# Interests, Social Relations and the Preference for Study and Future Profession of Talented Students Participating in a Gifted Program for Science and Mathematics

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**Abstract**

**Introduction:** Interest is often thought to be a key factor in predicting and stimulating students to choose a study and career in STEM–Science, Technology, Engineering and Mathematics. This study aims to denote an understanding of science and mathematics interest in relation to other aspects of life like social relations, and the preference of study and career.

**Method:** This research concerns *N* = 86 Dutch grade 12 students (38 male and 48 female) enrolled in a gifted science and mathematics program that aims to foster the talent and motivation of gifted students. A survey containing propositions, open-ended and closed-ended questions is used to point out the multiple aspects of interests.

**Results:** Analysis showed that participants had multiple interests and were mostly interested in STEM disciplines. Participants' STEM interest was predicted by the self-proclaimed importance of their friends [$b = .27$, $t\,(86) = 2.59$, $p < .001$] and gifted program [$b = .18$, $t\,(86) = 2.60$, $p = .011$]. Students chose predominantly for a STEM study or future profession reasoned that it mostly interested them.

**Conclusion:** Results confirmed previous research indicating the importance of a STEM supportive peer group for the interest of students. This research denotes an understanding of gifted students and reveals that even for STEM motivated students gender differences do occur. This research was limited using only a survey, interviews are recommended to reveal deeper reasoning to choose or not to choose study or future profession.

*Keywords:* interests, social relations, STEM, gifted program, study choice and future profession.

OECD (2008) notes a worldwide decrease of interest in STEM–Science, Technology, Engineering and Mathematics. A decrease of interest in STEM could withhold the influx of students in STEM education despite an increased demand for skilled scientific personnel. Masterplan Bèta en Technologie (2012) predicts a shortage of 155000 technical employees in The Netherlands by the end of 2016. This expected shortfall of personnel leads to broad concern about the subjects young students choose during middle school (Ainley & Ainley, 2011; Buccheri, Gürber, & Brühwiler, 2011; Frenzel, Goetz, Pekrun, & Watt, 2010). Research and paper based tests for example, PISA, TOSRA and SAS inquire into student interest in STEM and acknowledge the importance of a positive attitude (Feist, 2012) or interest (Ainley & Ainley, 2011; Buccheri et al., 2011) in STEM that might lead to STEM related educational choices.

This article focuses on students who are enrolled in a dual-enrollment program named Junior College Utrecht (JCU) and is designed to foster student's motivation and talent in science and mathematics (S&M) with the best education to keep students motivated, expand their capacity and amplify their motivation. Dual-enrollment or post-secondary school allows students to enroll in both high school and college courses during a set period, whereby college courses usually take place at a university or college campus (McCarthy, 1999). Dual-enrollment programs offer advantages such as having intellectual peers to chat with, preparation for competitive programs and universities, and builds motivation in a more homogeneous environment (Olszewski-Kubilius, 2009).

It is important to foster the talent and motivation of gifted STEM students in an educational program. Without opportunities for support and own professional development abilities might develop slower or students might become counterproductive (Subotnik & Jarvin, 2005). Insufficient challenges might decelerate student's motivation and achievement causing great capacity loss. Students are expected to do very well in STEM and to achieve the highest grades. However, as Olszewski-Kubilius (2009, p. 68) states: "high ability is clearly not a guarantee of success and many other factors come into play".

This research accommodates the need for more understanding of already STEM motivated students enrolled in a gifted program and aims to denote an understanding of the multiple factors influencing interest and the educational choices they make. It is possible to foster multiple interests at the same time which could lead to competing interests. This study outlines the bigger picture of gifted students' interest, and not only includes interest for STEM but also other interests such as hobbies, sports or philosophy. It also outlines social interrelations, and study and future profession choices possibly related to interests. This study describes the characteristics of JCU students' interests, the importance others have on the interest in STEM, the role interest plays in choosing a study or future profession. By describing the characteristics of JCU students, this study finds pragmatic importance by giving the JCU program an opportunity to adjust education to the characteristics of their students, evaluate the set objectives and targets, and an in-depth review of their students.

## Theoretical framework

Interest is considered as an individual's interaction with his or her environment on a topic by reengaging into activities (Hidi & Renninger, 2006). This reengagement into activities continues over time, has a positive energetic character, and is connected with positive emotions. Interest can be influenced by multiple factors in our lives of which the social environment will be taken in account. It is recommended to look at personal interest as well as the social environment in which it unfolds, interrelations between the individual and the social environment should be conceptualized (Akkerman & van Eijck, 2011). Interest was found to be one of the predictors of educational choices students make (Eccles, 2007) as well as for the completion of a STEM degree (Maltese & Tai, 2011). The expectancy-value model designed by Eccles and Wigfield (2002) distinguishes possible factors influencing educational choices and is used in this research.

### Description of gifted program

The Junior College Utrecht (JCU) program is designed by the Freudenthal Institute for Science and Mathematics Education (FIsme)-a research institute of the University Utrecht-, in close cooperation with other departments and secondary education teachers connected with the JCU. This gifted program aims to foster students' motivation and talent in science and mathematics to keep students motivated, expand their capacity and amplify their motivation. Grade 12 students are selected for participation based on their motivation and talent in STEM (JCU, 2011). Grade 12 is comparable with the Dutch pre-university class 5 or 6 and aims to prepare students for university education. JCU offers a program carried out on two days of the week–Monday and Tuesday–as a substitute of S&M

lessons given by teachers on their own middle school. The JCU program teaches five subjects: mathematics, biology, chemistry, physics and an additional subject Nature Life and Technology (NLT). NLT is an interdisciplinary subject and coincides with the aforementioned subjects taught at JCU. Accepted students–later referred to as JCU students–attend lectures and lessons at the Utrecht University held by both professors from the Utrecht University of as well as teachers from secondary education.

**Interest**

Dewey (1913) was one of the first authors to write about interest and being interested and his study was elaborated by empirical research later. Interest can be seen as an activity which develops over time and carries out fulfillment in which a person can identify oneself (Dewey, 1913). Cognitive and affective components show an interwoven pattern as well as that these components individually contribute to interest (Hidi & Renninger, 2006). For example: knowledge, being cognitive, could contribute to interest as well as enjoyment, which is affective. Affective components such as enjoyment and meaningfulness (Dewey, 1913; Krapp, 1999; Stokking, 2000) are needed to become or stay interested. When an activity becomes monotonous happiness will cease and with that occupation and interest (Dewey, 1913). Humans can engage in several topics without knowledge about this topic (Neitzel, Alexander, & Johnson, 2008), but interest will lead to cognitive activity. Review of studies reveal that a correlation is found between interest and learning outcomes (Krapp, 2002; Schiefele, Krapp, & Winteler, 1992).

It is acknowledged that interest can be classified between personal and situational interest. Personal interest links to self-initiating activities over an extended time while situational interest links to others and/or objects that arouse interest, which could become personal interest eventually (Barron, 2006; Hidi & Renninger, 2006; Krapp & Prenzel, 2011; Mitchell, 1993; Neitzel et al., 2008). Personal and situational interest can be approximated as separate components, but show an interwoven relation. Ainley, Hidi, and Berndorff (2002) found a correlation between personal and situational interest, and showed that participants who stated to have personal interest for certain topics got triggered by headings of texts. In this case an external factor or situational interest was found to correlate with their personal interest. Hidi and Renninger (2006) theorized these two forms of interest into a four-phase model showing four phases from situational interest to becoming personally interested. This theory has not been proven empirically yet and thus interest is classified in personal and situational interest within this research.

Personal interest is a form of self-expressive activity (Dewey, 1913), and it is questioned how self-initiating activities contribute to interest (Barron, 2006). Interests relate with self-intentional activities (Krapp, 1999; Krapp & Prenzel, 2011), meaning that activities are driven out of personal motives. Wide recognition is found in the self-perspective of interest which finds a formulation in the following terms: self-initiated (Barron, 2006; Krapp & Prenzel, 2010; Mitchell, 1993; Neitzel et al., 2008), self-intentionality (Krapp, 2002), self-regulated (Cleary & Zimmerman, 2004; Woolfolk, Walkup, & Hughes, 2007), self-determined (Hidi & Renninger, 2006), self-motivated (Bandura & Schunk, 1981), and self-directed (Bandura & Schunk, 1981). Personal engagement into activities is seen to be the basis of interest and drives activities. Interest appears as an independent pursue for new information (Barron, 2006; Neitzel et al., 2008), but does not necessary stay independent and could be aroused by others or objects. Interest could therefore lead to new contexts, additional learning, new activities and new roles (Barron, 2006).

