

RESEARCH REPORT

Gender and the STEM Fields in Education- and Career-Related Discussions between Finnish Parents and their Adolescent Children

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Abstract: Occupational gender segregation in Finland is high and persistent in the fields of science, technology, engineering, and mathematics. Previous research has concluded that, rather than differences in aptitude, gendered educational and vocational choices originate from more complex system of attitudes, self-concepts, motivations and both direct and indirect social influences, all of which shape young people's future goals. In the sphere of social influences on career choice, parents play a special role in adolescents' education and career exploration. This study explores two interrelated areas: firstly, the ideas expressed by Finnish adolescent children's parents about the role of gender in education and career choices, and secondly, parent-child discussions about such ideas, especially with regard to STEM career pathways. The research data (N=103) was collected by means of an online survey. Almost half of the parents reported having had discussions about STEM careers with their children. Problematically, many parents considered that they had too little information about these careers. Our results indicate that mothers are more aware of the societal and individual consequences of occupational gender segregation than fathers are. The results also suggest that parents should be provided with up-to-date information on STEM careers and on the consequences of occupational gender segregation in order to enhance parents' readiness to support their children in their future exploration of education and careers. Greater collaboration between homes, career counseling, teachers and relevant organizations concerned with the economic world, working life and entrepreneurship would be beneficial in promoting awareness of these aspects during adolescents' career development.

Keywords: Career choice, gender segregation, parental involvement, STEM

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Introduction

This present study aims to investigate how Finnish parents consider the role of gender in the education- and career-related discussions that they have had with their adolescent children, and how much parents know about career opportunities within the fields of science, technology, engineering, and mathematics (STEM). In addition, this study aims to shed light on how aware parents may be of the individual and societal consequences of occupational gender segregation.

In Finland, occupational gender segregation levels are noticeably high and persistent in the fields of STEM (Statistics Finland, 2018) despite the fact that Finland is one of the leading countries in fostering gender equality (European Institute for Gender Equality [EIGE], 2017a; United Nations Development Programme [UNDP], 2017). As early as in their secondary-level vocational education, female students are underrepresented in the fields of ICT and technology: in 2017 only 12 per cent of the new students who participated in education leading to vocational qualifications in these fields were women (Official Statistics of Finland [OSF], 2017a). In higher education, women orientate towards the fields of the life sciences more often than towards the physical sciences, applied mathematics, or engineering. For example, at the universities of applied sciences only 16 per cent of the students pursuing technology degrees in 2017 were women (OSF, 2017b). Science and engineering are among the principal occupations of Finnish men, while social work, healthcare and education are strongly female-dominant occupations (Statistics Finland, 2018).

Education and labour markets in many other egalitarian welfare states in Europe and in the USA have similar characteristics to those seen in Finland (EIGE, 2017b; National Science Foundation, 2017; U.S. Department of Labor, 2018). The employment of STEM-skilled workers is increasing, while a high number of people working in STEM fields will be retiring in the course of the coming decade (Caprile et al., 2015, National Science Foundation, 2019). The supply of a workforce does not meet the demands of the job markets in many countries because of an insufficient number of graduates in the fields of STEM and ICT. Too few young people are attracted to study STEM subjects or ICT, and the underrepresentation of women in these fields persists (European Centre for the Development of Vocational Training [Cedefop], 2016). While societies all over the world today rely on the development of science and technology, missing skills and labour input of women causes continuing concern in these fields. In Finland, the technology industry, chemical industry and forestry are the largest industries and their products account for approximately 80 per cent of Finnish exports (OSF, 2019). Hence, developing a sufficient supply of STEM-skilled labour is essential for maintaining and developing our well-being.

In addition to contributing to the inefficient functioning of the labour markets, occupational gender segregation has several other negative effects, both on individuals and at a societal and economic level. Gender segregation partially explains the gender gap in terms of wages since male-dominated occupations are often better paid than female-dominated occupations. Lower rates of pay can also discourage men from entering female-dominated occupations or from taking time off for family life. (EIGE, 2017b.). Prejudices about men's supposedly lower need for a work-life balance and job quality are also matters that have been

posited as the consequences of segregation (Bettio & Verashchagina, 2009; Burchell et al., 2014; EIGE, 2017b). In general, occupational segregation can reinforce gender stereotypes and maintain gendered working life, as people choose careers which they have come to regard as suitable for their gender through observation of their environment (Bettio & Verashchagina, 2009, EIGE, 2017b).

Meta-analyses produced in recent decades of gender differences in science and mathematics performance have to this day shown that differences in abilities have narrowed and are currently quite small, while in some cases female students have outperformed male students in these domains (Else-Quest et al, 2010; Hyde et al., 1990; O'Dea et al., 2018). Research into gendered career choices has concluded that rather from differences in innate aptitudes only, gendered choices in STEM originate from a complex system of intellectual abilities, achievement motivations, the influence of family, school and peers, as well as sociocultural and biological factors (Wang & Degol, 2013).

