Choice or Consequence? Explaining Differences in Female Participation in Mathematics, Science and Technology in the Netherlands and Sweden
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CHAPTER 5

Freja and Fleur are not that different: Swedish and Dutch girls’ intentions to study mathematics, science and technology

A slightly different version of this chapter is currently under review at an international peer-reviewed journal as Yazilitas, D., Svensson, J.S., Saharso, S. (2016). Freja and Fleur are not that different: Swedish and Dutch girls' intentions to study mathematics, science and technology.
Abstract
Female students in Sweden opt more often for mathematics, science and technology (MST) than female students in the Netherlands. This study tries to explain this difference using a quantitative approach to compare differences in high school students’ perceptions of MST fields on six key factors that are expected to affect the choice for MST. We hypothesize and also find that students’ intentions to opt for MST in higher education can be explained to some extent through differences in these perceptions and differences in the weight students assign to each of the six factors when making a study choice. We find that Dutch girls not only associate MST with the lowest scores on each of the six factors, which makes them different not only from Dutch boys but also from Swedish girls. Moreover, we find that Dutch girls assign more significance to these lower scores when making their study choices. However, differences between Swedish and Dutch girls are smaller than initially expected and as such insufficient to really explain the large difference in female participation in MST fields in higher education.
5.1 Introduction
Female participation in higher education has risen sharply in recent decades. In most EU and OECD countries more than half of all students in higher education are now female. Yet, female participation in mathematics, science, and technology (MST) remains low. This lagging female participation in MST is a worldwide phenomenon of concern to many (Caprile et al., 2012; Marchetti & Raudma, 2010; Organisation for Economic Co-operation and Development [OECD] 2006a).

The research literature provides three types of explanation for this gender imbalance in MST: micro-level explanations, macro-level explanations and institutional explanations. It is clear, however, that each of these individual types of explanation falls short in explaining the sometimes remarkable differences in gendered study choice patterns across countries, and that explaining such differences requires a deeper understanding of the interactions between individual choice processes and factors at play at the macro-level and institution-level (Yazilitas et al., 2013).

This paper reports on a study that focuses on understanding the remarkable differences in gendered study choice patterns between Sweden and the Netherlands. In spite of similar levels of gender equality and socioeconomic development, it is observed that female participation in MST in Sweden is two-and-a-half times higher than in the Netherlands (Eurostat, 2012; United Nations 2014a, 2014b, 2014c, 2014d; World Economic Forum, 2014, 2015).

The quantitative study reported in this paper was conducted as a follow-up on two separate qualitative exploratory studies in the Netherlands and Sweden, which revealed gendered study choice patterns which were in fact very similar in both countries, with students focusing mostly on the same, limited, set of factors (Yazilitas et al., 2016a, 2016b). Moreover, these studies showed that the weight attributed to these factors when making study choices was not only determined by the individual characteristics of the student, but also by the different national and institutional contexts.
5.1.1 Aim of this study

In this paper we focus on testing three hypotheses derived from our previous studies. The central research question reads: To what extent do boys and girls in Sweden and in the Netherlands differ in their evaluation of MST fields in terms of a) the evaluation of MST fields on the factors considered most important for their study choice and, b) the relative weight they give to these factors?

In the next paragraph, we present the theory used and the results of the previous qualitative studies to arrive at the hypotheses we will test. In paragraph 3 we explain the research method. In paragraph 4 we present our findings. In paragraph 5 we present a short discussion. The article ends in paragraph 6 with our conclusions.

5.2 Theory and previous research

The research literature on gender imbalances in MST fields provides various explanatory frameworks, at various levels of aggregation.

Explanations at the micro-level refer to individual student characteristics. An example is the finding that girls’ mathematics self-efficacy beliefs – that is, their confidence in their own mathematics abilities and skills – tend to be lower than boys’. This would explain why girls opt for MST less often (Bussey & Bandura 1999; Lent, Brown & Hackett, 1994). Within this framework, gendered patterns in academic choice in MST are also explained through different values that men and women attach to various options available to them, especially in relation to utility, attainment and cost. Differences in these subjective task values of men and women, would then explain why boys and girls choose different subjects within the education system, (Eccles [Parsons], Adler, Futterman, Goff, Kaczala, Meece & Midgley, 1983; Eccles, 1994, 2005; Jacobs, 2005). This is also evidenced, for example, by the finding that in general, girls display much greater value and enjoyment in biology, chemistry or life science than boys. Boys on the other hand show much greater value and interest in mathematics and physics than girls (Nagy, Trautwein, Baumert, Köller, Garrett, 2006).
Explanations at the institutional level relate gender differences in study choice to characteristics of the education system. For example, countries with highly differentiated education systems are found to produce more gender inequality than countries with less differentiated systems (Charles, 2011; Van Elk, Van der Steeg & Webbink 2011; Wößmann 2009). Related to this effect of differentiation is the effect of freedom of choice. In countries in which students are given more freedom to choose between alternative trajectories, gendered patterns of educational choice in MST are, for example, found to be less equal (Abiss, 2009; Van Langen, 2005; Van Langen & Dekkers, 2005; Van Langen, Rekers-Mombarg & Dekkers, 2008; Van de Werfhorst, Sullivan, & Cheung, 2003).

