasley, M. A., & Fischer, M. J. (2012). Why they leave: The impact of stereotype threat on the attrition of women and minorities from science, math and engineering majors. *Social Psychology of Education, 15*(4), 427-448.

Beaulieu, M.-D., Rioux, M., Rocher, G., Samson, L., & Boucher, L. (2008). Family practice: professional identity in transition. A case study of family medicine in Canada. *Social science & medicine, 67*(7), 1153-1163.

Beijaard, D., Meijer, P. C., & Verloop, N. (2004). Reconsidering research on teachers' professional identity. *Teaching and teacher education, 20*(2), 107-128.

Berkhout, E., Bisschop, P., & Volkerink, M. (2013). *Technici: mobiel en toch honkvast: uitstroom van technici vergeleken met andere sectoren.* Retrieved from

Canrinus, E. T., Helms-Lorenz, M., Beijaard, D., Buitink, J., & Hofman, A. (2012). Self-efficacy, job satisfaction, motivation and commitment: exploring the relationships between indicators of teachers' professional identity. *European journal of psychology of education, 27*(1), 115-132.

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of research in science teaching, 44*(8), 1187-1218.

Chen, X. (2013). STEM Attrition: College Students' Paths into and out of STEM Fields. Statistical Analysis Report. NCES 2014-001. *National Center for Education Statistics*.

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B. J., & Kim, S. (2011). Do female and male role models who embody STEM stereotypes hinder women's anticipated success in STEM? *Social Psychological and Personality Science, 2*(6), 656-664.

Crocetti, E., Avanzi, L., Hawk, S. T., Fraccaroli, F., & Meeus, W. (2014). Personal and social facets of job identity: A person-centered approach. *Journal of Business and Psychology, 29*(2), 281-300.

Ellemers, N., Kortekaas, P., & Ouwerkerk, J. W. (1999). Self-categorisation, commitment to the group and group self-esteem as related but distinct aspects of social identity. *European journal of social psychology, 29*(23), 371-389.

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of personality and social psychology, 102*(4), 700-717.

Griffith, A. L. (2010). Persistence of women and minorities in STEM field majors: Is it the school that matters? *Economics of Education Review, 29*(6), 911-922.

Gupta, A., Chong, S., & Leong, F. T. (2014). Development and validation of the vocational identity measure. *Journal of Career Assessment*, 1069072714523088.

Hansen, J.-I. C., & Scullard, M. G. (2002). Psychometric evidence for the Leisure Interest Questionnaire and analyses of the structure of leisure interests. *Journal of counseling psychology, 49*(3), 331-341.

Hayes, A. F., & Preacher, K. J. (2014). Statistical mediation analysis with a multicategorical independent variable. *British Journal of Mathematical and Statistical Psychology, 67*(3), 451-470.

Hong, H.-Y., & Lin-Siegler, X. (2012). How learning about scientists' struggles influences students' interest and learning in physics. *Journal of Educational Psychology, 104*(2), 469.

Hong, J. Y. (2010). Pre-service and beginning teachers' professional identity and its relation to dropping out of the profession. *Teaching and teacher education, 26*(8), 1530-1543.

Ibarra, H. (1999). Provisional selves: Experimenting with image and identity in professional adaptation. *Administrative Science Quarterly, 44*(4), 764-791.

Izadinia, M. (2013). A review of research on student teachers' professional identity. *British Educational Research Journal, 39*(4), 694-713.

Kendall, L. (2011). "White and nerdy": Computers, race, and the nerd stereotype. *The Journal of Popular Culture, 44*(3), 505-524.

Khapova, S. N., Arthur, M. B., Wilderom, C. P., & Svensson, J. S. (2007). Professional identity as the key to career change intention. *Career Development International, 12*(7), 584-595.

Kunnen, E. S. (2009). Qualitative and quantitative aspects of commitment development in psychology students. *Journal of Adolescence, 32*(3), 567-584.

Lyons, S. T., Higgins, C. A., & Duxbury, L. (2010). Work values: Development of a new three-dimensional structure based on confirmatory smallest space analysis. *Journal of Organizational Behavior, 31*(7), 969-1002.

Male, S. A., Bush, M. B., & Chapman, E. S. (2011). An Australian study of generic competencies required by engineers. *European Journal of Engineering Education, 36*(2), 151-163.

Marcia, J. E. (1966). Development and validation of ego-identity status. *Journal of personality and social psychology, 3*(5), 551.

