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Motivated Behavioral Choices of Young Technological Talents - From Adolescence to Career Success

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Abstract: Technical abilities are fundamental to human existence. At each stage within the cycle of life, humans continuously strive to acquire new skills or to refine existing ones in the hope that productivity and quality of life are enhanced. Despite the fact that skilled behavior underlines nearly every human activity, our understanding about the factors that contribute to the attainment of expertise in technology education is far from complete. Not to mention, that we do not really know what is needed in career success for technological professions. This article builds on earlier research that defined and assessed technical abilities among adolescents. The aim of the study was to examine determinants of technological competence and try to predict student potential for career success. It tracks the students whose technical abilities were assessed in a study twenty five years ago. The follow-up study was carried out as a qualitative case study. Although, we must be cautious about final conclusions because of the limited number of research subjects, the study shows that it is possible to predict student potential for career success in the technical professions. However, the process in making motivated behavioral choices in the area of technology seems to be much more complicated for technologically talented females than for males.

Keywords: Motivated behavioral choices, Technological talent, Career success

Introduction

The aim of this study was to find out if it is possible to predict students' potential for career success in technological professions by using the Expectancy-Value theory. In addition, this study examined how the best male and female students have progressed during last twenty five years. Are they working in technological area or did they end up in other professions? Another point of view was to determine the elements accounting for the participants' motivated behavioral choices in the area of technology. The main research questions were as follows:

1. Is it possible to predict career success in technological professions?
2. What were the main elements in test participants' motivated behavioral choices in the area of technology?

The results from each participant interview are shown in a figure based on Eccles (2009) Expectancy Value Model of Motivated Behavioral Choice. The model indicates each person's motivated behavioral choices in the area of technology during their life. These figures based on the expectancy value theory will be explained in more detail later.

Motivated Behavioral Choices

During the interviews, typical elements affecting motivated behavioral choices in the area of technology were identified. These were classified according to the Eccles (2009) Expectancy Value Model of Motivated Behavioral Choice. Theory can be used as a conceptual framework for understanding how youth come to choose and pursue a given career (Wigfield & Eccles, 1992; Eccles, 2008). According to Expectancy-Value Theory, students' achievement related choices are mostly determined by two factors, expectancies for success, and

subjective task values. Expectancies refer to how confident an individual is in his or her ability to succeed in a task whereas task values refer to how important, useful, or enjoyable the individual perceives the task.

Furthermore, the model conceptualizes the value an individual associates with a given career choice as based on complex web of influences deriving from personal characteristics and various social contexts (e.g. peer group, gender roles, parental expectations). The most recent model consists of several factors or themes including: a distal cultural milieu with the cultural stereotypes and behaviors of key socializers. In addition, individual's perceptions of emerging self-knowledge is generating future goals and shaping self-confidence. Furthermore, individual characteristics and experiences are important while making the interpretations of previous experiences. These elements are later turned out to the expectation of success and into subjective task values. Finally based on the experiences in life and complicated decisions between all the elements in the model, the individuals are making motivated behavioral choices.

Study Method

Case study research excels at bringing us to an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships (Stake, 1995). It is correct that the case study is a detailed examination of a single example, but it is not true that a case study cannot provide reliable information about the broader class (Flyvbjerg, 2006).

The research was carried out as a qualitative case study and the data was collected from individual theme interviews. The interviews were first tape-recorded and transcribed. Themes were identified and the portraits of each subject established. Later the data was analyzed using the content analysis methodology. The analysis was carried out by assessing which of the essential elements in the Expectancy Value Model contributed motivated behavioral choices in the area of technology during test subjects' lives. These findings were later classified according to the themes and were reported in the conclusions. Prior to the interviews, the researcher had a short e-mail discussion with each test participant about the concept technological competence and about the Expectancy Value Model of Motivated Behavioral Choice. However, Expectancy Value Model was just a starting point and as the interviews were based on self-reports, there was no right or wrong answers in the conclusions.