Parental influence on children

In the sphere of social influences on career choices, parents play a special role in adolescents' education and career planning. Parents are typically the most significant people in the process of socialization, especially in relation to childhood, but they also play an important role in their children's adolescence, along with friends, teachers and other social influencers (Grusec & Hastings, 2016). Eccles' Conceptual model of parental influences on children (2014) concludes that parents hold specific beliefs and perceptions and expectations, such as perceptions of their children's competence and interests, which influence the kind of advice, equipment and toys, and experiences that they provide their children with. These behaviour patterns, in turn, shape children's beliefs, goals, and identities, as well as their expectations and values regarding various domains such as STEM (Eccles, 2014).

Parents' perceptions of students' abilities

Research has shown that parents' perceptions of their children's academic abilities depend on their children's gender (Jacobs et al., 2005; Jacobs et al., 2006; Rätty & Kasanen, 2007). These perceptions are typically based on cultural gender stereotypes about boys' and girls' abilities in different domains (Jacobs, 1991; Jacobs & Eccles, 1992; Rätty & Kasanen, 2007; Tiedemann, 2000). Parents who hold gender stereotypes concerning mathematics and science abilities are likely to underestimate their daughters' ability and overestimate their sons' ability in these domains (Rätty & Kasanen, 2007; Tiedemann, 2000). The parents of girls have been found to place an evaluation on their children's mathematics abilities that is either lower or equal to boys' abilities even in studies in which the girls' actual achievement was the same or higher than that of the boys (Frome & Eccles, 1998; Yee & Eccles, 1988). Parents have also been found to think that girls' success results from hard effort rather than from actual ability (Frome & Eccles, 1998; Yee & Eccles, 1988), and that girls have to put more effort into achieving good learning results in mathematics (Frome & Eccles, 1998). Similar biases exist regarding parents' perceptions of their sons' and daughters' respective competence in the natural sciences. In a study conducted by Tenenbaum and Leaper (2003), for example, parents thought that science was less interesting and more difficult for

daughters than for sons. In some studies, mothers have been documented holding more gender-stereotyped views regarding their children's abilities than those of fathers (Frome & Eccles, 1998; Yee & Eccles, 1988).

There is a considerable amount of research evidence that parents' perceptions of their children's ability in science and mathematics have a significant influence on their children's self-perception in these domains (Bleeker & Jacobs, 2004; Frome & Eccles, 1998; Gunderson et al., 2012; Makwinya & Hofman, 2015; Parsons et al., 1982). Boys will often evaluate their own mathematics competence higher than girls will (OECD, 2015) and this has occurred even in studies in which girls achieved better grades (Jacobs, 1991). Studies have also documented that girls experience greater fear of failure in academic tasks in general than boys do (Alkhazaleh & Mahasneh, 2016; McGregor & Elliot, 2005). These kinds of self-perceptions impact on young people's school course selections and, later, their higher education and career choices (Bleeker & Jacobs, 2004; Correll, 2001; Eccles et al., 1999; Gunderson et al., 2012).

Parental support

Parental support plays a meaningful role in their children's self-perceptions regarding their abilities in, and attitudes towards, science and mathematics. Students who perceive greater social support for mathematics and science from their parents, teachers, and friends report better attitudes and have higher perceptions of their own abilities in these subjects (Rice et al., 2012). Parental motivational practices can also increase the likelihood of their children choosing science and mathematics courses (Harackiewicz et al., 2012), all of which enhance children's learning results and persistence in STEM careers later in life (Ing, 2014). In a study published by Dick and Rallis (1991), parents and teachers were perceived as influencing career choice more often for students choosing careers in engineering and science than for those not choosing such careers.

The study of Archer et al. (2012) showed that in developing and supporting children's science interests and aspirations, families' habitus (meaning family's everyday practices, values and sense of identity), and science-specific capital (referring to science-related knowledge, attitudes, experiences and resources), hold a significant power. Archer et al. found out that in families that had a "pro-science" habitus, it was typical that parents were holding science degree and/or were working within science-related fields, but also such "pro-science" families that lacked specific science capital, were able to utilize their existing resources in developing and supporting their children's science interest. In contrast, within families of lower socio-economic status, science is often less familiar and visible to parents' and children's everyday lives (Archer et al., 2012). Such families tend not to possess the same quantity and quality of resources to provide an equivalent basis for supporting the development of children's science aspirations (Archer et al., 2012).

Parents' lack of STEM career knowledge

Earlier research has indicated that parents may lack knowledge, and hence support that would help to motivate their children towards taking up STEM careers (Ing, 2014). In a study produced by Hall et al. (2011) the parents of high school students rated their knowledge of science, mathematics, engineering, and technology jobs and careers as weaker than their

knowledge of other college- and career-related topics. Parents seem to be poorly informed about the opportunities that further education in STEM fields can offer (Organisation for Economic Co-operation and Development [OECD], 2008). In particular, parents with lower education may convey negative and stereotypical images of STEM professionals to their children (van Tuijl & van der Molen, 2016). Parents working in STEM fields themselves are, in turn, more able to dismantle stereotypes and inform their children about STEM opportunities since they have more knowledge of and are more familiar with both STEM work and STEM workers (van Tuijl & van der Molen, 2016).