Explanations at the macro-level focus on societal factors, such as dominant cultural values and gender roles, which can explain different patterns in different societies. Here, Schreiner and Sjøberg (2004; Schreiner, 2006; Sjøberg and Schreiner, 2005) have applied Inglehart’s modernization theory (1997; Inglehart & Norris, 2003; Inglehart & Welzel, 2005), to provide an insightful explanation for the paradoxical gender imbalances in study choice in Western Countries. They argue that economic development and prosperity, in these countries, has led to an increased dominance of postmaterialist values, and that as a result study choices are more based on intrinsic motivation and on the connection of study fields to students’ core identities. Following this assumption, Schreiner and Sjøberg argue that both men and women in late modern societies, when offered a choice between different alternatives in higher education, will tend to choose study fields which are more in line with their gender roles, which leads to a division in male and female fields of study.

As elaborated in the earlier literature study (Yazilitas et al., 2013), it is obvious, that each of these analytic frameworks indeed helps to understand a piece of the puzzle of gendered study choice. However, it is also clear that focusing on each of these pieces separately may obfuscate the puzzle as a whole, which is essentially about how these pieces interlock in practice. Given the scientific evidence available, it is now clear that individual, cultural and institutional factors all play a role in explaining gendered patterns of
choice in MST fields. Yet, still little is known about the way these factors interact when students make their actual choices.

In order to get more insight in this latter issue, we examined Dutch and Swedish high school students’ intentions to choose MST fields among a range of study fields. As explained before, female enrolment in MST fields in Sweden is two-and-a-half times higher than in the Netherlands. So we set out to study this difference in female enrolment in MST fields between Sweden and the Netherlands, taking into account the effects of factors at play at the different levels.

5.2.1 Results of previous research in the Netherlands and in Sweden

This study of the differences in female enrolment in the Netherlands and Sweden started with separate case studies in both countries in which we explored the educational systems and conducted semi-structured interviews with the students about their study choices (Yazilitas et al., 2016a, 2016b).

The semi-structured interviews followed a topic list based on the existing literature. The interviewer started with a short explanation about the research. This was followed by asking what program the interviewee had chosen and why. Next, questions relating to various topics were asked; including questions about their self-efficacy beliefs in MST subjects, the influence of significant others in their choice-making process, and their future expectations with regard to field of study and careers.

A major insight gained from these qualitative studies was that the gendered choice patterns regarding natural science tracks and interest in MST study fields in both countries were actually very similar. In particular, when talking about their future study choices, students in both countries focussed on a very similar set of factors, namely:

a) The extent to which they had an intrinsic motivation for MST fields in the terms of interest and fun (intrinsic motivation);

b) The extent to which they believed MST fields would help them to achieve modernist ambitions in terms of
societal status, material prosperity and income security (job-prospects);

c) The way and the extent to which MST fields were connected to personal goals, e.g. to help others as a medical doctor or to facilitate the combination of employment and motherhood (self-realisation);

d) Beliefs concerning their personal talents in MST fields and how these were related to expectations of success or failure (self-efficacy) and to the amount of effort an MST field would demand from them (hard work);

e) The opinions of significant others, including parents, teachers and peers, about the choice towards or away from MST fields and the importance attached to those opinions by students themselves (perceived pressure).

Also, the differences in study choice preferences between boys and girls were found not only to result from differences in these evaluations of MST fields on these individual factors, but also, and perhaps more importantly from differences in the implicit weight they assigned to these factors. For example, for girls, as compared to boys, MST fields not only seemed to have a lesser connection with ideas of self-realisation, it also seemed that this aspect of self-realisation was more important to girls.

Furthermore, in discussing these individual factors, we found that these evaluations in both countries were to some extent shaped by institutional conditions. For both Dutch and Swedish girls, for instance, the self-realisation value of the natural science track was for a large part shaped by the fact that this track gave access to a much wider set of university study fields in health and medicine.

Having said this, the final conclusion from the two case studies was that the differences in gendered study choice between the Netherlands and Sweden had become even more paradoxical. This left us with a puzzling question: Why do significantly more female students in Sweden opt for MST studies in higher education if girls in both countries – and also boys in both countries – think so alike about natural science tracks?
5.2.2 Theoretical model

Based on the literature and the two case studies, we expect students’ intentions to choose MST fields to be explained by six micro-level factors. The first factor relates to students’ perceptions of MST fields as fun and interesting, i.e. intrinsic motivation. The second factor relates to students’ perception of MST fields as an important tool for students’ self-realisation. The third factor relates to students’ perceptions of the job prospects of MST fields. The fourth factor relates to students’ perceptions of the amount of hard work that is required for MST fields. The fifth factor relates to how much pressure students feel from significant others to choose MST fields. The sixth factor relates to students’ self-efficacy beliefs in relation to MST fields.