Study Participants

The study group consisted of two male and two female. They were born in 1980 and 1982 and when tested for technological competence twenty five years ago as students they achieved the best results in boys' and girls' test groups. The definition of technological competence was based on Autio and Hansen (2002) who defined technological competence as an interrelationship between technical abilities in psychomotor, cognitive, and affective areas. A simplified model of technological competence is described in Figure 1.

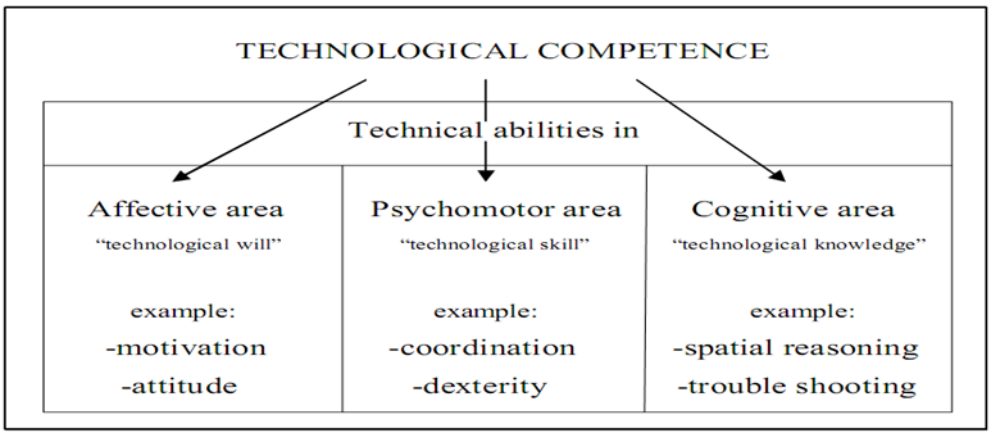

Figure 1. Technological competence

The test subjects were selected according to overall accomplishment in all three areas. In the original test group twenty five years ago comprising 267 participants. More information of the research and test instruments, etc. in the original study is available in Autio and Hansen (2002). According to the test results twenty five years ago, it was easy to conclude that the selected test subjects were technologically talented and what's more they were definitely talented enough to pursue on a technological career.

The researcher had no previous knowledge of the test subjects' current employment status. Fortunately, the background of each test subject was somewhat different, but there were enough similarities in the elements behind their motivated behavioral choices in the area of technology to make some conclusions. The test participants were difficult to trace, but with the help of their old teachers, old school mates and the internet this was done after two months of investigation. The test participants were:

Subject 1 - multi-talent with plenty of options. He was born 1980 in Helsinki which is the capital of Finland. His first school years were spent in a normal primary school, but at secondary and upper secondary level he studied at one of the highest ranked upper secondary schools in Finland. He lived with his parents and one younger brother. Both parents had earned Masters of Science in technology and both worked at the State Technical Research Centre. Many of his older relatives had also studied at the University of Technology.

Subject 2 – from vocational school to engineering career. He was born in 1980 and spent his school years in the same village as Subject 1. Both were exposed to technology education in the same primary and secondary schools. Following secondary school, he moved to a larger city with approximately 100000 inhabitants to study in vocational school. He lived with his parents and had two elder brothers and two sisters. His father worked as a taxi driver, but was a main owner of a local bus company. His mother worked in a bank.

Subject 3 – difficult choice - machine technology or an architect. She was born in 1982 and spent her school years in Helsinki area. She lived with her parents and a little sister. Her father had earned Master of Science in Technology (machine technology) and her mother was Master of Science in Economics and Business Administration. Her little sister was currently studying in Italy (bio information technology).

Subject 4 – technology or childhood dream as veterinarian. She was born in 1982 and she spent all her school years in University training school in Helsinki area. She lived with her parents and sister. The family was just an ordinary Finnish family with no academic degrees. Her father was a janitor and her mother was a homemaker, whom occasionally worked in a food store.