To find concrete behavior explained by interest, Barron (2006, p. 217) describes five different learning strategies used to extend learning: (1) finding text-based informational sources, (2) creation of new informal activity contexts, (3) exploration of media, (4) the pursuit of formal or structured learning opportunities, and (5) the development of knowledge networks such as mentoring relationships. These learning strategies give an insight of how personal interest is sustained by the individual through self-engagement, which extends learning and such an extension is a form of personal interest (Dewey, 1913).

In this research interest will be regarded to as an ongoing and extended personal search for new information by engaging in activities or topics that lead to enjoyment and meaningful fulfillment of personal interest. This personal search for new information could be accompanied by others and/or objects in their social environment.

**Social environment**

Individuals are influenced by multiple facets in their lives. For example, Bergin (1999) shows that culture influences the beliefs and practice of groups, which on their turn influence interest. The social environment is a wide and complex entity within the lives of students. In order to highlight facets of this dimensional social world it is chosen to follow in line with Phelan, Davidson, and Cao (1991) who divide the social environment into three worlds wherein students live and participate: family, school and peers/friends. The term world is used because this indicates the possible differences between “values and beliefs, expectations, actions, and emotional responses” (Phelan et al., 1991, p. 225).

Individuals participate in these different social worlds and it is therefore most likely that relations with these different groups lead to changes of the individual, called consequential transitions (Beach, 1999). Students experience different forms of transitions but only collateral transitions will be explained because it highlights the setting of this research. A collateral transition is the simultaneous participation of an individual in relating activities (Beach, 1999), for example discussing your study choices with both your parents and a teacher in middle school. These transitions are subjective to multiple facets of the social environment and change the individual (Frenzel et al., 2010). Only the social relations entered into will be included. Therefore family, school and peers/friends world will be viewed as the social relation with parents, teachers, and friends.

**Parents.** Eccles (1993) underlines the importance of parents for the development of adolescents. Family encouragement during a science program predicted the impact of the program on the gains in science motivation and career expectation (Stake & Mares, 2001). Family can have a major impact on the students’ perception of science. A close friend or family member engaged in science was found to refrain girls from stereotypes and present positive images of science careers (Baker & Leary, 1995). There appears to be a difference between parents, fathers are seen to affect academic values to a greater extent when compared to mothers (Gniewosz & Noack, 2012). To include the possibility of gender differences in science attitudes, father, and mother (or male and female guardians) are discussed independently.

**Teacher.** Teachers have a social interrelationship with students, are bound to school, and are stated to “have a major positive impact” on the lives of adolescents (Eccles & Harrold, 1993). Research shows a positive correlation between the enjoyment of a teacher teaching his/her discipline and the enjoyment of students experiencing this discipline (Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009). This study inquired students enrolled in a dual-enrollment program and therefore two groups of teachers could be distinguished: (1) teachers teaching the gifted program teaching STEM and (2) teachers at their own middle school teaching other subjects (e.g. language or arts). Teachers from their own middle school did teach STEM subjects in the first four years of middle school education and recommended the student to follow a gifted STEM program but this was before the students got enrolled in the gifted program.

**Friends.** Presumably students’ choice making is associated with the choices friends make or the interests they have. An example of this possible association derives from the work of Azevedo, who stated: “Still others appeared to be motivated solely by the social aspects of given activities, such as cultivating friendships or mediating the execution of group tasks, to the detriment of other substantive components of the program” (2012, p. 40). Peers thus appear to have a major influence on the attitude and motivation of students. This is supported by Stake and Nickens (2005, p. 8) who found that “having peers with whom to share science interests would enhance both girls’ and boys’ imagined future personal life as a scientist”. Understanding the influence of friends on interests is complex. Individuals can maintain a lot of friendships of which not all friendships have the same importance for interests. Robnett and Leaper (2012) found that personal value of a STEM career increased most rapidly when students have a STEM supportive friendship group. I therefore chose to distinguish two forms of friendships: classmates enrolled in the same gifted program and friends not enrolled in the same gifted program. Students enrolled in the same gifted program are supposed to be more STEM supportive since their selection for this program is based on their ability as well as motivation for STEM. Friends not enrolled in the same gifted program could, but do not need to be STEM supportive.

There is a constant interaction between a person and his or her environment (Frenzel et al., 2010). Friends, teachers, and parents are stated to have influence on the lives as well as the interest of students. This study focuses on students' interests in its social environment and is motivated by the wish to denote a better understanding of the role interests plays in students' study and future profession choices.

**Career decision-making**

The process towards making a career-decision is a complex process (Gati, Krausz, & Osipow, 1996). Secondary education students are stimulated to pursue the desired study or career, but their choice-making process is influenced by multiple factors. To inquire educational choice making and factors influencing this, the expectancy-value model of Eccles and Wigfield (2002) is used. This theoretical model combines the latest research on motivation, beliefs, values, and goals focusing on education psychology and shows a model that explains educational choice making of students; presented in Figure 1 (Eccles, 2007; Eccles & Wigfield, 2002).

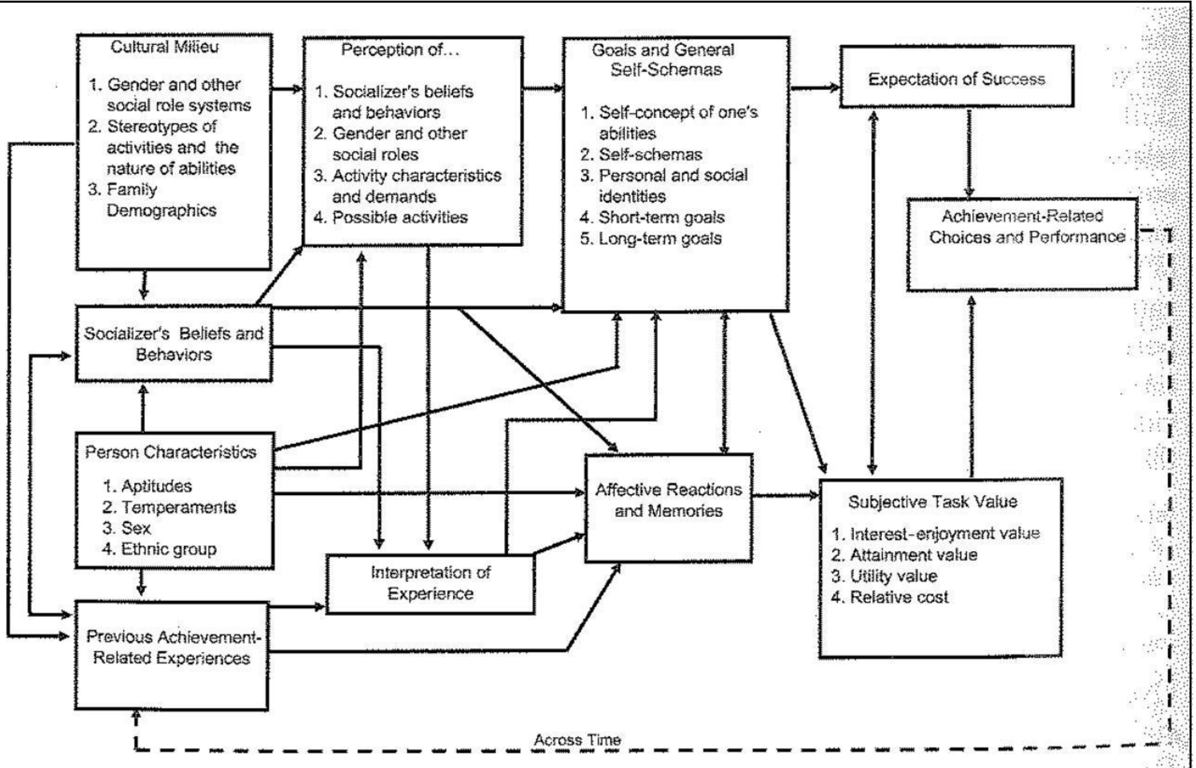


*Figure 1:* Eccles (2007) expectancy-value model of achievement choices. An overview of all the different factors which could possibly influence achievement-related educational choices and performance of students.