Research aims

As addressed above, parents play a special role in the formation of their children's future education and career-related aspirations, and this also applies to gendered choices in STEM. Much of the past research has focused on parental beliefs concerning their children's academic abilities and on parental expectations of their children's success in academic and working life. However, little research has been done into how parents consider the role of gender in any of the education- and career-related discussions that they have had with their children, nor has much attention been paid to how much parents know about STEM career possibilities, nor into how aware they may be of the individual and societal consequences of occupational gender segregation. This study aims to fill this research gap by investigating parents' ideas regarding these aspects. Past research provides some evidence that children's science aspirations are largely formed when they are between 10-14 years of age (Archer et al., 2012). At the age of 10, gender differences are small compared to when children are older (Murphy & Beggs, 2005). Thus, we decided to study the parents of adolescent children, since this kind of investigation helps to develop innovatory interventions and educational materials supporting parent-child interaction at a level where they are undoubtedly necessary.

Hence, we plan to address the following research questions:

1. How much do parents think that their children's gender has influenced the education- and career-related discussions that they have had together?
2. How much do parents report discussing with their children the role played by gender in the choice of education and career?
3. From their own perspective, how well do parents think that they know about the career opportunities in the fields of science, mathematics and technology?
4. What kinds of views do parents hold of the consequences of occupational gender segregation in the fields of science, mathematics and technology?

Methodology

Data collection

A survey instrument (Trochim, 2006) was designed and implemented so that we could address the ideas held by the parents of Finnish adolescents about the various aspects listed in our research aims. In total, ten survey questions were constructed by a team of three researchers with the aim of filling the research gap that had been discovered after reviewing the earlier

research on parental influence on education and career-choice and parents' STEM career knowledge presented in Introduction. It was discovered that there exist little research concerning parental self-reports especially on the influence of gender in educational and career-related discussions they have had with their children and on parents' knowledge on the consequences of occupational gender segregation. In the present study, parents' responses to five of these questions have been examined because their responses were discovered to be the most pertinent as sources of information related to the research questions investigated in this study.

These five survey questions were: a) do you consider that your children's gender affect any of the discussions that you have had related to their future education and careers? b) have you consciously discussed the influence of gender in making choices for future education or in choosing a career with your children? c) how well do you know about the educational and career possibilities in the fields of science, mathematics and technology?, d) to what extent have you discussed educational and career possibilities in the fields of STEM with your children?, and f) what kinds of consequences do you consider being related to occupational gender segregation in the fields of science, mathematics and technology? In the case of each one of these survey questions there were a comment box in which parents were allowed to write as long responses as they wanted. Even though questions a) and b) were basically closed-ended questions, each one of the parents' responses were more detailed than just "yes" or "no".

Sample

The survey was administered online, after which a link to the survey was sent to 17 middle school guidance counsellors. Middle school in Finnish education system refers to grades 7-9 for pupils aged 13 to 15. After middle school, pupils continue to the upper secondary level education and typically orient either to general upper secondary schools or secondary vocational institutions. (Finnish Ministry of Education and Culture, 2020)

The contacted school guidance counsellors were working in in our partnering school network. These partnering schools were public middle schools mainly alike, located in eastern Finland area. Eastern Finland area comprises of relatively small cities with population ranging between a few thousands to 93000, and the surrounding rural regions. Of the guidance counsellors, nine agreed to distribute the survey to their pupils' parents via school administration software. The guidance counsellors sent a link to the survey to all of their pupils' parents, of whom 85 mothers and 18 fathers eventually responded to the survey. The data was collected in the spring of 2017.

The age and academic background distributions of the mothers and fathers are presented in Tables 1 and 2, and, as the Tables show, a majority of the mothers and fathers had a university or polytechnic university degree, and a majority of them were 40-49 years of age.

Table 1.

Age and academic background distribution of the mothers participating in the study (N=85).

Age/academic background	Comprehensive school	Upper secondary school	Vocational school	University or polytechnic
30-39	1	2	6	5
40-49	-	4	7	34
50-60	3	1	4	18
Total	4	7	17	57

Table 2.

Age and academic background distribution of the fathers participating in the study (N=18).

Age/academic background	Vocational school	University or polytechnic
40-49	4	6
50-60	-	8
Total	4	14

Data analysis

The survey data was analyzed by means of qualitative content analysis (Mayring, 2014). The analysis process started with inductive category development. Not all of the survey questions were adopted for analysis, but our focus was placed only on the questions that were relevant to research questions 1-4 (see p. 8). This kind of selection is considered permissible in the procedure of inductive category summarizing (Mayring, 2014). First, two researchers who were experienced in qualitative content analysis defined the categories individually by systematically reviewing all of the responses to the survey questions and examining the parents' ideas in the light of the research questions. In the case of each of the survey questions, they then defined the main categories of the parents' responses.