As shown in figure 1, we also expect students’ perceptions towards each of these six factors to be influenced by students’ country background, gender and an interaction between country and gender (in short ‘country-gender’).

As a result, we expect to see differences in students’ intentions to choose MST fields (in short ‘MST intention’) between Swedish and Dutch students, between male and female students, and between Swedish boys, Swedish girls, Dutch boys and Dutch girls (hereafter: ‘the four comparison groups’).
5.2.3 Hypotheses

We hypothesize that:

1) Girls in both Sweden and in the Netherlands, when compared to boys in these countries, have more negative perceptions of MST fields in terms of intrinsic interest, self-realisation, job prospects, self-efficacy and hard work and experience less pressure from others to choose these study fields.

2) As a result of country differences, these effects of gender are stronger in the Netherlands than in Sweden.

3) The extent to which each of the six factors affects MST intention is dependent on not only the student’s gender but also on their country background.
5.3 Methodology

5.3.1 Sample and Procedure

5.3.1.1 Sampling method
For this study, we collected quantitative data through survey research in upper secondary schools in the Netherlands and Sweden. On the basis of our contacts with teachers and study counselors, we selected seven schools to take part in the survey. Of these three were located in the Netherlands and four in Sweden. These seven schools were selected based on the availability of natural science tracks in upper secondary school level, the location, population size, ethnic diversity, and the entry level required by schools for admission in natural science tracks in order to ensure comparability between schools. Within these schools, surveys were administered to all students in natural science tracks at upper secondary school level since these students have direct access to MST fields in higher education. In the Netherlands, the survey was administered to students in the Nature and Technology (NT)-profile and the Nature and Health (NH)-profile in preparatory scientific education (Voorbereidend Wetenschappelijk Onderwijs, hereafter VWO) years 4 (age group 15/16), 5 (age group 16/17) and 6 (age group 17/18). In Sweden, surveys were administered to students in the Natural Science Program, consisting of either the Natural Science -Natural Science or Natural Science – Social Science orientation) in higher preparatory track in year 1 (age group 16/17), 2 (age group 17/18) and 3 (age group 18/19) of gymnasium (‘gymnasieskola’) (for a detailed description of the various grades and programs, see Yazilitas et al., 2016a, 2016b).

5.3.1.2 Data collection
We collected data in Sweden, from January to March in 2014. This was then followed by data collection in the Netherlands, from October to December 2014. The surveys were administered during normal classroom hours, e.g. during chemistry class, by the main researcher herself. The research design and the survey were discussed beforehand with teachers in order to
ensure that teachers were well informed about the survey and the data collection procedure. The teachers then informed the students briefly about the scheduled survey.

The survey was first developed in Dutch before it was translated and tested in English. Two native English speaking colleagues, who also have a fluent understanding of Dutch, were asked to independently go through the translation in order to make sure that the translation was clear and consistent. We decided to administer the survey in English in Sweden, after careful assessment of students' proficiency levels in English and after testing the survey several times among students and teachers to be sure the survey questions were clear and unambiguous. This also enabled us to have full control over the data collection. In the Netherlands, we decided to administer the survey in Dutch because we had already developed the survey in Dutch.

On the scheduled time, the researcher entered the classroom and shortly introduced her and the research concerned. Next, the researcher briefly went through the survey questions with the students. Students were then asked to fill in the survey without talking to other students. Students were asked to continue their normal schoolwork after having finished the survey as not to bother other students. During data collection, the main researcher stayed in the classroom in order to answer questions that students might have. In most cases, teachers also remained in the room in order to supervise the data collection. On average it took students approximately 15 minutes to finish the survey.

5.3.1.3 Description of sample
In total, 638 students completed our survey including 277 students from Sweden and 361 students from the Netherlands. Table 1 shows that the distribution of male and female students in the two countries is very similar.
5.3.2 Measurements

5.3.2.1 Description of the survey
To measure gender, students were asked to indicate their sex in the survey. Male students were coded as 0 and female students as 1.

To measure country, the main researcher noted in which country the survey took place. Sweden was coded as 0, the Netherlands as 1.

To measure the interaction between country and gender, students were re-coded in 4 categories: Swedish boys, Swedish girls, Dutch boys, and Dutch girls.

To measure students’ MST intention, students were first asked whether or not they wanted to go to university after finishing high school. We thereby specified ‘university’ to include both universities of applied sciences as well as research universities. When respondents answered ‘yes’, they were presented with the following item:

If you do want to continue your studies at university, which field are you thinking of choosing? You can choose more than one.

0 Economics (business administration, business analytics of international business)
0 Healthcare (medicine, dentistry, biomedical sciences)
0 Technology (civil engineering, industrial design, building engineering)
As we were specifically interested in students MST intention, relative to other fields that were available to them, we calculated MST intention as the sum of the interests shown in ‘Technology’, ‘Natural sciences’, as well as mentions of such fields under ‘Something different’, divided by the sum of interests shown in other fields.