One of the male study participants had finished his studies at the University of Technology. However, in the beginning he was interested in several other areas as well and he could have chosen a number of other careers. The other male study participant was equally talented in technical matters; unfortunately he was not particularly interested in other school subjects while being in comprehensive school. So he began to study computers and automation technology in vocational school instead of continuing in a more academic direction. Both female study participants had also studied at the University of Technology. The first was quite sure of her decision of choosing a technology career already after secondary school, but the second had a lower self-concept related to technology and started her studies in the University of Technology a couple of years later.

Results

Each test participant's educational path related to technology is presented in the next section. The descriptions of the educational paths were based on the Expectancy Value Model of Motivated Behavioral Choice. The model was first introduced to the test subjects by e-mail and then discussed within the theme interviews in more detail. The elements of the motivated behavioral choices of each test subject are described more precisely in Figures 2-5. As the results were based on self-reports no absolute value was given to the strength of the particular elements.

Subject 1 - multi-talent with plenty of options

Subject 1 finished upper secondary school in 1999 with good grades (overall 9.4 / 10.00). As most of his school mates had very ambitious career plans, he was planning studies in medicine as well. However, after compulsory military service he decided to study automation technology at the University of Technology. In 2007, he completed Master of Science in technology and began working for an international company which

manufactures hospital automation devices. He feels comfortable in his job, enjoys the innovative working atmosphere, and thinks that his technological competence will still improve in the future.

Subject 1 had become acquainted with technology in early childhood through familiarity with Lego and radio-controlled (RC) cars. His family was competent in technology and his mother in particular was very supportive, often fixing toys with the children. Subject 1's motivation was based on a child's curiosity and he wanted to know how toys worked. The teacher was also very competent and could create an open and atmosphere, while maintaining rational planning, investigation, implementation, and evaluation processes. It was easy to talk with the teacher, whose feedback was rewarding, and developed skills and technical thinking further.

In upper secondary school Subject 1 had to concentrate more on academic subjects and was not at all sure that he would choose a technology-related profession in the future. He was interested in physics, chemistry, and mathematics, but still wanted to find a balance between theory and practice. Computers gave him a new chance to develop his technological competence without being too theoretical. This was one of the main reasons why he chose automation technology as his major subject at the University of Technology. Today he sees the inspiring and technically open environment of his work as the main factor in his development. As well, his good friends with a common interest in technology provide him with support and new ideas to develop his competence further. The elements behind Subject 1's motivated behavioral choices are presented in Figure 2.