Following the first round of category development, a pilot loop (Mayring, 2014) was executed, which meant that the researchers revised their whole category systems and checked to find whether there were any overlaps and to ensure that the category systems suited the research questions. Finally, an intercoder check was implemented in which the researchers examined their definitions of categories together and compromised if there were any differences in their views. It was discovered that in the case of most survey questions the parents' responses fell quite clearly into yes/no/no opinion categories or scale-like categories. In the case of the question concerning occupational gender segregation and its consequences in the fields of science, mathematics and technology, eight categories were found to occur. The researchers classified as Other any of the responses that they considered to be either ambiguous or providing inadequate insight into the survey question.

The survey was performed in Finnish and the qualitative content analysis was conducted using the Finnish data. For the present study, the survey items and examples of the parents' responses were translated from Finnish into English only after the analysis had been completed so that the potential interpretations could be regarded as being as accurate as possible. The translations have been made by the authors, who have years of experience of translating different

types of text from Finnish into English, and vice versa. The underlying idea with regard to the translations was to concentrate on intended meanings and readability, and the authors debated some of the potentially ambiguous cases in order to ensure the quality of the translations.

In the Results section, examples of the parents' responses have been presented in order to enable the reader to evaluate the analysis and to gain a better insight into parents' reactions to the survey questions. A statistical analysis was not made in this study as it was entirely qualitative, but to complement the reported data, the division of the parents' responses into categories is also presented quantitatively in the Tables in the results section.

Results

The results related to research questions 1-4 are presented in this section. First is shown how the parents' ideas of the influence of their children's gender on parent-child discussions about education and career choice. Next, there is a presentation of the parents' views regarding parent-child discussions of the influence of gender in education and career choices. And thirdly, the focus will be on the parents' self-evaluations of their own knowledge of STEM career opportunities and on their ideas about the consequences of occupational gender segregation.

The influence of adolescent children's gender on parent-child discussions related to education and career choice

At the beginning of the survey the parents were asked a closed-ended question about whether they thought their adolescent children's gender affected any of the discussions that they had had related to their future education and careers; in other words, whether they discussed the various career opportunities in different ways depending on the gender of their child. Table 3 shows the division of both the mothers' and the fathers' views into categories that resulted from the parents' responses. A majority of the parents considered that the child's gender had no bearing on the discussions. Nevertheless, eleven of the 85 mothers considered gender to have had an impact on their discussions.

Table 3.

Parents' views regarding the impact of their children's gender on the education- and career-related discussions they had had.

	Gender had no impact	Gender had an impact	No opinion
Mothers (N=85)	78%	13%	9%
Fathers (N=18)	94%	-	6%
Total	80%	11%	9%

The mothers who considered that gender had had an impact on their discussions justified their views by reporting that their children had gender-typical career interests and aspirations, as seen below (the number alongside the respondent is the consecutive numbering of the respondents retrieved from the survey data):

“My sons have expressed very clearly that they are not interested in jobs in healthcare.” (Mother3)

“Most likely yes: gender has an impact. My sons are interested in the military and in aviation, which are quite male-dominant fields.” (Mother4)

“Yes, it [gender] does have an impact. My son has different aspirations from my daughter. The conversations with, and occupations of, relatives have also had an influence.” (Mother90)

Views of this kind suggest that parents may not consciously steer the education- and career-related discussions with their children in gender-stereotyped directions, but if adolescents already have quite clear interests and aspirations, these may restrain their discussions with their parents, and the converse may be true with respect to other career pathway alternatives that may be challenging, especially if adolescents hold strong attitudes and stereotypes regarding jobs dominated by the opposite gender.

One mother who was unsure about the impact of gender thought that gender segregation in society might infiltrate into their education- and career-related discussions:

“I would hope that it [gender] did not have an impact, but it is difficult to determine objectively. Our society is still strongly gendered, so the topic is inevitable in discussions, I guess.” (Mother14)

Parents who denied that their children’s gender had had an impact on their education- and career-related discussions justified their views by referring to the non-traditional choices that their children had already made. They also foregrounded their own generally encouraging approach to education- and career-related discussions and their non-stereotypical attitude to different occupations in terms of gender-appropriateness.

“In my opinion, gender does not influence our discussions. One of my sons, for example, has chosen to orientate towards a traditionally female-dominated vocational trade. I did not try to guide him towards a more so-called masculine career pathway.” (Mother98)

“I have similar hopes regarding the future education of my son and my daughters – I want to support each of them in finding an educational pathway that will be suitable for their personalities. So, I don’t think that our discussions have been different with each of them.” (Mother21)

Some of the mothers and fathers denied that their children’s gender had had an unjustifiable impact on their education- and career-related discussions, and some of the parents seemed to hold noticeably strong opinions about the topic.

“It has not had any influence.” (Mother64)

“No! It does not have any influence on our discussions.” (Father3)

Parent-child discussions of the influence of gender in education and career choices

The parents were next asked if they had consciously discussed the influence of gender in making choices for their children’s future education or in choosing a career with them. They were also asked to focus on the impact that they thought gender has had on educational and occupational choices. Over half of the fathers and a third of the mothers had not discussed the influence of gender with their children (see Table 4). One in three of the mothers and one in six of the fathers reported having discussed this topic with their children. There were several responses about which it was impossible to say whether there had been any parent-child discussions regarding the influence of gender. This kind of response has been placed in the *Other* category.

Table 4.