To measure the six mediating factors, we used Likert-scales with five response categories. For intrinsic motivation, we used the following items:

Please indicate below what you think about natural science fields by checking the circle that is closest to your own experience (the middle circle means you are neutral). Natural science fields are:

Interesting 0 0 0 0 0 Boring
Something for me 0 0 0 0 0 Not for me
Fun 0 0 0 0 0 Frustrating

For self-realisation we used the following items:

To what extent do you agree with the following statements that compare natural science fields to other fields of study?
– Natural science lead to more interesting jobs
– Natural science provide more opportunities to develop yourself
– With natural science you have more options
For job prospects we used the following items:
To what extent do you agree with the following statements that compare natural science fields to other fields of study?
– Natural science have better job opportunities
– With natural science it’s easier to find jobs
– Natural science provide you with better future prospects
– With natural science you can have a more comfortable lifestyle
– With natural science you can earn more money later on
– With natural science you are less likely to become unemployed
– With natural science you have more status

For hard work we used the following items:
To what extent do you agree with the following statements that compare natural science fields to other fields of study?
– For natural science you get more homework
– For natural science you have to work harder to get good grades

For perceived pressure we used the following items:
To what extent do the following statements apply to you?
– My father thinks I should choose natural science
– My mother thinks I should choose natural science
– My friends think I should choose natural science
– My teacher(s) and/or study counsellor thinks that I should choose natural science
– One or more older brother(s) thinks that I should choose natural science
– One or more older sister(s) thinks that I should choose natural science
– My classmates think I should choose natural science
– Other people that are important for me think that I should choose natural science

We moreover weighted these perceived pressures from the different others by presenting the students statements about
the importance of these others’ opinions to them, using items like ‘My father’s opinion is important to me’.\footnote{6}

For MST self-efficacy beliefs we included the following items:
To what extent do you agree with the following statements?
\begin{itemize}
  \item I think I can easily do natural science
  \item I have talent for natural science
  \item I worry about my grades in natural science (R)
  \item I am worried that natural science is too difficult for me (R)
\end{itemize}

5.3.2.2 Descriptives
Table 2 gives an overview of the minimum, maximum, mean, and standard deviation of all the variables in our model. It also presents the reliability scores for each of the six factors in the combined and the separate data-sets, using Cronbach’s $\alpha$. Furthermore, table 3 provides the correlations matrix for all variables in the combined dataset, based on Pearson’s correlation. It also presents the level of significance for each correlation.

Intrinsic motivation, job prospects, perceived pressure and self-efficacy all have high reliability in both the combined and separate datasets, all Cronbach’s $\alpha$ are larger than 0.70. Self-realisation has a high reliability in the combined and Dutch dataset, with Cronbach’s $\alpha = 0.77$ and 0.71 and a slightly lower reliability in the Swedish dataset Cronbach’s $\alpha = 0.68$. Hard work similarly has a high reliability in the combined and the Swedish data set, Cronbach’s $\alpha = .76$ and .75, but a relatively low reliability in the Dutch data set, Cronbach’s $\alpha = .46$.

In table 3, we present the bivariate correlations between all variables in the model. Since we will discuss the hypothesized relationships between country, gender, the six factors and MST intention in the results paragraph, we limit ourselves here to discussing the correlations between the six factors.

Three correlations stand out. First, the correlation between self-realisation and job prospects. Second, the correlation between intrinsic motivation and self-efficacy. Third, the correlation between hard work and self-realisation. The correlation between self-realisation and job prospects is particularly interesting but is perhaps understandable considering that self-realization
requires a work environment with positive job prospects. Likewise, having a level of self-efficacy often goes hand in hand with a high intrinsic motivation. Similarly, the expectation of hard work can logically be linked to expecting less opportunity to develop oneself.

Table 2. Descriptives of all variables with Cronbach’s alpha’s for the combined dataset (α) and for Sweden (α SE) and the Netherlands (α NL) (N=638)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>α</th>
<th>α SE</th>
<th>α NL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
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<td>1.00</td>
<td>.52</td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>.00</td>
<td>1.00</td>
<td>.57</td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MST intention</td>
<td>.00</td>
<td>1.00</td>
<td>.43</td>
<td>.42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrinsic motivation</td>
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<td>1.00</td>
<td>.73</td>
<td>.21</td>
<td>.85</td>
<td>.84</td>
<td>.87</td>
</tr>
<tr>
<td>Self-realisation</td>
<td>.00</td>
<td>1.00</td>
<td>.67</td>
<td>.22</td>
<td>.77</td>
<td>.68</td>
<td>.71</td>
</tr>
<tr>
<td>Job prospects</td>
<td>.00</td>
<td>1.00</td>
<td>.63</td>
<td>.17</td>
<td>.83</td>
<td>.79</td>
<td>.83</td>
</tr>
<tr>
<td>Hard work</td>
<td>.00</td>
<td>1.00</td>
<td>.68</td>
<td>.23</td>
<td>.76</td>
<td>.75</td>
<td>.46</td>
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<tr>
<td>Perceived pressure</td>
<td>.00</td>
<td>1.00</td>
<td>.35</td>
<td>.19</td>
<td>.88</td>
<td>.87</td>
<td>.88</td>
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<tr>
<td>Self-efficacy</td>
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<td>1.00</td>
<td>.56</td>
<td>.19</td>
<td>.76</td>
<td>.72</td>
<td>.82</td>
</tr>
</tbody>
</table>
Table 3. Correlations matrix for all variables with Pearson's correlation (N=638)