The Eccles' expectancy-value model distinguishes two motivational beliefs, describing the contextual influence on students' behavior: (1) individuals' self-concept of ability (beliefs about competence and future performance) and (2) subjective task value (Eccles, 1993). These motivational beliefs are seen to directly influence choice-making.

STEM study or career aspirations are evaluated in the light of two variables: *Expectations for success* and *Subjective task value* [Interest-enjoyment value, Attainment value, Utility value, and Relative cost]. Expectation for success is defined by the belief that the participant will do well in this subject. Subjective task value is described by four factors: (1) Interest-enjoyment value: an ongoing and extended personal search for new information by engaging in activities that lead to enjoyment and meaningful fulfillment of personal interest (2) Attainment value: realization of ideals by the portrayal of the self, (3) Utility value: to what purpose and how well it relates to current or future goals, and (4) Relative cost: what would be given up by making this choice (Eccles, 2007; Eccles & Wigfield, 2002: Robnett & Leaper, 2012).

**Current research**

This study aims to denote an understanding of personal interest, social relations, and perceived STEM study or career aspirations of JCU students. This study elaborates an understanding of the tail of distribution by inquiring already motivated and talented students participating in a gifted program.

**Research questions.** How do social relations relate to the interests of JCU students and their perceived study and future profession aspirations? To answer the leading question, sub questions are formulated. To examine the variety of interests it is questioned what the interests of already STEM motivated secondary education students are. Next I will look at the social environment students are situated in. Investigation will determine the social relations students have and how these relations connect with their interest in STEM; elaborating the relation between personal interest and the social relations of secondary education students. The third sub question deepens the understanding of how personal interest relates to the preference of study field and future profession of secondary education students.

**Hypothesis.** Due to mentioned theories, it is conjectured that students, enrolled in a gifted program, have a higher level of personal interest in STEM related disciplines since this program is chosen based on their motivation and their capability. It is expected that students are widely interested in different topics, subjects, or activities. Students from JCU are estimated to have a more general interest in various disciplines. It can be expected that classmates enrolled in the same gifted program and teachers teaching S&M subjects in the gifted program are evaluated to have a high importance on the participants' interest in STEM. Friends who are not enrolled in a gifted program are expected to have a lower importance on STEM interest, because they might not share the same interest in STEM. Males are stated to be more motivated for STEM than females, therefore a difference between the importance of father and mother on their STEM interest is expected. I expect that students who are motivated for STEM, prefer S&M related fields of study, and describe personal interest to be the motivation in deciding. Students are expected to write about their interest in STEM as well as other factors predicting educational choices when motivating a choice for study or future career.

## Method

### Participants

This research shows results of $N = 86$ students between the age of 15 and 18 ($M_{age} = 16.7$, $SD = 0.8$), all of whom are participating in the JCU program; grade 12; a minimum of six months enrollment in the JCU program and Dutch nationality. This sample included 38 male and 48 female participants; of the total sample size 48 were studying in grade 11 (fifth year) and 38 were studying in grade 12 (sixth year of pre-university education). All participants studying at JCU were contacted and asked to participate in this research. Other gifted programs are not accounted for. The survey was conducted in February, ensuring that participants had experienced the JCU program for at least six months. Experience with the JCU was mandatory because it enables participants to reason out of their own experience as JCU student.

### Instrument

This research draws on both quantitative and qualitative data. Interest for disciplines, the importance of different social groups and possible actions of social relations are scored in qualitative data allowing for enhanced analysis. To prevent a distorted image of the characteristics of JCU students, open-ended questions were formulated to provide rich qualitative data.

This survey has been evaluated during a pilot assembly of students in the Science education and Communication program, and by multiple consultations with my supervisors to achieve high face validity. Students Science Education and Communication were asked to fill out the questionnaire and provide feedback. The questionnaire has been revised accordingly to its final version. Since the mother tongue of the targeted participants is Dutch, the survey, was formulated in Dutch, by a native Dutch speaker. The survey contained 37 questions and propositions subdivided into three parts: (1) student interests, (2) social relations, and (3) study and future profession preference, and was preceded by descriptive information such as name, age, gender, educational year, education of parents, and parents' occupation. The survey was processed anonymously, but names were needed for further and corresponding research. All participants signed an agreement to be subjected to research.

**Student interests.** Schiefele (1991, p. 302) states interest to be "a relatively enduring preference for certain topics, subject areas, or activities" and to get detailed information about possible interests, participants were asked to point out the wide range of interests students could have and how they are situated in their lives. To focus on specific interests it was then asked what participants were most interested in during the last month. Responses to these questions contained qualitative data and are categorized into: social environment, Arts and Humanities, science, Social Sciences, hobby, and sports. The category 'social environment' is explained by the interest for social interaction of the participants with others for example, chatting with friends or going out with friends. Arts and Humanities is the interest in products of human activity, science is the interest of non-human nature and Social Science the interest in human activity. To determine the background of this interest an open-ended question 'Why did you get interested in this?' was asked. To get an understanding of the personal engagement needed to fulfill their interest, possible actions could be declared: I used Google, I read about it, I watched TV/ DVDs and I talked to someone.

In previous research, interest has been measured by asking the participant to rate activities, topics or subjects in correspondence to their interest (OECD and PISA, 2005; Schreiner & Sjoberg, 2004). This survey follows this line, by questioning students' interest for thirteen different disciplines: mathematics, physics, chemistry, biology, geography, informatics, economics, history, language, society, statistics, psychology, and philosophy. Participants rated how much these disciplines interested them; ranging from 0 (*not interested*) to 5 (*very much interested*). It was expected that students were interested and therefore interest is measured with a five point Likert scale; 0 indicated no interest for this discipline. Students may be interested in disciplines, but less so in this particular school subjects. STEM motivated students might interpret some stereotyping, and therefore it is asked how participants viewed their own interests with predefined answers.

**Social relations.** Two open-ended questions were used to give an extended description of social relations students hade and how these relations exposed the participant to new interests. This is measured by asking if there was someone that got them interested and what action(s) this person did.

To describe the importance of social relations for the participants' personal STEM interest, participants were asked to score the importance of father, mother, JCU teacher, JCU classmates, middle school teacher, and friends not from JCU. Participants rated the importance on a seven point Likert scale ranging from 0 (*not*) to 7 (*a lot*). A seven point Likert scale was used to achieve a better visible contrast between the different social relations.

Eight propositions measured if parents, classmates from JCU, teachers from JCU and friends outside JCU could be appointed with special roles in facilitating the participants' interest in STEM. Participants were asked to range the different propositions on a seven point Likert scale ranging from 1 (*disagree*) to 7 (*agree*), to obtain more variance. Parents are represented by two propositions picturing them encouraging and supporting (e.g., buying books, funding school) the participants STEM interest (Barron, 2006). Classmates were portrayed to help students think in order to elaborate their STEM interest (Barron, 2006), and extend their learning by the opportunity to ask questions to (Dewey, 1913). Teachers from the JCU are portrayed to draw attention to relevant information (Barron, 2006) and to explain new information, extending learning (Dewey, 1913). Friends outside the gifted program were outlined to facilitate participation in different settings (Neitzel, Alexander, & Johnson, 2008) such as talking when they get together (Barron, 2006).

S**tudy and future profession preference.** Eight open-ended questions measured the reasons for study and future profession choice-making. It was asked what participants considered to be a possible study or future profession as well as what they would choose now to be their preference of study or future profession. Answers are open-coded to show the variety of studies and future profession that participants perceive. To understand the reasoning behind this choice, it was asked why they would choose this study or future profession. This question is also open coded, what is used as a base for selective coding (Boeije, 2010). In the process of selective coding a great coherence with the expectancy-value model (Eccles, 2007) was visible and therefore selective codes describe: (1) Expectations for success, (2) Interest-enjoyment value, (3) Attainment value, (4) Utility value, and (5) Relative cost (Eccles, 2007; Eccles & Wigfield, 2002). To relate educational choice-making to the social relations students have it was asked if students knew someone with the same study or profession. In this study it is chosen to include medical sciences within STEM for study and future profession choices.