Parents’ responses to the question of whether they had discussed the role of gender in education and career choices with their children.

	We have discussed this topic	We have not discussed this topic	Other
Mothers (N=85)	26%	36%	38%
Fathers (N=18)	17%	44%	39%
Total (N=103)	24%	38%	38%

The mothers who had discussed the influence of gender on educational and career choices with their children pointed out that they had talked about the particular challenges that girls might face if they orientated towards a male-dominant field. The mothers also suggested that they had had conversations regarding the physical requirements of certain occupations, women’s conditions in working life, and the gender pay gap.

Yes, I have discussed the influence of gender in education and career choices. The vocational education for auto mechanics, for example, is physically too demanding for a girl. (Mother19)

Yes, I have discussed the influence of gender. Gender does not have any influence in education, but in working life it certainly has an impact. Women have to do more to prove their competence. (Mother10)

In our discussions we have expressed the opinion that, in general, anybody should be able to do anything. One just has to have some kind of job. Sometimes, though, we have also discussed the pay gap that exists between men and women, and also which fields of work are female dominated, and so on. (Mother26)

Some of the mothers and all of the fathers who had had discussions about the influence of gender in education and career choice with their children reported that they had emphasized to their children that gender should not have an influence on career choice.

Yes, we have discussed this topic a bit. A chef can be a man or a woman, a midwife can be man or a woman, and so on. We do not think that gender has any influence. (Mother32)

Gender should not have any influence, even though statistically it seems to have. In our discussions I have pointed out that everything is possible for both girls and boys. (Father59)

Career possibilities in the fields of science, mathematics and technology

The parents were also asked, in open-ended question format, to evaluate their own knowledge about the educational and career possibilities in the fields of science, mathematics and technology. It was found that, in terms of inductive category development, three categories matching the familiar scale Good-Mediocre-Poor were clearly visible in the views held by the parents (see Table 5). Only 18 per cent of the mothers evaluated their personal knowledge as good. Their evaluation of their knowledge was lower than that of the fathers, since 44 per cent of the latter regarded their knowledge about such jobs as being good.

Table 5.

Parents' self-evaluation of the state of their knowledge in relation to various different STEM educational and career opportunities.

	Good	Medium	Poor
Mothers (N=85)	18%	32%	50%
Fathers (N=18)	44%	39%	17%
Total (N=103)	22%	33%	45%

Many of those parents who evaluated their knowledge of career possibilities as good also reported having themselves gained academic or working life experience in those fields.

I am very well aware of the career possibilities in these fields. I have a PhD in physics myself, and currently I'm an entrepreneur and a CEO. (Father14)

Good (I have graduated in computer science myself). (Father22)

Parents who reported having only a medium level of knowledge concerning the career possibilities in such fields either reported being familiar with only the commonplace educational pathways or referred to the academic background or occupation of one or more of their family members.

My wife has studied these subjects, and I have become acquainted with them in that way. (Father88)

In addition, a mother who rated her knowledge of these careers as poor referred to her inner circle:

[I know] very little [about these jobs]. I have no experience of these jobs as far as the people close to us are concerned. (Mother20)

Parents' responses to this question suggest that their main sources of knowledge vis-à-vis STEM education and career opportunities are their own academic and working life backgrounds or those of their spouse, relatives or other individuals close to them. In this context, none of the parents mentioned the teachers, school guidance counsellors or any of the Finnish organizations that are focused on providing career information to schools and to citizens in general.

The parents were next asked about the extent to which they had discussed education and career possibilities in the fields of STEM with their children. The categories that the parents' responses fell into were reminiscent of the categories on the Likert scale (see Table 6). More than half of the fathers and almost half of the mothers reported having had this kind of discussions with their children either extensively or to some extent.

Table 6.

Parents' evaluations of the extent to what they have discussed different STEM education and career opportunities with their children.

	Extensively/ To some extent	Very little/Not at all
Mothers (N=85)	49%	51%
Fathers (N=18)	56%	44%
Total (N=103)	50%	50%

Parents who reported having discussed STEM education and career opportunities either very little or not at all with their children mentioned that this was because they had insufficient knowledge about such topics or even because their children were uninterested in STEM career pathways.

We haven't discussed this topic, because I don't know much about it. (Mother13)

Very little at the moment. Besides, I have too little information about the topic! (Mother34)

The fields of mathematics and technology – we have not discussed these fields and my children are not interested in these fields, partly because they lack

mathematical ability, I guess. My eldest child orientated towards agriculture
(Mother36)

The parents' responses to this question support our speculations which the previous question had provoked. It quite clearly appears that parents are provided with too little STEM career information to talk about the jobs in these fields with their children. It is also concerning that the lack of interest and lack of abilities determine some adolescents' career aspirations at even the middle school level and shape their education- and career-related discussions at home.

Occupational gender segregation and its consequences in the fields of science, mathematics, and technology

Finally, parents were presented with an open-ended question concerning the nature of the consequences that parents think are related to occupational gender segregation in the fields of science, mathematics and technology. Parents were allowed to list as many consequences in the text box included in the survey as they wanted. Some of the parents mentioned only one thing, while some parents listed several consequences. The parents' responses could be divided into the eight categories presented in Table 7.