Marsh, H. W., Lüdtke, O., Trautwein, U., & Morin, A. J. (2009). Classical latent profile analysis of academic self-concept dimensions: Synergy of person-and variable-centered approaches to theoretical models of self-concept. *Structural Equation Modeling, 16*(2), 191-225.

Meeus, W., Iedema, J., Helsen, M., & Vollebergh, W. (1999). Patterns of adolescent identity development: Review of literature and longitudinal analysis. *Developmental review, 19*(4), 419-461.

Meijers, F., Kuijpers, M., & Gundy, C. (2013). The relationship between career competencies, career identity, motivation and quality of choice. *International Journal for Educational and Vocational Guidance, 13*(1), 47-66.

Morin, A. J., & Marsh, H. W. (2015). Disentangling shape from level effects in person-centered analyses: An illustration based on university teachers' multidimensional profiles of effectiveness. *Structural equation modeling: a multidisciplinary journal, 22*(1), 39-59.

Muthén, L. M., Bengt. (2012). *Mplus User's Guide* (Seventh Edition ed.). Los Angeles, CA.

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling, 14*(4), 535-569.

O'Connor, K. E. (2008). "You choose to care": Teachers, emotions and professional identity. *Teaching and teacher education, 24*(1), 117-126.

Passow, H. J. (2007). *What competencies should engineering programs ephasize? A meta-analysis of practitioners'opinions informs curricular design.* Paper presented at the Proceedings of the 3rd International CDIO Conference.

Pastor, D. A., Barron, K. E., Miller, B., & Davis, S. L. (2007). A latent profile analysis of college students' achievement goal orientation. *Contemporary Educational Psychology, 32*(1), 8-47.

Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology, 106*(1), 315.

Pratt, M. G., Rockmann, K. W., & Kaufmann, J. B. (2006). Constructing professional identity: The role of work and identity learning cycles in the customization of identity among medical residents. *Academy of management journal, 49*(2), 235-262.

Price, S. L. (2009). Becoming a nurse: a meta-study of early professional socialization and career choice in nursing. *Journal of advanced nursing, 65*(1), 11-19.

Rijksoverheid. (2014). *Nationaal Techniekpact 2020 Eèn jaar na de ondertekening*. Retrieved from https://www.rijksoverheid.nl/documenten/rapporten/2014/05/19/nationaal-techniekpact-2020-een-jaar-na-ondertekening

Roberts, B. W., & Robins, R. W. (2000). Broad dispositions, broad aspirations: The intersection of personality traits and major life goals. *Personality and Social Psychology Bulletin, 26*(10), 1284-1296.

Rommes, E., Van Gorp, B., Delwel, M., & Emons, P. (2010). *Nut, Noodzaak of Nerds? Veranderende beelden over bètatechniek in de Nederlandse media en samenleving tussen 1989 - 2009*. Retrieved from Den Haag:

Ros, M., Schwartz, S. H., & Surkiss, S. (1999). Basic individual values, work values, and the meaning of work. *Applied Psychology, 48*(1), 49-71.

Sabanciogullari, S., & Dogan, S. (2015). Relationship between job satisfaction, professional identity and intention to leave the profession among nurses in Turkey. *Journal of nursing management, 23*(8), 1076-1085.

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education, 96*(3), 411-427.

Schwartz, S. J., Luyckx, K., & Vignoles, V. L. (2011). *Handbook of identity theory and research*: Springer.

Sheldon, K. M., Elliot, A. J., Kim, Y., & Kasser, T. (2001). What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of personality and social psychology, 80*(2), 325-339.

Shin, J. E. L., Levy, S. R., & London, B. (2016). Effects of role model exposure on STEM and non-STEM student engagement. *Journal of Applied Social Psychology, 46*, 410-427.

Spelke, E. S. (2005). Sex differences in intrinsic aptitude for mathematics and science?: a critical review. *American Psychologist, 60*(9), 950.

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of personality and social psychology, 100*(2), 255.

Volkerink, M., Berkhout, E. E., & de Graaf, D. (2010). *Bèta-loopbaanmonitor 2010* (9058610810). Retrieved from

Volkerink, M., Berkhout, P., Bisschop, P., & Heyma, A. (2013). *Monitor technische arbeidsmarkt 2013* (9067337196). Retrieved from

Wang, M., & Hanges, P. J. (2011). Latent class procedures: Applications to organizational research. *Organizational Research Methods, 14*(1), 24-31.

Zhao, X., Lynch Jr, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of consumer research, 37*(2), 197-206.