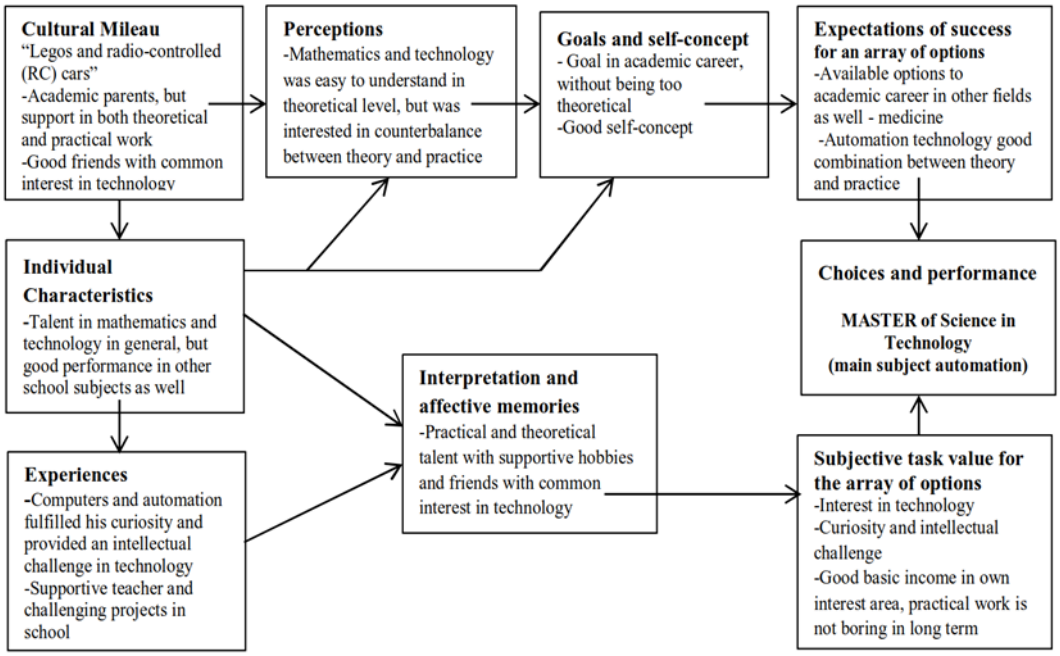

Figure 2. Elements behind Subject 1's motivated behavioral choices

Subject 2 – from vocational school to engineering career

Subject 2 finished secondary school in 1997. His grades were not particularly good (overall 7.3 / 10.00) and instead of choosing an academic career and upper secondary school, he began to study computers and automation technology in vocational school. After finishing in 2000, he did his compulsory military service where he had an opportunity to work with optical cables and computers. He also became interested in the mechanics of tanks and other vehicles. He began his studies in automation technology in polytechnics and in 2005 he graduated as an engineer and started working in an engineering office as an electrical wiring designer. In his current post in an international mining and construction company - he feels comfortable and enjoys the innovative working atmosphere.

Subject 2 had become familiar with technology in early childhood, using Lego and emulating his elder brothers. There was plenty of stimulation at home. His father had good facilities for working on cars, tools of all kinds, and available machines. At least he thinks, there was no significant increase in his competence during primary school as he had seen his elder brothers working with real cars, there was nothing interesting in making wooden toys. In secondary school, however, electronics in particular provided him a challenge and he generally felt

much better as he had more freedom and his choices were respected by the teacher; this was not the case with several other school subjects.

Subject 2 was gifted with his hands so he could concretely witness his own development in the products he produced (e.g. an infrared light gate and metal detector). He felt comfortable in technology education classes, but his competence developed even more through his hobbies than through school. When he was older and more skillful his two elder brothers allowed him to repair cars with them as a respected co-worker and not just a pain in the neck.

After finishing secondary school Subject 2 went on to study in vocational school. This presented him with a new kind of challenge as he could concentrate on areas of special interest and develop his technological talent. Later his competence in technology was developed by his studies in automation technology. Although he was not especially good in several school subjects during his earlier school years he graduated from polytechnic school near the top. In his current post in an international company, he feels he could have learned more languages at school, but his choice of moving straight into vocational school was the best decision in terms of his talent and interests. According to him, how his technological competence develops in the future will depend on interesting and challenging future projects. The elements behind Subject 2's motivated behavioral choices are presented in Figure 3.