Table 7.

Parents' notions of the individual and societal consequences of occupational gender segregation in the fields of science, mathematics and technology, based on their prevalence.

	Mothers (N=85)	Fathers (N=18)	Total (N=103)
Gender pay gap	27%	1%	23%
National competitiveness and innovations	14%	1%	13%
Gender equality	9%	0	8%
Gendered career choices	8%	1%	8%
Advancing one's career	4%	1%	4%
Attitudes	2%	1%	3%
There are no consequences	22%	16%	21%
I do not know/No response	13%	56%	20%

The consequences of the various responses to gender segregation were distributed quite diversely in the parents' responses. It was, however, discovered that the mothers were able to mention more consequences resulting from occupational gender segregation than could the fathers. Every fourth mother mentioned the gender pay gap and every eighth mother mentioned the innovations or competitiveness of the Finnish nation. One mother also raised the problem resulting from cultural perceptions of what is appropriate for boys:

Gender segregation still supports the division of occupations into male- and female-dominated occupations in our society. This leads to lower pay rates in female-dominated fields, while it also generally impacts on gender equality,

which also in fact concerns men. If everyone could choose a career based on one's strengths and interests, we would be a happier and more innovative nation. It is still the case that boys cannot choose to do girls' things... I realized this yesterday, when my son was making his course selections for the eighth and ninth grades!" (Mother23)

With respect to this type of remark, only a few instances were observed in the fathers' responses. On the other hand, one of the fathers had covered gender segregation very thoroughly and analytically in his response:

If gender segregation was caused by biological factors, I would not see it as problematic. In that case, it would be questionable to try to fix imbalances by setting gender quotas. However, because the strong imbalance most likely results from cultural factors, I consider it detrimental. The most urgent concern is that many girls who have talent in these domains [science, mathematics and technology] and could find their calling there, are not orientating toward these fields because they do not receive enough support, and because their environment or cultural stereotypes are pointing them in other directions, the teaching in those fields favors boys (the curriculum or teachers' attitudes) et cetera. Thus, it is essential that, regardless of their gender, people should be able to find the jobs that they are really excited about and really enjoy doing (regardless of gender roles etc.). If this happened and there was then very little gender imbalance in occupations, it would not be a problem. Currently, in the worst-case people do not find a rewarding job or career for themselves. (Father34)

This father recognized the cultural impact of a stereotypical education and career choices, which together constitute nowadays the dominant explanation for segregation is research, rather than biological differences between different genders, as we discovered in the Introduction of this study. This father also recognizes the detrimental effects of segregation at an individual level and also on the STEM fields that have to forego the inclusion of skilled female workers.

In general, the fathers who responded to the survey did not seem to consider occupational gender segregation to be a very problematic phenomenon.

I don't know. There are hardly any significant consequences! The phrasing of this question is strange! (Father101)

Thirteen percent of the mothers and over half of the fathers answered "I don't know" or did not respond to the question at all. It is notable that a considerable proportion of the parents participating in the study did not know or did not perceive occupational gender segregation as having any societal or individual consequences.

There is an imbalance between the genders in these fields. But does it matter? (Father11)

This finding makes it recommendable that, in addition to STEM career information, parents should be provided with the facts connected with the impact that gender segregation in these fields has on individuals, the economy, the environment and society, both in Finland and globally, in order to help parents, become more aware of the importance of discussing jobs in STEM with their children.

Discussion

This study investigated, firstly, the ideas expressed by Finnish adolescent children's parents about the role of gender in education and career choices, and secondly, parent-child discussions about such ideas, especially with regard to STEM career pathways. The results of this study contribute to the field of research on parental involvement in adolescents' career exploration in the aspect of STEM career pathways.

In relation to research question 1 on the amount that parents consider their children's gender having an influence on the education- and career-related discussions that they have had together, a majority of the parents participating in this study did not consider their adolescent children's gender to have an influence on the future education- and career-related discussions. The parents' responses mediated a consensus view that it is adolescents' interests and aspirations that guide their discussions. Parents seem to encourage their children to find an educational and occupational path that will suit their personality and interests, regardless of their gender. Some parents, however, reported that their child had noticeable gender-stereotypical aspirations, and as a consequence their child's gender to some extent restrained the education- and career-related discussions that they had at home.

What comes to the research question 2 on how much parents report discussing with their children the role played by gender in the choice of education and career, fewer than a third of the parents reported having discussions with their children about the influence of gender on educational and career choices. In many cases parents avoided mentioning such topics because they thought that other things mattered in education and career choices more than gender, and hence they did not include the gender aspect in their conversations with their children. However, many mothers reported talking about the challenges that girls, in particular, might face if they were to orientate towards a male-dominant field.