## Procedure

All students who went to JCU were asked to participate in this research at the end of a lecture or lesson held at the JCU. Participants were asked to stay seated and to fill out a hard copy version of this survey after class. The survey was handed to JCU students by a teacher and I was available for questions and helped collecting questionnaires. Confidentiality of the collected information was guaranteed in the written introduction. It stated that the information given by the participants will only be used in this research for interest development. Students also completed other interest-related questions not relevant in this research. Students were encouraged to elaborate and provide honest answers.

## Analysis

### Quantitative data.

Two preliminary tests were ran to identify possible subscales for further analysis. A three-way principal component analysis was conducted on the 14 disciplines. The second preliminary test was a principal component analysis. This test was used to make a distinction between the social relations participants have. Correlation coefficients displayed can vary from -1.00 to 1.00, where 1.00 indicates a perfect correlation of this item with the distinguished component. A loading of 0.5 till 0.8 means that this item correlates well with this component (Howitt & Cramer, 2007). The Kaiser-Meyer-Olkin test was used to measure the sample size adequacy; in this test it is found that the sample size is mediocre, *KMO* = .58 and *KMO* = .66. Varimax rotation was used because this maximizes the distribution of loadings within factors allowing a bigger contrast (Field, 2009). Descriptive statistics were used to outline the participants' interest, social relations, preferred field of study and future profession. Next an ANOVA was used to test whether gender difference was evident in this sample group. Homogeneity of variance was assumed based on the outcome of Levene's test. Pearson's correlation test was used to confirm the roles attributed to parents, teachers, friends and classmates. Linear regression analysis was used to point out which item(s) and which subscale(s) predict the interest in STEM. The assumption of no perfect multicollinearity was met (*VIF* = 1.02 and 1.00), which was also reflected in the correlations among predictors. Durbin-Watson statistics (1.97 and 1.91) showed that residuals were uncorrelated; assumption for independent errors is met. All executed test are based on a 0.05 level of significance. A Cronbach's $\alpha$ of > .60 is seen to be sufficiently reliable and Cronbach's $\alpha$ > .70 to be reliable when it concerns a test on group level without important decisions according to COTAN criteria (2009).

The assumption of normality was met for most separate items. Assumption of normality was not expected to be met fully, since the targeted group is a specified as a highly STEM motivated group and are more likely to give higher scores for STEM disciplines leaving the data set slightly skewed.

**Qualitative data.** Most of the open-ended questions in this research were coded according to the three steps for qualitative analysis namely: open coding, axial coding and selective coding (Boeije, 2010). The reasons for getting interested were coded with predefined coded stemming from earlier research showing: enjoyment (Ainley & Ainley, 2011; Dewey, 1913), individual pursue of new information (Barron, 2006; Neitzel et al., 2008), different contexts enhance interest (Alexander, 2003; Frenzel et al., 2010) and others extend interest (Hidi & Renninger, 2006). Descriptive statistics were used to make conclusive remarks over the distinguished categories.

## Results

### Preliminary analyses

The questioned disciplines were tested in a principal component analysis to reduce the disciplines into Arts and Humanities, Science, and Social Science. This makes comparison with the coded questions possible and allows the use of mean scores for Arts and Humanities, Science, and Social Science to indicate interest. This analysis, visualized in Table 1, shows different components as were expected. In this study it appears that Arts and Humanities are scored correlating with Social Science, but because this sample is not representative enough and there are no consequences to this component analysis the mean scores of Arts and Humanities, and Social Science were used.

Table 1

*Factor Loadings for Exploratory Three-Way Principal Component Analysis with Varimax Rotation of Disciplines*

| Interest in | Social science and humanities | More theoretical STEM science | More applied STEM science |
|---|---|---|---|
| Geography | **.63** | .00 | .07 |
| Economics | **.50** | .21 | -.04 |
| Psychology | **.65** | -.22 | .14 |
| Language | **.35** | .15 | .20 |
| History | **.63** | -.03 | -.10 |
| Society | **.78** | -.21 | -.13 |
| Philosophy | **.57** | .14 | .20 |
| Physics | .04 | **.69** | .27 |
| Mathematics | .00 | **.78** | -.06 |
| Informatics | .06 | **.79** | .03 |
| Chemistry | -.07 | .20 | **.91** |
| Biology | .29 | -.53 | **.59** |

*Note:* Highest factor loading are in boldface. STEM = Science, Technology, Engineering and Mathematics.

More interesting is the possible distinction within STEM disciplines, implying that STEM subjects are distinguishable into two components. These two STEM components make sense and could be argued for: physics, mathematics and informatics can be described as more theoretical or formal science while biology and chemistry appear to be more applied or life science. On average, participants were more interested in more applied science (*M* = 3.49, *SD* = 0.90) than for more theoretical science (*M* = 3.11, *SD* = 1.00), $t(85) = -3.92$, $p < .001$, Cohen's $d = 0.39$ indicates a medium effect.

To distinguish between the social relations the participants had, a preliminary component analysis was run. This analysis aimed to reduce the data to one or multiple subscale(s) that could be used in regression analysis. It was measured if parents, classmates from JCU, teacher from JCU and friends outside JCU could be distinguished in four different components.

Table 2

*Factor loadings of a Principal Component Analysis with Varimax Rotation on Social Relations*

| Item | Parents | JCU Importance | JCU Actions | Friends Outside JCU | *M* | *SD* |
|---|---|---|---|---|---|---|
| Importance father for STEM interest | **.79** | .05 | .10 | .05 | 4.63 | 2.01 |
| Importance mother for STEM interest | **.79** | .18 | .05 | .03 | 3.73 | 1.81 |
| Parents encourage STEM interest | **.72** | .03 | .22 | .11 | 5.41 | 1.47 |
| Parents support STEM interest | **.64** | -.01 | -.05 | .15 | 3.98 | 1.98 |
| Importance teachers JCU for STEM interest | .01 | **.85** | .11 | .00 | 5.15 | 1.19 |
| Importance classmates JCU for STEM interest | .19 | **.66** | .16 | .09 | 5.18 | 1.23 |
| Teacher JCU draws attention to relevant STEM information | -.01 | **.64** | .50 | .04 | 5.44 | 1.12 |

| Item | Parents | JCU Importance | JCU Actions | Friends Outside JCU | *M* | *SD* |
|---|---|---|---|---|---|---|
| JCU Classmates stimulate thinking about STEM | .11 | .31 | **.70** | .17 | 5.51 | 1.18 |
| I ask JCU classmates about STEM | .15 | .06 | **.84** | .02 | 4.87 | 1.52 |
| I ask Teacher JCU for explanation about STEM | .04 | .07 | **.66** | .17 | 4.79 | 1.36 |
| Importance friends outside JCU for | .16 | **.52** | -.02 | **.64** | 3.62 | 1.44 |
| I talk to friends not in JCU about STEM | .18 | .19 | .21 | **.77** | 4.90 | 1.75 |
| Friends not in JCU ask what I do at JCU | .07 | -.41 | .24 | **.65** | 5.52 | 1.27 |

*Note.* Factor loadings > .50 are boldface. JCU = Junior College Utrecht. STEM = Science, Technology, Engineering and Mathematics. Mean and Standard Deviation for all (*N* = 86) JCU students are represented in vertical rows.

Component analysis, as shown in Table 2, indicated a great coherence of answers resulting into four components. Component two and three are both explained by the influence of teachers and classmates from the JCU. In this research the distinguished components were used to indicate different influences and were therefore transformed into subscales. A subscale was not directly observed but inferred from observed items.

Subscale (1) ‘Parents’ explains the importance of parents for the participants interest in STEM, felt encouragement and support (e.g., financial) of parents for their interest in STEM (Barron, 2006; Olszewski-Kubilius, 2009). Subscale one is found to be reliable, Cronbach’s $\alpha$ = .73. Subscale (2) ‘JCU importance’ explains the importance teachers and classmates from the JCU have on the participants’ interest in STEM as well as the action of teachers drawing attention to relevant information for their interest in STEM (Barron, 2006). Subscale two is found to be reliable, Cronbach's $\alpha$ = .71. Subscale (3) 'JCU actions' is explained by the actions classmates and teacher from JCU undertake that sustains the participants' interest in STEM. Subscale three is found to be reliable, Cronbach's $\alpha$ = .70. Subscale (4) 'Friends outside JCU' is explained by how important friends not studying at JCU are for their interest in STEM, this is expressed by talking to friends and friends asking questions about the JCU program. Subscale four is found to be not sufficient reliable, Cronbach's $\alpha$ = .59.