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Country</th>
<th>MST intention</th>
<th>Intrinsic motivation</th>
<th>Self-realisation</th>
<th>Job prospects</th>
<th>Hard work</th>
<th>Perceived pressure</th>
<th>Self-efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1</td>
<td>.01</td>
<td>-.37***</td>
<td>-.15***</td>
<td>-.12**</td>
<td>-.15***</td>
<td>0.00</td>
<td>0.01</td>
<td>-.29***</td>
</tr>
<tr>
<td>Country</td>
<td>.01</td>
<td>1</td>
<td>.04</td>
<td>-.04</td>
<td>-.50***</td>
<td>-.34***</td>
<td>-.64***</td>
<td>-.24***</td>
<td>.03</td>
</tr>
<tr>
<td>MST intention</td>
<td>-.37***</td>
<td>.04</td>
<td>1</td>
<td>.33***</td>
<td>.18***</td>
<td>.13***</td>
<td>-.11**</td>
<td>.11**</td>
<td>.32***</td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>-.15***</td>
<td>-.04</td>
<td>.33***</td>
<td>1</td>
<td>.25***</td>
<td>.15***</td>
<td>-.06</td>
<td>.24***</td>
<td>.55***</td>
</tr>
<tr>
<td>Self-realisation</td>
<td>-.12**</td>
<td>-.50***</td>
<td>.18***</td>
<td>.25***</td>
<td>1</td>
<td>.68***</td>
<td>.48***</td>
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<td>Job prospect</td>
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<td>1</td>
<td>.44***</td>
<td>.34***</td>
<td>.16***</td>
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<tr>
<td>Hard work</td>
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<td>-.11**</td>
<td>-.06</td>
<td>.48***</td>
<td>.44***</td>
<td>1</td>
<td>.18***</td>
<td>-.13***</td>
</tr>
<tr>
<td>Perceived pressure</td>
<td>.01</td>
<td>-.24***</td>
<td>.11**</td>
<td>.24***</td>
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<td>.34***</td>
<td>.18***</td>
<td>1</td>
<td>.19***</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>-.29***</td>
<td>.03</td>
<td>.32***</td>
<td>.55***</td>
<td>.18***</td>
<td>.16***</td>
<td>-.13***</td>
<td>.19***</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: *=p≤.05; **=p≤.01; ***=p≤.001 (1-tailed)
5.4 Results
Below we first present the results concerning hypotheses 1 and 2 about the effects of country, gender and country-gender on the six factors that explain MST intention. Then, in the second section, we present the results with respect to hypothesis 3 concerning the different weights these six factors take in establishing MST intention for boys and girls in both countries.

5.4.1 Explaining differences in the six mediators
Below, table 4 presents the mean scores for the four comparison groups on each of the six mediators. Furthermore, table 5 presents the results of a multiple regression analysis explaining the variation in these six factors as a result of country, gender, and country-gender interaction.

Firstly, although we did not hypothesise any direct effects of country on the perceptions of MST fields, table 5 shows that there are indeed significant differences between Sweden and the Netherlands in this respect, that are independent from gender. More specifically, Dutch students have significantly more negative perceptions of MST fields in terms of their self-realisation value, job prospects, hard work and perceived pressure, than Swedish students.

Secondly, as hypothesized in H1, it can be observed that gender too has a direct effect on these factors, independent from students’ country background. Significant gender differences relate to girls expecting MST fields to require more hard work and to girls having lower MST self-efficacy beliefs than boys.

Thirdly, we find that for intrinsic motivation and hard work, H2 is confirmed. As table 5 shows, significant country-gender interactions exist for these factors. Dutch girls significantly differ from Swedish girls in that they are less intrinsically motivated to choose MST fields and also expect MST fields to require less work.
### Table 4. Mean scores for the four comparison groups on each of the six factors (N=638)

<table>
<thead>
<tr>
<th></th>
<th>Intrinsic motivation</th>
<th>Self-realisation</th>
<th>Job prospects</th>
<th>Hard work</th>
<th>Perceived pressure</th>
<th>Self-efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swedish boys</td>
<td>.76</td>
<td>.81</td>
<td>.71</td>
<td>.83</td>
<td>.40</td>
<td>.60</td>
</tr>
<tr>
<td>Swedish girls</td>
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<td>.78</td>
<td>.68</td>
<td>.87</td>
<td>.41</td>
<td>.51</td>
</tr>
<tr>
<td>Dutch boys</td>
<td>.77</td>
<td>.61</td>
<td>.61</td>
<td>.56</td>
<td>.31</td>
<td>.63</td>
</tr>
<tr>
<td>Dutch girls</td>
<td>.68</td>
<td>.54</td>
<td>.54</td>
<td>.54</td>
<td>.31</td>
<td>.50</td>
</tr>
<tr>
<td>Total</td>
<td>.73</td>
<td>.67</td>
<td>.63</td>
<td>.68</td>
<td>.35</td>
<td>.56</td>
</tr>
</tbody>
</table>