With regards to the research question 3 on how well parents think that they know about the career opportunities in the fields of science, mathematics and technology, the study showed that half of the parents had discussed educational pathways and potential careers in the fields of science, mathematics and technology with their children, even though especially the mothers also mentioned that they had only a poor knowledge of the jobs in these fields. The fathers evaluated their knowledge about careers of this kind more highly than did the mothers. What comes to the research question 4 on parental views concerning the consequences of occupational gender segregation in the fields of science, mathematics and technology, the mothers were able to refer in greater detail to the consequences that occupational gender segregation has on individuals and at a societal level. The mothers emphasized the gender pay gap and the problems in competitiveness at a national level, stressing that greater equality was the best way to discover

the full innovatory potential of their country. Our study suggested that some of the fathers were almost dismissive of the problems associated with occupational gender segregation and its consequences.

With respect to discussion of the influence of gender in education and careers, it can be debated whether it would be more beneficial to recognize the reasons underlying gender-stereotypical education and career choices and then to promote gender-conscious discussions rather than to try to fade the gender aspect out of career planning. For example, one of the factors underlying girls' retention of STEM career pathways is their lower self-perception of their personal abilities in these domains. It would be beneficial to make parents aware of this fact and to give them tools to support especially their female children in building a stronger self-concept in science and mathematics. In addition, familiarizing adolescents diversely with different occupations, also with gender-atypical occupations, could be a gender-conscious way for parents to contribute to their children's planning for the future. In a study by Rice et al. (2012) students who perceived greater social support for math and science from their parents, teachers and friends displayed better attitudes and had higher perceptions of their own abilities in math and science. There are also several other studies in which adolescents who have made non-traditional career choices report feeling supported by their parents and teachers (e.g., Buschor et al., 2014; Dick & Rallis, 1991).

Even though our study suggests that parents do not think that gender has an influence on their education- and career-related discussions with their children, it is still plausible that parents hold gender-stereotypical beliefs and attitudes subconsciously. A study made by Jacobs et al. (2006) has demonstrated that parents' early gender-stereotyped expectations for their children's occupational achievements were closely related to the actual occupational decisions made by their adult children. Parents should be provided with information about this topic to make them more aware of the parental influence on course selections and career choices. Educational practitioners, such as guidance counsellors and subject teachers, should help parents and their children to conduct a critical examination of gender-stereotyped perceptions of occupations that may occur in their family, in their children's social groups or in the media. Thinking about traditional expectations and gender stereotypes concerning abilities and aptitudes would help both parents and their children to recognize and question widely-held beliefs that may be limiting children's choices regarding their future education and career.

In the present study, a relatively greater number of mothers reported having discussions with their children about the influence of gender on educational and career choices than did fathers, and mothers seemed to be able to mention more consequences of occupational segregation than could fathers. One has to, however, bear in mind that these findings raised only from the conversion of the qualitative data to a quantitative data presentation, and no statistical analysis was conducted in this study to see if the differences in mothers' and fathers' views were significant. There are some earlier studies that have suggested that fathers hold more traditional attitudes about gender than do mothers (Blakemore & Hill, 2008; Tenenbaum & Leaper, 2002) and are somewhat more likely to encourage their children into gender-typed activities (Lytton & Romney, 1991). On the other hand, the study published by Frome and Eccles (1998) suggests that mothers are more influential than fathers in terms of the extent to which girls develop gender-

stereotypical views of their academic abilities. Another study, by Borrell-Porta, Costa-Font and Philipp (2018), suggests that fathers are less likely to hold traditional views about gender roles if they help to raise a girl. Future research should delve more into the role of fathers in adolescents' future planning, especially in the case of girls orientating towards stereotypically masculine fields.

Our study suggests that parents' knowledge related to STEM career pathways is quite limited and some parents stated outright that they did not know much about the STEM jobs and thus could not discuss them with their children. There are also a few other studies that have pointed out that parents may often lack knowledge and support to motivate their children towards STEM careers (Hall et al., 2011; OECD 2008). Concerning career education carried out in schools, it could be fruitful to include parental participation in some of the lessons and activities. In Finland, compulsory basic education has started to implement a revised national core curriculum in which entrepreneurship and skills for working life are two of the aims set down for transversal competences (Finnish National Board of Education [FNBE], 2014, p. 24-25). The curriculum now also focuses specifically on physics and chemistry with a view to increasing pupils' awareness of careers that require skills in these subjects (FNBE, 2014, p. 418, p. 424). Collaboration and interaction between STEM subject teachers and homes would be beneficial in this context as it provides an opportunity to simultaneously increase parental knowledge on STEM career pathways and harness parental influence on educational and career choices for the benefit of adolescents' STEM career aspirations. A study by Harackiewicz et al. (2012) has shown that a simple intervention consisting of brochures and a web-site aimed at parents that highlights the usefulness of STEM courses has enhanced both parents' and adolescent children's perceptions of the value of studying science and mathematics and has increased the likelihood of adolescents selecting courses in these domains.