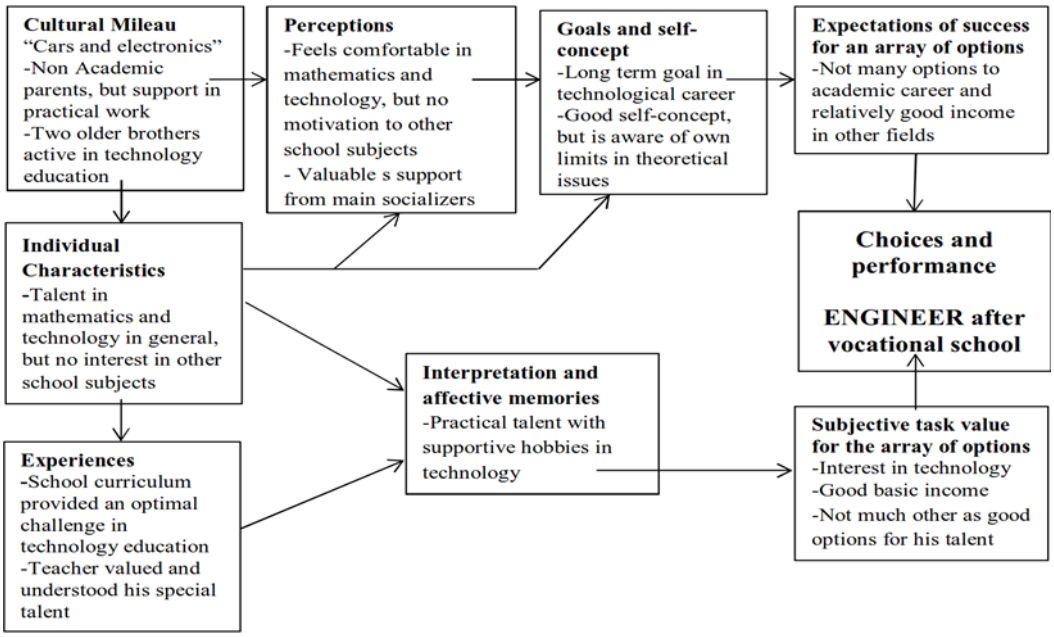

Figure 3. Elements behind Subject 2's motivated behavioral choices

Subject 3 – difficult choice - machine technology or an architect

Subject 3 finished school in 2001 with good grades (average of all school subjects over 9.0 / 10.00). After finishing upper secondary school, she started to study machine technology at the University of Technology. However, after five years she changed her major to Architect. Currently, she is working in an architect office and having a couple of years to finish her degree.

Subject 3 had become familiar with technology in early childhood, using Lego but she played with Barbie as well. Subject 3 responded positively to technology education: already early in comprehensive school and she was interested in how things work in general, but any products were not especially interesting. The teacher was capable although the test subject thought that he was a little bit frightening for a small girl. Furthermore, she had no friends with the same interest area to join her in technology education lessons. His father was a good role model, but she did not get much support for her technological talent as father was not at home too often because of his work. In any case, the support from her main socializers was limited and in upper secondary school she noticed her technological talent mainly because he was good in mathematics, not because of her accomplishment in technology.

Yet she received the best encouragement from being able to understand how things work in everyday life. Her self-confidence in technology was high and actually she did not need much support as she felt comfortable in the technological world. While her later studies in machine technology she got more experiences in real life technological environment. She became acquainted with welding and making concrete elements. She felt comfortable but noticed that her skills were limited at least when compared with other students who had much more experience from the technological world during their hobbies. Anyway she thought that her competence in technology developed but she had no passion for any special phenomena in technology. Furthermore, she had no technologically related hobbies to develop her competence further. In the long term, to study machine technology seemed to be meaningless to her future. Because of this, she decided to change her major and started studying to be an architect. As she was a woman of diverse talent, she felt this area much more rewarding to herself. She could fulfill her technological interest with different points of view: design, different materials, weather conditions and sociological elements. As she had finally found a technological area that suits her talent, she is willing to accept 3-4 years of more studies and even lower salary. Her choice corroborates with the idea that women seem more likely than men to be involved in, and to value, competence in several activities simultaneously (Baruch, Barnett & Rivers, 1983). The elements accounting for Subject 3's motivated behavioral choices are described in Figure 4.