Table 3

*Categorized Interests of Students and Main Interest in the Last Month*

| | Multiple Interests | | Main Interest During Last Month | |
|---|---|---|---|---|
| Interested in | *n* | % | *n* | % |
| Social environment | 27 | 32 | 5 | 6 |
| Alpha sciences | 12 | 14 | 5 | 6 |
| Beta sciences | 61 | 72 | 28 | 33 |
| Gamma sciences | 11 | 13 | 4 | 5 |
| Hobbies | 58 | 68 | 24 | 28 |
| Sports | 48 | 57 | 8 | 9 |
| Undefined | 0 | 0 | 12 | 14 |

*Note.* Interests of *N* = 86 participants presented by multiple response and main interest.

**JCU students' interests**

JCU students had a great variety of interests, not only STEM interests. Results showed that JCU students were interested in more subjects, activities, or topics at the same time. Most students (*n* = 41) were interested in STEM and/or their hobby. This pictured JCU students as multiple interested; they could for example, be interested in STEM, playing guitar, and playing soccer (represented in Table 3). When multiple interests exist, competing interests could occur. Sixty-one participants named

STEM to be one of their interests, but only 28 participants prioritized STEM to be their main interest for the last month (see Table 3).

To fulfill the needs of their interests, participants talked to someone else about their interest (*n* = 46), used Google to find new information about their interest (*n* = 38), read books about interest (*n* = 22), or watched TV/ DVDs in relation to their interest (*n* = 14). When participants talked about their interests they mostly talked with friends and family members.

Fifty-two participants stated that someone-family (*n* = 17), teacher (*n* = 14), friends (*n* = 13), classmates (*n* = 2), or others not specified people-got them interested in their main interest of last month. These social relations mainly talked about their interest with the participant, drew attention to their current interest, came together, or participated in the same interest.

Table 4

*Participants' Interest Ordered by Discipline*

| Interested in | *M* | *SD* |
|---|---|---|
| STEM [a] | **3.28** | 0.69 |
| Biology | **3.73** | 1,19 |
| Physics | **3.62** | 1,11 |
| Mathematics | **3.45** | 1,25 |
| Chemistry | **3.35** | 1,12 |
| Informatics | 2.27 | 1,53 |
| Art and Humanities [a] | 2.21 | 1.08 |
| Philosophy | 2.44 | 1,65 |
| History | 2.20 | 1,58 |
| Language | 1.99 | 1,55 |
| Social sciences [a] | 2.18 | 1.05 |
| Psychology | **2.64** | 1,63 |

| Interested in | *M* | *SD* |
| --- | --- | --- |
| Economics | 2.21 | 1,47 |
| Society | 1.99 | 1,58 |
| Geography | 1.88 | 1,44 |
| Statistics | 2.01 | 1,29 |

*Note:* Means > 2.50 are in boldface. Scores are presented for N = 86. Scores could range from *min* = 0 to *max* = 5, score 1 till 5 measure interest on five point Likert scale and 0 meant to be not interested.

[a] Represents mean scores of $N = 86$ participants of the below presented interests.

JCU students were overall mostly interested in STEM, as shown in Table 4, rating mathematics, biology, chemistry, physics, and psychology to be more interesting (mean > 2.50). A One-Way ANOVA, revealed a statistical difference between the interest in STEM and Social Sciences when compared for gender. Boys ($M = 3.63$, $SE = 0.10$) were significantly more interested in STEM sciences than girls ($M = 3.01$, $SE = 0.09$), $F(1, 84) = 21.31$, $p < .001$, $\omega = 0.44$ indicating a big effect of gender for interest in STEM science. In contrast, girls ($M = 2.47$, $SE = 0.15$) were significantly more interested in Social Sciences than boys ($M = 1.89$, $SE = 0.17$), $F(1, 84) = 5.78$, $p = .018$, $\omega = 0.23$ indicating a medium effect of gender for interest in Social Sciences.

Sixty-four percent of the participants stated to be widely interested in the questioned disciplines. Descriptive statistics showed that participants were more interested in STEM than other disciplines. A high interest in STEM did not exclude other interests such as hobbies or sport. Participants were overall less interested in arts and humanities, and social sciences, and more interested in STEM sciences. Interestingly this research also confirmed gender difference in STEM interest for the top of distribution, STEM motivated and gifted students.

**Social relations**

A stepwise linear regression was conducted with all the possible items questioning the contribution of different social relations and their actions that influenced the participants' interest in

STEM. Talking about STEM with friends not studying at the JCU was found to significantly predict the score on interest in STEM, $b = .15$, $t(86) = 3.87$, $p < .001$ and asking teachers from the JCU explanation about STEM subjects was found to significantly predict the score on interest in STEM, $b = .13$, $t(86) = 2.45$, $p = .015$. These two items explained a significant proportion of variance in the interest in STEM of the participant, $R^2 = .21$, $F(1, 83) = 12.28$, $p < .001$.

The distinguished subscales, as represented in Table 2, were tested with a stepwise linear regression. This showed that two subscales were able to significantly predict the score on interest in STEM. Subscale four – friends outside JCU – predicted he score on interest in STEM $b = .25$, $t(86) = 3.66$, $p < .001$, and subscale three – JCU actions – predicted the score on interest in STEM $b = .18$, $t(86) = 2.60$, $p = .011$. These subscales significantly explained the proportion of variance in STEM interest, $R^2 = .20$, $F(1, 83) = 10.08$, $p < .001$.

Subscale one and two were not found to predict the score for interest in STEM but did influence the participants' interest in STEM. Table 2 shows that some items were scored above 5.00 on a seven point Likert scale indicating a high influence of this social relation on the participants' interest in STEM.

**Preferred study or career choice**

Most of the questioned participants knew a possible field of study $n = 83$ (97%) and/or a future profession $n = 50$ (58%) which they would like to pursue. The field of study was categorized into eleven categories of which four categories were chosen most: health $n = 26$ (30%), techniques $n = 18$ (21%), nature $n = 14$ (16%) and mathematics $n = 14$ (16%) which led to the following top five fields of study: medicine/ physician $n = 11$ (13%), mathematics $n = 7$ (8%), biomedical sciences $n = 6$ (7%), informatics $n = 5$ (6%), technical physics $n = 4$ (5%). None of the participants chose a study that aligns with behavior and society, law, and language and culture. Five students chose a study that did not relate to STEM, 94% chose a STEM relating study. Interestingly these five students were all female participants, whereof one chose nursing and four chose a Liberal Arts related study aiming to develop the students all-round intellectual.

Descriptive statistics showed the reasons to choose a study or future profession. The argument to choose a study or future profession did not have many differences for the participants. Participants mostly wrote about their interest, attainment and/or utility this study or future profession has for the person. Most participants wrote about their interest for study *n* = 59 [78% of answers] or future profession *n* = 36 [66% of answers] whereof 26 participants wrote about their interest for both study and future profession. Students (*n* = 10) wrote less about the relative costs this study or future profession would take. Some participants wrote that a certain study choice was made to keep all possibilities open and to have an open future. Participants (*n* = 3) hardly wrote about their expectation of success for either study or future profession.

Forty-one percent of the participants knew someone–mostly family–with the same study as the preferred field of study. Descriptive statistics showed that 20 of the 50 participants who knew a future profession also knew someone with the same profession.

Future professions varied widely, mostly participants saw researcher (*n* = 12), physician (*n* = 4), and architect (*n* = 2) as a possible future profession. Other professions varied greatly, and were accounted by only one participant for example, composer, gynecologist, soldier, farmer, physician, architect, professional gamer, roller coaster designer, architect, biologist, teacher, industrial designer, laboratory technician, programmer, writer or nurse. Interestingly most participants saw researcher by first (*n* = 12), second (*n* = 10), third (*n* = 2) or fourth choice (*n* = 1) as possible future profession, which makes a total of 25 out of 61 (41%) participants who wrote that they consider being a researcher. Most participants, 85%, who knew their future profession chose a future STEM profession.