Considering how big an impact middle school and upper secondary school course selections have in terms of further education and career, it would be important to take gender segregation issues into account with parents even at the earliest stages in their children's education. In Finland, advanced mathematics grades have become ever more emphasized in the application criteria not only in STEM fields but other fields as well, in terms of student selections. When adolescents are applying for STEM fields, their mathematics skills are also measured in the entrance examinations. If a young person is disengaged from mathematics and does not select advanced mathematics courses while in upper secondary school, it makes orientating towards higher-level STEM education more challenging. Helping parents to become more aware of this fact early enough is essential, since they can have a significant influence on supporting girls, in particular, who may have a lower mathematics self-efficacy but in fact considerable mathematical abilities to embark on STEM pathways. It would be especially important that parents with lower educational backgrounds should be targeted, since parents with higher educational backgrounds seem to be more aware of the importance of early interventions and they are more likely to place their children in STEM pre-schools and provide their children with extracurricular STEM activities.

The study that we have undertaken suggests that parents tend not to be particularly well aware of the consequences of occupational gender segregation nor do they consider segregation

to be a problematic phenomenon. Yet, as mentioned at the start of this article, research concerning job markets and the economy in the European Union and in the United States suggests that occupational gender segregation has several individual and societal consequences, such as wage inequality and labour and skill shortages. Parents should be provided with up-to-date information about the problems that STEM fields are suffering and they should be better informed about the importance of educating a STEM skilled work force that will be able to deal with the challenges related to environmental issues and social and economic well-being both in Finland and globally. This should also be undertaken in a way that will help to make them better prepared to talk about jobs in STEM with their children and to promote conscious educational and career choices. Collaboration between homes, school guidance counsellors and relevant organizations operating in the area of the economy, working life and entrepreneurship may prove to be an effective way of promoting awareness of these aspects.

Limitations

One flaw concerning the validity of our results is that social desirability may have influenced some parents' responses when they were inquired if their children's gender has an influence on the education and career related discussions. That is, some parents may have responded that gender matters very little because they believe that this is the "correct" response. Socialization into gender-typed career pathways in family context often occurs through subtle patterns of encouragement and discouragement, rather than explicit conversations about gender (e.g., Leaper, 2015) and parents may be unable to accurately self-report on the role gender plays in their socialization practices. Experimental or observational methods (e.g., Tenenbaum & Leaper, 2003) would be more appropriate methods for obtaining accurate information about parent-child conversations.

In the case of this present study, however, the aim was to construct a narrative from parents' self-reports concerning these questions, and to discuss the responses critically in the light of previous research findings in the field of study. The aim was not as much to obtain totally accurate insight into the role of gender in parent-child conversations. We argue, that it is valuable to investigate parents' subjective self-reports in this context as it provides an opportunity to reveal disagreements between parents' ideas and previous research findings on the type of conversations they have with their children. This in turn, provides information on the needs of interventions targeted particularly to parents for making them more conscious and perhaps less euphemistic of their role in children's gender socialization.

As far as the transferability of the results of this study is concerned, it should be noticed that the findings represent the views mainly of parents who have a higher-level academic background. Since past research suggests that parents with high academic background place a greater value on science and mathematics (Archer et al., 2012; Shin et al., 2015), our data may provide a more positive impression of parental awareness of both STEM job possibilities and occupational gender segregation than would a sample of parents with more diverse backgrounds.

On the other hand, all of the respondents were from the Eastern Finland area, which is regarded as one of the more rural areas of Finland, especially in comparison with the metropolitan area in Southern Finland. In Eastern Finland there are fewer STEM-related companies and organizations with which parents could have become familiar than is the case in

the area in and around the capital, Helsinki. This factor may well have influenced parents' awareness of the diversity of STEM jobs as discussed in this study. Future research should control more parents' academic background influences on the education and career exploration with their children. Future research could also investigate the areal differences in Finland in parental awareness of both STEM occupations and the consequences of occupational gender segregation.

Additional limitation of this study was that significantly more mothers than fathers responded to the survey. It may be argued that this study is more a representation of the views of mothers with a higher-level academic background from Eastern Finland area rather than of the views of Finnish parents as a whole. It has to also be acknowledged that perhaps some of the fathers that responded in the survey were more gender progressive and involved in their kids' education, and some of them exceptionally critical concerning gender issues, which provoked them to take part in this study. Hence, the transferability of our findings concerning fathers' views must be evaluated very critically.

Conclusion

This study documents that Finnish adolescents' parents' knowledge related to STEM jobs and the consequences of occupational gender segregation is rather limited. There has been research in other countries too, that have indicated that parents may lack knowledge on these career pathways and thus lack of tools to motivate their children towards taking up STEM careers (Hall et. al., 2011; Ing, 2014). These types of results suggest that parents should be provided with more information on STEM career possibilities and on the consequences of occupational gender segregation in order to enhance parents' readiness to support their children in their future exploration of education and careers. Collaboration between homes, schools and relevant organizations concerned with the economic world, working life and entrepreneurship would be beneficial in promoting awareness of these aspects to parents.

Regarding future research, it would be interesting to examine the influence of children's gender on parents' responses in a survey similar to the one that was implemented in this study. Such a study could also be expanded by investigating simultaneously both adolescents' and their parents' views about the role of gender in education- and career-related discussions and in choosing careers in the fields of science, mathematics, or technology. In addition to investigating the influence of parent-child interactions in adolescents' education and career choices, future research should look more closely at other influences such as the encouragement given to subject teachers and guidance counsellors and also provided by peer-to-peer interactions.

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