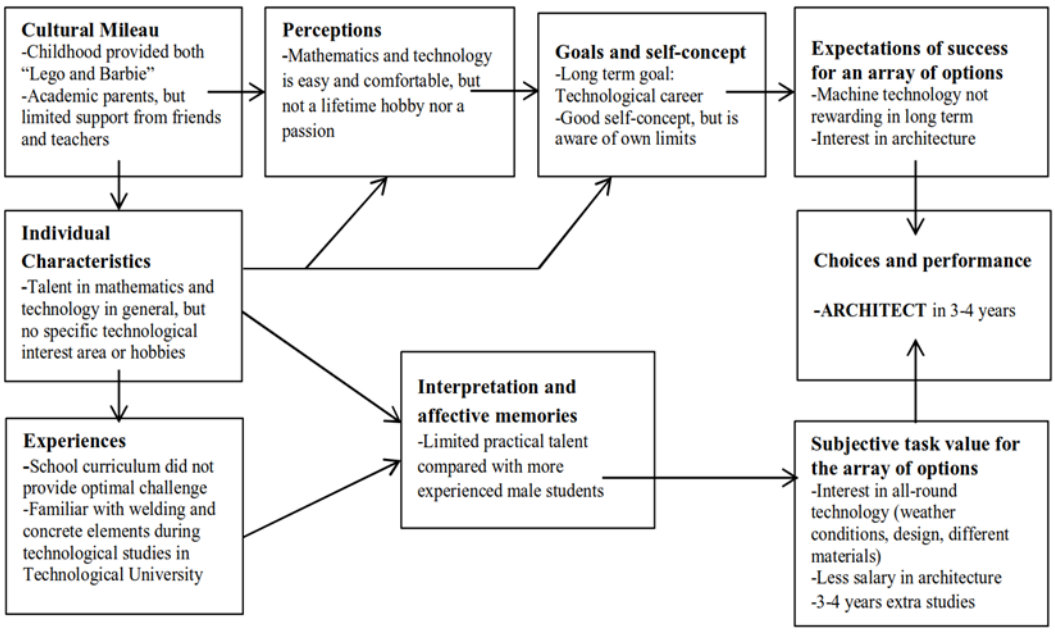

Figure 4. Elements behind Subject 3's motivated behavioral choices

Subject 4 – technology or childhood dream as veterinarian

Subject 4 finished school in University training school 2001. The school was one of the highest ranked upper secondary schools in Finland. She was good in several school subjects and graduated with good grades (average of all school subjects about 9,3 / 10.00). After finishing upper secondary school, she started to study computer science 2002 in vocational high school. However, as the studies were not as practical as she expected, she found out quite soon that this was not what she wanted to do for the rest of her working life. In the year 2003 she changed to study environmental technology in a smaller town close to Helsinki area in vocational high school. She felt comfortable in her studies and noticed her technological talent and finally she had enough self-confidence to take part in the qualification exam of technological University in Helsinki. In the year 2004 she started to study material technology in the technological University. Currently as single mother she has had some breaks in her studies, but she thinks she could graduate as a Master of Science in Technology in 1-2 years. However, she still wonders that her life as a single mother would be much easier if working as a veterinarian, which was her childhood dream.

Since her early childhood Subject 4 has been involved in technological area as her father always made renovations or was working with cars. Fortunately, she was the favorite girl of her father and she could join him in all the work he was doing as a janitor. Subject 5 also had an opportunity to take some extra technology education lessons while studying in upper secondary school; especially she enjoyed the internal combustion engine course. The teacher was encouraging and like-minded and she thought that her self-confidence grew up

when she could show the boys that her skills and knowledge in technological area were remarkable. In addition, she has always felt comfortable in analytical thinking required in technological area. However, she has never had any specific aims or specific hobbies regarding to technology. To develop her technological competence further she thinks that she still needs continuous encouragement as her self-confidence in real life is still limited.

Currently, she is in the middle of hard decisions. As a single mother her life could be much simpler while working as a veterinarian. She thinks that she could organize her daily routines much easier by having a private practice. On the other hand, she could finish her studies in material technology and graduate as a Master of Science in Technology in 1-2 years. Although she thinks that her ability suits well in her current study area, she knows that in technological area a diploma is not enough - updated knowledge is required all the time. While working as a veterinarian as much updating training is not needed. Her choice is consistent with the statement that mathematically talented woman go into the biological and medical sciences instead of physical sciences and engineering (Vida & Eccles, 2003). The elements accounting for Subject 4's motivated behavioral choices are described in Figure 5.