### Table 5. Explanation of variance in the six factors (dependent) as a result of effects of county, gender, and the interaction between country and gender (N=638)

<table>
<thead>
<tr>
<th></th>
<th>Intrinsic motivation</th>
<th>Self-realisation</th>
<th>Job prospects</th>
<th>Hard work</th>
<th>Perceived pressure</th>
<th>Self-efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country (NL=1)</td>
<td>.01</td>
<td>-.20***</td>
<td>-.10***</td>
<td>-.27***</td>
<td>-.08***</td>
<td>.03</td>
</tr>
<tr>
<td>Gender (Girl=1)</td>
<td>-.03</td>
<td>-.02</td>
<td>-.03</td>
<td>.04*</td>
<td>.01</td>
<td>-.09***</td>
</tr>
<tr>
<td>Dutch girls</td>
<td>-.06*</td>
<td>-.05</td>
<td>-.04</td>
<td>-.06*</td>
<td>-.02</td>
<td>-.04</td>
</tr>
<tr>
<td>Explained variance</td>
<td>.02</td>
<td>.26</td>
<td>.14</td>
<td>.41</td>
<td>.06</td>
<td>.08</td>
</tr>
</tbody>
</table>

(Adjusted R Square)

Note. *=p≤.05; **=p≤.01; ***=p≤.001 (1-tailed)

### 5.4.2 The effects of the six factors on MST intention

Next, we investigated hypothesis 3 – about the different weights attached to the six factors. The results of this investigation are presented in table 6 which investigates the extent to which MST intention is predicted by the six factors in both countries. We compare the outcomes of a linear regression analysis in which we take MST-intention as the dependent variable and the six factors as predictors for this intention as independent variables, and we furthermore compare the outcomes of this regression model for the four comparison groups, as well as for the total sample.

The first finding is that the variance explained by the six factors is in surprisingly small. This means that, although the
factors have been selected and measured with great care, they only explain MST-intention to a rather limited extent. This applies even more to the Swedish sample than to the Dutch sample.

Secondly, table 6 shows that despite this limited explanatory power, intrinsic motivation, self-realisation, hard work and self-efficacy, are indeed all significant predictors for students’ MST-intention, when we regard the total sample.

With respect to hypothesis 3, however, a comparison of the four groups is most interesting. This comparison indeed provides support for our hypothesis that girls and boys in Sweden and the Netherlands attach quite different weights to the six factors. As the table shows, for Swedish boys not one factor significantly predicts MST-intention. In the case of the Swedish girls, MST-intention is significantly predicted by intrinsic motivation. For Dutch boys, hard work and perceived pressure predicts MST-intention. In the case of Dutch girls, MST-intention is significantly predicted by intrinsic motivation, self-realisation, hard work and self-efficacy.

When we compare Swedish to Dutch girls, difference in effect of hard work expectations and MST-self efficacy beliefs are remarkable. For Dutch girls we find a significant negative association between the expectation of hard work and MST-intention, and a significant positive association between MST self-efficacy and MST-intention. For Swedish girls these associations are not significant, but surprisingly the direction of both association is found to be opposite. This outcome suggests that Dutch girls are put off MST studies when they have low MST-self efficacy and expect to have to work hard. Swedish girls - who expect MST studies to be harder than Dutch girls - seem more prepared to accept this challenge.
### Table 6. Explanation of MST-intention (dependent) for the four comparison groups (N=638)

<table>
<thead>
<tr>
<th></th>
<th>Total (N=638)</th>
<th>Swedish boys (N=134)</th>
<th>Swedish girls (N=143)</th>
<th>Dutch boys (N=170)</th>
<th>Dutch girls (N=191)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-.10</td>
<td>.08</td>
<td>-.22</td>
<td>.38</td>
<td>-.23</td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>.37***</td>
<td>.24</td>
<td>.44*</td>
<td>.16</td>
<td>.54***</td>
</tr>
<tr>
<td>Self-realisation</td>
<td>.31**</td>
<td>.41</td>
<td>.32</td>
<td>.27</td>
<td>.28*</td>
</tr>
<tr>
<td>Job prospects</td>
<td>.11</td>
<td>-.02</td>
<td>-.07</td>
<td>.17</td>
<td>-.06</td>
</tr>
<tr>
<td>Hard work</td>
<td>-.31***</td>
<td>-.19</td>
<td>.14</td>
<td>-.67***</td>
<td>-.28*</td>
</tr>
<tr>
<td>Perceived pressure</td>
<td>-.01</td>
<td>-.10</td>
<td>-.01</td>
<td>.31*</td>
<td>.07</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>.35***</td>
<td>.24</td>
<td>-.25</td>
<td>.23</td>
<td>.27*</td>
</tr>
</tbody>
</table>

**Explained variance**

(Adjusted R Square)

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.16</td>
<td>.03</td>
<td>.03</td>
<td>.18</td>
<td>.22</td>
</tr>
</tbody>
</table>

*Note.* *=p≤.05; **=p≤.01; ***=p≤.001 (1-tailed)

### 5.5 Discussion

As explained in paragraph 2, we expected to distinguish three main effects in our study.