## Conclusion and discussion

This study showed that gifted students were mostly interested in STEM and stated it to be one of their interests, as well as some who stated STEM to be their main interest in the last month. STEM disciplines were rated most interesting while other disciplines rated less interesting. JCU students stated to be widely interested and were not only interested in STEM, but had a more general interest for disciplines. These results confirmed the first hypothesis. I expected that classmates and teachers in the gifted program would have a high importance for the participants STEM interest, descriptive confirmed this hypothesis and showed scores ranging from 4.79 till 5.51 on a seven point Likert scale. Subscale three–JCU actions-was found to explain the score of the participants' interest in STEM. Friends not enrolled in the same gifted program were expected to have lower importance, which is confirmed by descriptive statistics. But the score of friends outside JCU predicted the participant's interest in STEM. Gender differences were also evident in this research. Fathers showed to have a higher importance to the participants' interest in STEM, also boys were found to be more interested in STEM than girls. I expected that motivated and gifted students preferred a STEM study and future profession, this hypothesis is confirmed and shows that 94% chooses a STEM study and 85% chooses a future STEM profession. Participants were expected to write about all five factors predicting educational choice-making, but statistics showed that participants mostly wrote about their interest. Relative cost was less written about whereas their expectation of success was almost not mentioned, partly confirming the stated hypothesis.

This study shows that gifted and motivated STEM students have a high interest for STEM disciplines. This interest in STEM might be distinguishable into more theoretical and more applied sciences. More theoretical sciences endorsed significantly less interest than more applied science. This stresses the relation between a self-expressive activity and personal interest (Dewey, 1913). Participants stated to be widely interested and showed a variety of interests. Students are not exclusively interested in STEM and have all sorts of interests.

Akkerman and van Eijck (2011) recommended looking at personal interest as well as the social environment in which it unfolds. This study shows the importance of social relations for the personal interest of students. Students viewed social relations with parents, friends, classmates, and teachers relatively important for their interest in STEM. Stake and Mares (2001) showed in their research that family encouragement predicted gains in science career motivation and expectations. This research confirms the reported importance of encouragement, but encouragement was not found to predict interest in STEM. Eccles (1992; 2007) underlines the importance of both school and family on the choice making process of individuals and this study confirms this finding. Teachers and classmates were rated the most important for their STEM interest showing the high importance of a gifted dual-enrollment program. Results in this research are in line with earlier research indicating the influence of friendships and peer relations on STEM (Robnett and Leaper, 2012; Stake & Nickens, 2005). A higher scored friendship predicted the score on STEM interest. Although friends outside JCU were rated lower than other social relations, this relation is able to predict the score on interest. This study implicates that friends predict interest in STEM and that teachers and classmates from the gifted program are most important for their interest in STEM.

Gender differences in science still appear to be evident. Osborne, Simon, and Collins (2010, p. 106) conclude in their literature review that "girls' attitudes to science are significantly less positive than boys", however girls' aversion of a science career decreases. This study concerned motivated and gifted STEM students and still found a significant difference in STEM interest. Motivated and gifted boys participating in a STEM dual-enrollment program are more interested in STEM than motivated girls participating in the same STEM dual-enrollment program. This stresses the already acknowledged gender difference in STEM and shows that this occurs in gifted education as well. Fathers were found to affect academic values to a greater extent compared to mothers (Gniewosz & Noack, 2012) and this research displays that fathers are also found to be more important for the participants STEM interest.

Students participating in a gifted STEM program mostly preferred a study or future profession that aligned with STEM. It is interesting that students who chose not to follow a STEM study were all female. A possible explanation for not choosing a STEM study is that a STEM study is not believed to involve helping or working with other people (Diekman & Eagly, 2008). I want to exemplify a statement from a girl who chose a STEM study and stated "I would like to help humans and make them healthy again" she chose to study medicine research and development.

Gifted students mostly wrote about their interest for a study or career when asked to reason their preferred study or future profession. It was expected that students would write about all the factors explained in the expectancy-value model (Eccles, 2007; Eccles & Wigfield, 2002). Students did not write about the expectation of success for this study or future profession. Students are selected for the gifted program based on their performance as well as motivation for STEM and therefore they are likely to already know their ability in STEM. Relative cost of a study or future profession was hardly mentioned by students. A possible explanation might be, that the students are determined about their study or future profession and therefore don't state what they are giving up, or what this choice might cost them. Students might be willing the embrace the possibilities and accept restrictions and effort a study or future profession has.

It is important to have a further elaboration of gifted students enrolled in a STEM program. Gifted students have a lot of potential to persist and achieve in STEM (Stake & Nickens, 2005). But few is known about gifted students, their achievements, social relations, and preferred study and future profession. The findings of this study add to the current theory. This research gives insight in gifted students' interests and pictures students as talented students with a wide interest in multiple subjects, activities and topics. Students' STEM interest was predicted by the gifted program as well as friends showing the important role peers and school play in their lives. This research also highlights the big importance of interest on the educational choice-making process. Interest was mostly written about when giving a reason for a study or future profession, showing students need to have an interest in STEM (Ainley & Ainley, 2011; Buccheri et al., 2011) in order to choose a study or career that aligns.

This research only inquired students participating in the JCU gifted program, a larger sample group of gifted students would help to make more generalizable remarks and to test whether the findings in this study are applicable to other gifted programs. This research used a survey which was completed by self-report and might have biases that could influence outcomes. Students could have filled out this survey as quick as possible to be done with it. I recommend using career guidance scheduled hours to conduct the survey, it is more likely that students will take the survey serious. This survey only inquired the importance and roles of social relations, but to effectively measure the impact of the JCU program a cognitive as well as emotional longitudinal research should be used to clarify the impact of a gifted program. This survey asked for reasons to choose a study or future profession, whereas it is important to know why they would not choose a certain field of study or future profession. A more qualitative approach with for example, interviews could unravel these reasons. I recommend using interviews when asking for education choice-making. Students tend to write answers as short as possible and might not write the expected reasoning, an interview allows the researcher to extend questions and elaborate on answers.

This research is unique because it showed the interests of gifted students linked with their social relations, and their study and future profession choice; supported by qualitative as well as quantitative data.

References

Ainley, M., & Ainley, J. (2011). Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science. *Contemporary Educational Psychology, 36*, 4–12. doi:10.1016/j.cedpsych.2010.08.001

Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate their relationship. *American Psychological Association*, *94*(3), 545–561. doi: 1.1037//0022-0663.94.3.545

Akkerman, S. F., & Van Eijck, M. (2011). Re-theorizing the student dialogically across and between boundaries of multiple communities. *British Educational Research Journal iFirst Article,* 1-13. doi: 10.1080/01411926.2011.613454

Azevedo, F. S. (2012). The tailored practice of hobbies and its implication for the design of interest-driven learning environments. *Journal of the Learning Sciences,* (ahead-of-print), 1-49. doi: 10.1080/10508406.2012.730082

Baker, D., & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching*, *32*(1), 3-27. doi: 10.1002/tea.3660320104

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology*, *41*(3), 586-598. Retrieved from: http://aspheramedia.com/v2/wp-content/uploads/2011/02/Bandura1981JPSP1.pdf

Barron, B. (2006). Interest and self-sustained learning as catalysis of development: A learning ecology perspective. *Human Development, 49,* 193-224. doi: 10.1159/000094368

Beach, K. (1999). Consequential transitions: A sociocultural expedition beyond transfer in education. *Review of research in education*, *24,* 101-139. Retrieved from: http://www.jstor.org/stable/1167268

Bergin, D. A. (1999). Influences on classroom interest. *Educational Psychologist*, *34*(2), 87-98. doi: 10.1207/s15326985ep3402_2

Boeije, H. R. (2009). *Analysis in qualitative research*. London, England: SAGE Publications Limited.

Buccheri, G., Gürber, N. A., & Brühwiler, C. (2011). The impact of gender on interest in science topics and the choice of scientific and technical vocations. *International Journal of Science Education*, *33*(1), 159-178. doi: 10.1080/09500693.2011.518643

Cleary, T. J., & Zimmerman, B. J. (2004). Self-Regulation empowerment program: A school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychology in the Schools, 41*(5), 537-550. doi: 10.1002/pits.10177

COTAN. (2009). *Beoordelingssysteem voor de kwaliteit van tests* [Grading the quality of tests]. http://www.psynip.nl/website-openbaar-documenten-nip-algemeen/beoordelingssysteem.pdf

Dewey, J. (1913). *Interest and effort in education.* Boston: Riverside.