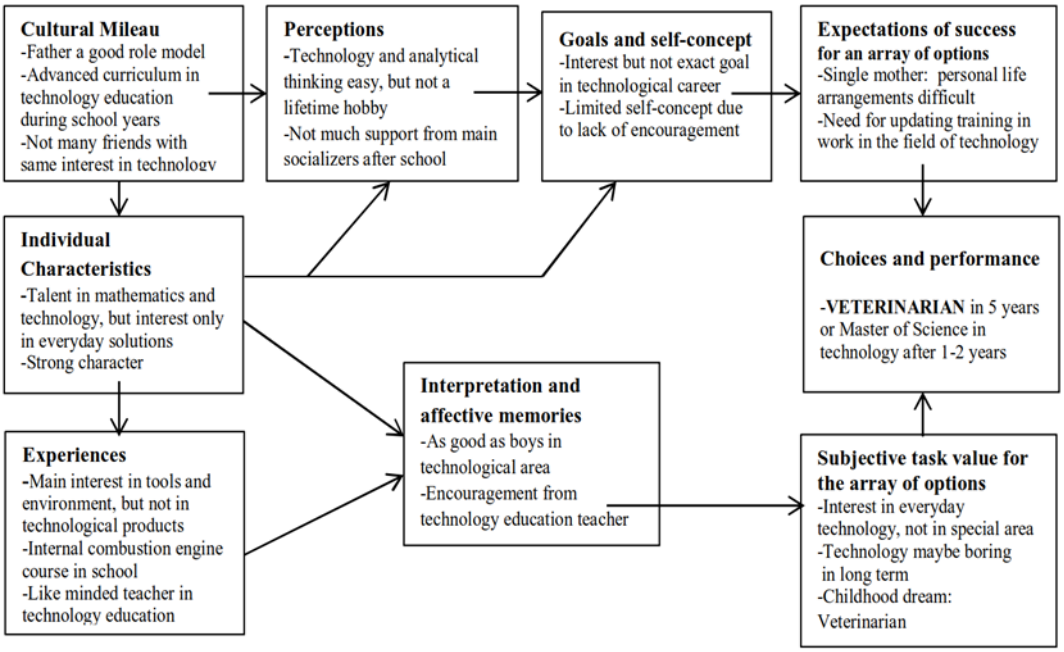

Figure 5. Elements behind Subject 4's motivated behavioral choices

Discussion

This study tried to find out: Did technologically talented males and females end up in technological careers? The research showed that both test participants were currently studying or had finished their studies in Technological University. Based on this finding, we can assume that it is possible to predict student potential for career in technologically related professions. However, the process in making motivated behavioral choices in the area of technology seems to be much more complicated for technologically talented females than for male. Female and male first year students are equally likely to have taken and earned high grades in the prerequisite math and science classes in high school and to have confidence in their math and science abilities (Brainard & Carlin, 1998; Vogt, Hocevar & Hagedorn, 2007). Hence, in this study the main difference seemed to be that technologically talented female assessed her technological abilities lower than male with same achievements and held her higher standard believing that she had to be exceptionally successful in technological field. This seems to be common phenomena in other technological subjects as well as can be conducted from Hill, Corbett and St.Rose (2010).

Another distinguishing element was the support from main socializers in the field of technology as female test participant reported limited support from parents, teachers or friends. Adolescents are especially concerned with peer relationship and may be in special need of close adult relationship outside of the home (Eccles, 2008). Reeve, Bolt, and Cai (1999) have shown that teachers who support students' autonomy in decision-making create more intrinsic motivation than those who intend to control their students. Support of autonomy is evident when an authority figure respects and takes the subordinate's perspective, promotes choices, and encourages

decision-making (Ratelle, Larose, Guay, & Senecal, 2005). Furthermore, parents, teachers and peers tell people what they are good at or not good at with very little information on which to base such conclusions (Eccles, 2009). Closely related to the effect of main socializers seems to be social networking. With fewer friends in the same interest area technologically talented females had limited supportive relationships. Prior research states that increase in social networking is predictive of increased job search intensity and many of the contacts assist career-directed behavior (Mortimer, Zimmer-Gembeck, Holmes & Shanahan, 2002). Furthermore, supportive relationships have been shown to facilitate adolescents' career exploration (Kracke, 2002). Thus social connections can either directly support career entry, or play an important role by pointing out a feasible path toward career attainment that makes an individual better prepared to choose their career and establish an effective plan toward establishing that career (Shane & Heckenhausen, 2012).