Firstly, we expected a gender effect. More specifically, we expected girls to have more negative perceptions of MST fields than boys, in both Sweden and the Netherlands. Secondly, we expected gender differences in students’ perceptions of MST fields to vary by students’ country background. More specifically, we expected Dutch girls to have more negative perceptions of MST fields than Swedish girls. And, additionally, we expected the country-gender interaction to manifest itself in two ways: in students’ perceptions of MST fields on the six factors, and in the
implicit weight assigned by students’ to each of these six factors, when making a choice for or against MST.

The findings of this study confirm these expectations to a certain extent.

The expectation that girls feel less positive about MST fields than boys has been confirmed in this study. In line with this expectation, we indeed found that girls significantly differ from boys in that they expect MST fields to require more hard work and also have lower MST self-efficacy beliefs.

With regard to the interaction between country and gender, we find that Dutch girls significantly differ from Swedish girls in that they have a lesser intrinsic motivation to choose MST and also expect MST fields to require less hard work. With regard to the country*gender interaction in the weight assigned to the six factors, we find that intrinsic motivation is significant for both Swedish and Dutch girls, although the effect is larger for Dutch girls. However, for Dutch girls the weight assigned to hard work, self-realisation and self-efficacy also significantly predict their MST-intention, whereas the same does not apply to Swedish girls.

How can we understand the results of this study to explain gender differences in the participation of female students in MST fields in higher education between Sweden and the Netherlands?

It appears that direct gender effects play a role in explaining differences in female participation in MST. However, the interaction between country and gender suggests that it is particularly Dutch girls who have very low perceptions of MST, rather than girls in general.

The obvious explanation for this is that at the Dutch country level and institutional level factors are at play that makes MST less attractive to Dutch girls. For example, the way MST relevant subjects are taught in the Netherlands, may be less appropriate for girls than the way these subjects are taught in Sweden.

At the societal level, it is furthermore likely that differences in labour market structure affect the individual choices boys and girls make. The Dutch economy can be typified as a high
developed, post-industrial economy with a large service sector. According to the Dutch Central Bank, services, for example, accounted for almost 50% of the value added in domestically produced exports in 2014 (De Nederlandsche Bank, 2014). The Swedish economy can also be characterized as a highly developed economy, but is still more orientated towards export of goods, such as by timber, hydropower and iron ore. These constitute the resource base of an economy orientated towards foreign trade (EC, 2016). Against the background of these differences, it is imaginable that Dutch girls can ‘afford’ more negative perceptions of MST fields considering that they have more varied career opportunities.

Similarly, differences among female students can be related to differences in family policies, although probably not as directly as some of the other factors. Since the 1970s Sweden’s family policy has been one of the strongest examples of a dual-earner model. Within this model parents are encouraged to equally participate in the labour market and to take part in unpaid care work (Ferrarini & Duvander 2009, 2010). To the contrary, the most common model in the Netherlands is the one-and-a-half-earners model, where one partner works full-time and the other part-time (Centraal Bureau voor de Statistiek [CBS], 2013). The model is common in households with and without children and prevails twice as frequent as elsewhere in Europe (Visser, 2002). From these two models also follow different formal care arrangements for young parents. For example, whereas Swedish parents have 18.6 months of childcare leave available to them - consisting of a combination of maternal, paternal and effective parental leave -, Dutch parents only have 3.72 months (Janta, 2015). At the same time, there are also large differences between Sweden and the Netherlands with regard to female employment in terms of full-time equivalent (FTE). In 2014, for example, 71% of women aged 20-64 in the Netherlands worked, against 78% of women in Sweden. However, more than 75% of employed women in the Netherlands worked part-time, as opposed to 36% in Sweden (European Commission [EC], 2015, Eurostat, 2015). In light of the these differences and the expectation of working part-time in
particular, it is likely that Swedish and Dutch girls make different assessments about future study and career choices. This is further supported by our finding that Dutch girls attach more weight to self-realisation than Swedish girls.

Altogether, we have to conclude that there is some support for the underlying mechanisms of our theoretical model, although some uncertainty and ambiguity still exist. Moreover, differences in students’ perceptions and the subsequent weight assigned to them between Swedish and Dutch girls are smaller than initially expected and as such insufficient to explain differences in female participation in MST fields in higher education.

In order to gain more thorough knowledge of the underlying mechanisms of the gender imbalance in MST and other fields, we need more research. Research, for example, that uses random samples and also extents to include students from different national, institutional and socio-economic contexts. It is also recommendable to operationalize the six factors in different ways. Particularly students’ perceptions of job prospects were not found to be significant, despite very large gender differences between the two countries. It is also advisable to review the stability of gender differences over time and throughout different stages in students’ school careers through longitudinal research. Finally, it is recommendable to conduct a similar study in fields with an opposed gender imbalance, such as health and education. This would make it possible to assess whether gender differences are context specific to MST fields or have a more general basis.