Diekman, A.B., & Eagly, A.H. (2008). Of men, women, and motivation: A role congruity account. In J.Y. Shah & W.L. Gardner (Eds.), *Handbook of motivation science* (pp. 434–447). New York: Guilford.

Eccles, J. S. (1993). Developmental perspectives on motivation. In J. E. Jacobs (Series Ed.), *School and family effects on the ontogeny of childrens' interest, self-perceptions, and activity choices.* (pp. 145 – 208). Lincoln: Nebraska Press.

Eccles, J. S. (2007). Families, Schools, and Developing Achievement-Related Motivations and Engagement. In J. E. Grusec, & P. D. Hastings (Eds.) *Handbook of socialization: Theory and research.* (pp. 665-691). New York: Guilford Press

Eccles, J. S., & Harrold, R. D. (1993). Parent – school improvement during the early adolescents years. *Teachers College Record*, *94*(3), 568 – 578. Retrieved from: http://rcgd.isr.umich.edu/garp/articles/eccles93e.pdf

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual review of psychology*, *53*(1), 109 - 132. doi: 10.1146/annurev.psych.53.100901.135153

Feist, G. J. (2012). Predicting interest in and attitudes toward science from personality and need for cognition. *Personality and Individual Differences, 52,* 771–775. doi:10.1016/j.paid.2012.01.005

Field, A. (2009). *Discovering Statistics Using SPSS.* London, England: SAGE Publications.

Frenzel, A. C., Goetz, T., Lüdtke, O., Pekrun, R., & Sutton, R. E. (2009). Emotional transmission in the classroom: Exploring the relationship between teacher and student enjoyment. *American Psychological Association, 101*(3), 705–716. doi: 10.1037/a0014695

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of research on adolescence, 20*(2), 507-537. doi: 10.1111/j.1532-7795.2010.00645.x

Gati, I., Krausz, M., & Osipow, S. H. (1996). A taxonomy of difficulties in career decision making. *Journal of Counseling Psychology, 43*(4), 510–526. Retrieved from: http://kivunim.huji.ac.il/courses/pdf/3/Gati,%20Krausz%20%26%20Osipow%20%281996%29%20JCP.pdf

Gniewosz, B., & Noack, P. (2012). The role of between-parent values agreement in parent-to-child transmission of academic values. *Journal of adolescence, 35*(4), 809-821. doi: 10.1016/j.adolescence.2011.11.007

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111-127. Retrieved from http://www.unco.edu/cebs/psychology/kevinpugh/motivation_project/resources/hidi_renninger06.pdf

Howitt, D. & Cramer, D. (2007). *Methoden en technieken en de psychologie.* Nederland: Pearson Benelux b.v.

JCU (2011). Junior College Utrecht: Alle ruimte voor bètatalent Schoolgids 2012-2013. Retrieved from http://www.uu.nl/SiteCollectionImages/Fac_Beta/JCU/JCU_Schoolgids12-13%20.pdf

Krapp, A. (1999). Interest, motivation and learning: An educational-psychological perspective. *European Journal of Psychology of Education, 14*(1), 23-40. doi: 10.1007/BF03173109

Krapp, A. (2002). Structural and dynamic aspects of interest development: Theoretical considerations from an ontogenetic perspective. *Learning and instruction, 12*(4), 383-409. doi: 10.1016/S0959-4752(01)00011-1

Krapp, A., & Prenzel, M. (2011). Research on interest in science: Theories, methods, and findings. *International Journal of Science Education, 33*(1), 27-50. doi: 10.1080/09500693.2011.518645

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among US students. *Science Education, 95*(5), 877-907. doi: 10.1002/sce.20441

Masterplan Bèta en Technologie. (2012). *Naar 4 op de 10: meer technologietalent voor Nederland* (Topsectoren van de Nederlands Economie in coöperation with Platform Bèta Techniek and the Groene Kennis Coöperatie). Retrieved from: http://www.top-sectoren.nl/humancapital/sites/default/files/documents/Masterplan%20B%C3%A8ta%20en%20Technologie.pdf

McCarthy, C. R. (1999). Dual enrollment programs: Legislation helps high school students enroll in college courses. *Journal of Secondary Gifted Education, 11*, 24–32. doi: 10.4219/jsge-1999-610

Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of Educational Psychology*, 85(3), 424-436. doi: 10.1037/0022-0663.85.3.424

Neitzel, C., Alexander, J. M., & Johnson, K. E. (2008). Children's early interest-based activities in the home and subsequent information contributions and pursuits in kindergarten. *Journal of Educational Psychology*, *100*(4), 782- 797. doi: 10.1037/0022-0663.100.4.782

Neitzel, C., Alexander, J. M., & Johnson, K. E. (2008). Children’s early interest-based activities in the home and subsequent information contributions and pursuits in kindergarten. *Journal of Educational Psychology*, *100*(4), 782-797. doi: 10.1037/0022-0663.100.4.782

OECD (Organization for Economic Co-operation and Development) and PISA (Programme for International Student Assessment). (2005). OECD Program for International Student Assessment 2006 [student questionnaire]. Retrieved from http://pisa2006.acer.edu.au/downloads/PISA06_Student_questionnaire.pdf

OECD (Organization for Economic Co-operation and Development). (2008). “Quantitative analyses: Is there a real decline?”, in Encouraging students’ interest in science and technology studies. Paris: OECD publishing. doi: 10.1787/9789264040892-3-en

Olszewski-Kubilius, P. (2009). Special schools and other options for gifted STEM students. *Roeper Review, 32*(1), 61-70. doi: 10.1080/02783190903386892

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: a review of the literature and its implications. *International journal of science education*, *25*(9), 1049-1079. doi**:** 10.1080/0950069032000032199

Phelan, P., Davidson, A. L., & Cao, H. T. (1991). Students' multiple worlds: Negotiating the boundaries of family, peer, and school cultures. *Anthropology & Education Quarterly*, *22*(3), 224-250. doi: 10.1525/aeq.1991.22.3.05x1051k

Robnett, R. D., & Leaper, C. (2012). Friendship Groups, Personal Motivation, and Gender in Relation to High School Students' STEM Career Interest. *Journal of Research on Adolescence.* Advance online publication. doi: 10.1111/jora.12013

Schiefele, U. (1991). Interest, learning, and motivation. *Educational psychologist*, *26*(3-4), 299-323.

Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic achievement: A metaanalysis of research. In K. A. Renninger, S. Hidi, & A. Krapp, *The role of interest in learning and development* (pp. 183–212). Hillsdale, NJ: Erlbaum.

Schreiner, C., & Sjoberg, S. (2004). *Sowing the seeds of ROSE*. Oslo, Norway: Unipub AS. Retrieved from http://roseproject.no/key-documents/questionnaire.html

Stake, J. E., & Mares, K. R. (2001). Science enrichment programs for gifted high school girls and boys: Predictors of program impact on science confidence and motivation*. *Journal of Research in Science Teaching*, *38*(10), 1065-1088. doi: 10.1002/tea.10001

Stake, J. E., & Nickens, S. D., (2005). Adolescent girls' and boys' science peer relationships and perceptions of the possible self as scientist. *Sex Roles*, *52*(1-2), 1-11. doi: 10.1007/s11199-005-1189-4

Stokking, K. M. (2000). Predicting the choice of physics in secondary education. *International Journal of Science Education, 22*(12), 1261-1283. doi: 10.1080/095006900750036253

Subotnik, R. F., & Jarvin, L. (2005). Beyond expertise. Conceptions of giftedness as great performance. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (2nd ed., pp. 343–357). New York: Cambridge University Press.

Woolfolk, A., Hughes, M., & Walkup, V. (2007). *Psychology in Education.* Edinburgh, England: Pearson Education Limited.

**Appendix A:**

**Vragenlijst interesseontwikkeling** **11 februari 2013**

Beste JCU leerling, deze vragenlijst is gemaakt om te kijken welk verband er is tussen jouw sociale omgeving, persoonlijke interesse en studiekeuze. Ik stel uitgebreide antwoorden erg op prijs, en deze helpen mij een om beeld te krijgen van jouw interesse. Het invullen van de vragenlijst neemt ongeveer 15 minuten in beslag.