The next study question was: What were the main elements in test participants' motivated behavioral choices in the area of technology? According to Eccles (2009) the kinds of educational and vocational decisions that might underlie differences in participation in physical science and engineering would be most directly influenced by individuals' expectations for success and the importance or value individuals attach to the various options they see as available. In this study, it was seen that many elements have an influence on the motivated behavioral choices in the area of technology already long before the test participants consider expectations for success or give value to the options they see as available. Consistent with the most recent simplified version of the Expectancy value model of motivated behavioral choices (Eccles, 2009); cultural milieu, individual characteristics and previous experiences seemed to be the main elements in the beginning of the process in motivated behavioral choices. If these elements are not in balance, the individuals' do not actively, or consciously, consider the full range of objectively available options in making their selections. What's more, many options are never considered because the individual is unaware of their existence or the individuals think these options are not realistically available to them (Eccles, 2008).

In the measurement of technical abilities twenty years ago the test participants were found to have technological talent and it was easy to conclude that the selected test subjects' individual characteristics were suitable for a technological career. According to Byman (2002), students usually prefer and choose subjects and tasks, in which they are proficient and can show their competence. In addition, Eccles (2009) predicts that people select those activities for which they feel most efficacious or for which they have the highest expectations for success. Furthermore, Betz and Hackett (1986) demonstrated a link between the ratings of personal efficacy in various academic subjects and career choice. In addition, all study participants had an opportunity to join technology education lessons in a school with advanced technology education curriculum. Although, the curriculum was not always optimal when providing technology for young girls, all test participants had experiences in the field of technology and were at least aware of the existence to consider this option as available. What's more, the schools were clearly aware of the gender role and cultural stereotypes. During the interviews, none of the test participants mentioned these elements as negative features. Vice versa all of them mentioned that they had positive feedback about their mathematical talent and they were not stereotyped as nerds or as a people with little direct human relevance.

Conclusions

In this study, the male and female student who had the best overall results in the measurement of technical abilities twenty five years ago were followed. Due to the long timeline, the study had obvious limitations: the research group was small and we can't be sure how well the participants remembered their pasts or did the researcher misunderstand some of the details during the interviews and in any case the self-reports are always quite subjective. In addition, the real action in making motivated behavioral choices is a much more complicated process than we can describe with a single figure.

It is easy to conclude that most of the differences between male and female can be explained by the support from the main socializers. Unfortunately, this seems not to be the whole picture. Most important elements that affected male participants' career decisions were technological talent, curiosity, interest and intellectual challenge. Other than talent, were not mentioned during the interview of the best female and it was clearly seen that their interest was restricted in everyday technology not in special areas. Technology-related hobbies (e.g. Lego, computers, cars, and electronics) were definitely another very important element between male and female. It is quite obvious that technology related hobbies which were started early in the childhood had a positive effect on technological talent which for its part generated more interest and curiosity on technology related activities. After a while these adolescents had also much better self-confidence in technological matters. Obviously this helped them to stay committed to a goal despite distractions and unexpected difficulties. In the

end it was much easier to make motivated behavioral choices. In other words as stated in Shane and Heckenhausen (2012) career-related personal control beliefs in primary control-contingent casual factors will lead an individual to extend motivational engagement to pursue career-related goals. Another fact seems to be that technologically talented females are more likely than men to be involved in, and to value, competence in several activities simultaneously (Baruch, Barnett & Rivers, 1983) and that mathematically talented woman go into the biological and medical sciences instead of physical sciences and engineering (Vida & Eccles, 2003). Hence, the process in making motivated behavioral choices in the area of technology seems to be more complicated for technologically talented females than for males.

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