5.6 Conclusions
This study started from the observation that female participation in MST fields in Sweden is two-and-a-half times higher than in the Netherlands, in spite of similar levels of gender equality, socioeconomic development and similar perceptions of natural science tracks in high school. To understand why relatively more female students in Sweden still opt for MST fields in higher education, we compared differences in high school students’ perceptions of MST fields on six key factors for four comparison groups: Swedish boys, Swedish girls, Dutch boys, Dutch girls. We hypothesized and indeed also found that students’ intentions
to opt for MST fields in higher education can to some extent be explained through differences in a) the evaluation of MST on six factors identified in the literature and b) that students in the four comparison groups also assign different weights to each of these six factors when it comes to their MST-intentions.

Our findings show distinctly that of the four groups, Dutch girls have the lowest score on each of the six factors, which makes them different from not only boys but also from Swedish girls.

Importantly, the findings of this study also partly go against Schreiner and Sjøberg’s theory that gender differences in MST participation can be explained by the level of socioeconomic development. Our findings suggest that the relationship between socioeconomic development and gender differences in MST choice is more complex than presented by Schreiner and Sjøberg. It appears that the level of socioeconomic development, although crucial, is too general to fully explain differences and is only the starting point for explaining gender differences from a comparative perspective. The next steps would also include other factors in the analysis, such as labour market structures, care arrangements and family policies.

These findings demonstrate that in explaining cross-national gender differences in MST participation, we have to take into account differences in students’ country background and gender but also the interaction effect between students' country background and gender. Failure to do so impedes research findings and limits our understanding of the underlying mechanisms of the gender imbalance in MST and other fields.

5.6.1 Limitations of this study
As explained in paragraph 3 the main limitation of this study concerns the non-random selection of schools and pupils. For practical reasons, the data was collection was geographically limited to two particular cities, and to those schools in these cities that were willing to participate in this study. Consequently, generalizability of the empirical findings may be limited. The value of this study thus lies especially in developing this approach and in our effort to explore the theoretical mechanisms at play.
1. In this fourth article, I decided not to pursue the issue of ethnicity any further. The reason for this was twofold. Firstly, the earlier case studies already showed that students with a Western native background did not differ distinctly from students with a non-Western migrant background in their choice processes towards natural science tracks and interest in MST. Secondly, a subsequent quantitative analysis of the data used in this article reaffirmed that having a non-Western migrant background did not have any positive effect on students’ MST-intentions.

2. Participation in ‘MST fields’ and ‘MST’ refers to the share of female students at ISCED levels 5-6 enrolled in the fields of science, mathematics, computing, engineering, manufacturing and construction as a percentage of all female students (Eurostat, 2012b). The levels and fields of education and training used, follow the 1997 version of the International Standard Classification of Education (UNESCO, 2006 [1997]) and the Eurostat manual of fields of education and training (Andersson & Olsson, 1999).

3. Schreiner and Sjøberg (2004; Schreiner, 2006; Sjøberg and Schreiner, 2005), use the terms ‘Western’, ‘developed’, ‘modern’, ‘modernized’ and ‘late-modern’ as synonyms in reference to cultural, economic and political development in Western societies.

4. In our earlier case study in the Netherlands, we focused on students’ choice processes for the NT-profile or a combined NT and NH-profile. In this study, we extend our focus to also include the NH-profile in order to be as inclusive as possible.

5. We used ‘högskola’ in Sweden and ‘hogeschool’ in the Netherlands to refer to universities of applied sciences and ‘universitet’ in Sweden and ‘universiteit’ in the Netherlands to refer to research universities.

6. We instructed students that in case they don’t live with their biological parents, they can answer the question for their step, foster or adoptive mother, father, brother(s) and sister(s). Moreover, we told students that when a certain statement wasn’t applicable to them, for example because they don’t have an older sister or brother, the question can remain unanswered.

7. According to Eurostat’s definition, a FTE ‘is a unit to measure employed persons or students in a way that makes them comparable although they may work or study a different number of hours per week. The unit is obtained by comparing an employee’s or student’s average number of hours worked to the average number of hours of a full-time worker or student. A full-time person is therefore counted as one FTE, while a part-time worker/student gets a score in proportion to the hours he or she works or studies. For example, a part-time worker employed for 20 hours a week where full-time work consists of 40 hours, is counted as 0.5 FTE.’ […] ‘The distinction between full-time and
part-time work is generally based on a spontaneous response by the respondent. The main exceptions are the Netherlands and Iceland where a 35 hours threshold is applied, Sweden where a threshold is applied to the self-employed, and Norway where persons working between 32 and 36 hours are asked whether this is a full- or part-time position’. (Eurostat 2015).


Eurostat. (2012). *Tertiary education participation. Female students at ISCED 5-6 enrolled in the following fields: science, mathematics and computing: engineering, manufacturing and construction – as % of all female students*. 

References