In het kader van dit onderzoek willen we je vragen je naam en achternaam in te vullen. Je antwoorden worden alleen binnen het onderzoek naar interesseontwikkeling gebruikt en niet verstrekt aan derden. Het is mogelijk dat andere onderzoekers binnen dit project je benaderen voor bijvoorbeeld een interview.

De vragenlijst bestaat uit 37 vragen en ik zou het erg waarderen als je de tijd neemt om alle vragen zorgvuldig in te vullen. Het gaat erom dat we jouw mening te weten komen. Als je een antwoord wilt veranderen, kruis dit antwoord door en kleur een ander rondje in.

a) Wat is je naam? ______________________________

b) Hoe oud ben je? ______

c) Wat is je geslacht? O Man
O Vrouw

d) In welke jaargroep zit je? O 5 VWO
O 6 VWO

e) Welk beroep hebben je ouders/ verzorgers?
Moeder/ verzorgster: ______________________________________________________________________
Vader/ verzorger: ________________________________________________________________________

f) Welke opleiding hebben je ouders/ verzorger?
Moeder/ verzorgster: ______________________________________________________________________
Vader/ verzorger: ________________________________________________________________________

➔ De volgende vragen gaan over **jouw** interesses. De interesses **mogen met van alles te maken hebben**, ze kunnen school of JCU gerelateerd zijn maar dat hoeft niet. Het kan bijvoorbeeld iets zijn waar je graag mee bezig bent de afgelopen tijd.

1) Waar ben je in geïnteresseerd? (Dit kunnen meerdere interesse zijn)

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

2) Waar was je de afgelopen maand het **meest** in geïnteresseerd?

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

3) Waarom raakte je hier het meest geïnteresseerd in?

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

4) Wat heb je gedaan om over deze interesse meer te weten te komen? (Meerdere mogelijkheden)

O Ik gebruikte Google om meer te weten te komen

O Ik ging boeken lezen die hiermee te maken hebben

O Ik zocht naar tv-programma's of dvd's die hiermee te maken hebben

O Ik praatte met anderen hierover

- Namelijk met: __________________________________________________________

O Anders: _____________________________________________________________________

5) Was er iemand **door** wie je geïnteresseerd raakte? En zo ja, wie? (Geen naam, maar zijn/haar relatie met jou. Bijvoorbeeld mijn beste vriend, opa, zus etc.)

______________________________________________________________________________

6) Wat deed diegene waardoor jij geïnteresseerd raakte?

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

➔ Geef bij de volgende **kennisgebieden** aan in hoeverre je geïnteresseerd bent. Het gaat hier **niet** om schoolvakken.

| Ik ben geïnteresseerd in | Niet<br>Heel erg | | | | | |
|---|---|---|---|---|---|---|
| 7) Wiskunde | O | O | O | O | O | O |
| 8) Biologie | O | O | O | O | O | O |
| 9) Aardrijkskunde | O | O | O | O | O | O |
| 10) Economie | O | O | O | O | O | O |
| 11) Psychologie | O | O | O | O | O | O |
| 12) Talen | O | O | O | O | O | O |
| 13) Informatica | O | O | O | O | O | O |
| 14) Geschiedenis | O | O | O | O | O | O |
| 15) Maatschappijwetenschappen | O | O | O | O | O | O |
| 16) Scheikunde | O | O | O | O | O | O |
| 17) Filosofie | O | O | O | O | O | O |
| 18) Natuurkunde | O | O | O | O | O | O |
| 19) Statistiek | O | O | O | O | O | O |

20) Het volgende is op mij van toepassing:

O Ik ben heel breed geïnteresseerd

O Ik ben erg geïnteresseerd in bèta, maar niet zo in andere kennisgebieden

O Ik ben erg geïnteresseerd in één of twee kennisgebieden, namelijk______________________________________________________________________

O Anders, namelijk:

______________________________________________________________________

21) Hoe belangrijk zijn de volgende personen voor jouw interesse in de bètawetenschappen?

| | | |
|---|---|---|
| - Vader/verzorger | Niet | Heel erg |
| | O O O O O O O | |
| - Moeder/verzorgster | Niet | Heel erg |
| | O O O O O O O | |
| - Docenten van het JCU | Niet | Heel erg |
| | O O O O O O O | |
| - Klasgenoten van het JCU | Niet | Heel erg |
| | O O O O O O O | |
| - Vrienden buiten het JCU | Niet | Heel erg |
| | O O O O O O O | |

➔ De volgende vragen gaan over de studie- en beroepskeuzes die jij wellicht al hebt gemaakt, of gaat maken. We stellen duidelijke uitgebreide antwoorden erg op prijs.

22) Welke vervolg**opleidingen** overweeg je?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

23) Welke vervolg**opleiding** zou je **nu** kiezen?

______________________________________________________________________

24) Waarom kies je voor deze **opleiding**?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

25) Ken je iemand met deze **opleiding**? En zo ja, wie? (Geen naam, maar zijn/haar relatie met jou. Bijvoorbeeld mijn oom, oma, neef etc.)

______________________________________________________________________

26) Welke **beroepen** zou je wel willen uitoefenen?

_______________________________________________

_______________________________________________

_______________________________________________

27) Welk **beroep** zou je het liefst willen uitoefenen?

_______________________________________________

28) Waarom zou je dit **beroep** graag uitoefenen?

_______________________________________________

_______________________________________________

_______________________________________________

29) Ken je iemand met dit **beroep**? En zo ja, wie? (Geen naam, maar zijn/haar relatie met jou. Bijvoorbeeld mijn tante, opa, moeder etc.)

_______________________________________________

➔ Geef voor de volgende stellingen aan in hoeverre je het hier mee eens bent.

30) Ik praat met **vrienden** die **<u>niet</u>** op het JCU studeren over bètawetenschappen

Oneens Mee eens

O O O O O O O

31) Ik wordt aangemoedigd door mijn **ouders/ verzorgers** om mij in de bètawetenschappen te verdiepen

Oneens Mee eens

O O O O O O O

32) **Klasgenoten van het JCU** zetten mij aan het denken over de bètawetenschappen

Oneens Mee eens

O O O O O O O

33) **Docenten van het JCU** trekken mijn aandacht naar informatie die ik relevant vind voor mijn inhoudelijke kennis van de bètawetenschappen

Oneens Mee eens

O O O O O O O

34) Ik stel **klasgenoten van het JCU** vragen om zelf meer te weten te komen over bètawetenschappen

Oneens Mee eens

O O O O O O O

35) **Vrienden** die **niet** op het JCU studeren vragen mij naar mijn studie en wat ik doe op school

Oneens Mee eens

O O O O O O O

36) **Ouders/ verzorgers** schaffen multimedia aan die te maken hebben met bèta (Tijdschriften, dvd's, boek etc.)

Oneens Mee eens

O O O O O O O

37) Ik vraag **docenten van het JCU** uitleg om meer kennis te krijgen over bètawetenschappen

Oneens Mee eens

O O O O O O O

Bedankt voor het invullen van de vragenlijst!

Deze vragenlijst is gemaakt door Jurg van der Vlies en voor meer informatie kun je mailen naar j.vandervlies@students.uu.nl.

Deze vragenlijst is een onderdeel van een overkoepelend onderzoek naar interesseontwikkeling van leerlingen aan het JCU. Annerose Louwaard voert een onderzoek uit dat parallel loopt aan deze vragenlijst. Zij wil voor haar onderzoek leerlingen interviewen, en wil deze leerlingen selecteren aan de hand van de resultaten van deze enquête. Wil je een kans maken om mee te doen met het onderzoek van Annerose Louwaard vul dan hieronder jouw e-mailadres in. Op deze wijze kan zij contact met je opnemen.

Sanne Akkerman en Arthur Bakker zijn bezig met de ontwikkeling van een Android-app voor op je smartphone om zo jullie interesses te kunnen volgen. Deelnemers die hun emailadres invullen maken kans mee te doen aan dit onderzoek en kunnen doordat ze deze app gebruiken kans maken op leuke prijzen!

e-mailadres: ______________________________________________________________

Android-Smartphone: Ja/ nee

1st version 14th December 2012

2nd version 15th January 2013

3rd version 11th February 2013