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Demographics of self-selected participants in mathematical tracks in Swedish Upper Secondary School

Linda Mattsson¹

Abstract: This study investigates the three demographic factors gender, geographical origin and parents educational level among self-selected students in mathematical tracks in Swedish Upper Secondary School (n=147). Comparisons are made, through statistical tests of significance, with corresponding student distributions on the closely related Natural Science program (n = 1528). Data is obtained from Statistics Sweden. Results confirm that females are under-represented in mathematical tracks ($p < 0,01$) and that parents of students in mathematical tracks have higher educational level than parents of students in the comparison group ($p < 0,05$). Results do not show that students with foreign background are under-represented in mathematical tracks, but raise questions about under-representation of Swedish students. Possible implications of these findings for these and similar programs are discussed.

Keywords: mathematical track; demographics; Sweden, self-selection; gifted

Introduction

In the search for educational equity the representation of different groups of students regarded as gifted has been studied since the rise of gifted education. Gender, students' ethnic origin and socio-economic background have been, and still are, three of the main measures used (see e.g. Bianco, Harris, Garrison-Wade & Leech, 2011; McBee, 2010; Yoon & Gentry,

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2009; Preckel, Goetz, Pekrun & Kleine, 2008; Wallace & Eriksson, 2006; Freeman, 2003; Donovan & Cross, 2002; Sarouphim, 2002; Borland & Wright, 2000; Feldhusen & Jarwan, 2000; Ford, 1998). These studies often identify a lack of equality in the representation or enrollment of different student groups in gifted programs.

According to the Swedish law (Swedish statute-book, 2010) all students should have equal access to educational opportunities in the school system. Thus lately there has been a focus on the demographic representation of students in “cutting-edge programs” (Swedish National Agency for Education, 2010a, 2011a). These cutting-edge programs, which were established nationally in 2009, are the Swedish version of gifted programs and the only form of gifted education that has been initiated by the Swedish government. The cutting-edge programs have been introduced in various subjects, including mathematics, for Upper Secondary School (Swedish statute-book, 2008). However, so far no evaluation of demographic factors of students in these gifted programs has used comparison groups, nor have clear accounts for the representations of different demographic factors in subject-specific programs been given.

During the last quarter of a century there have been a few Upper Secondary Schools in Sweden that have offered the national mathematics courses at higher pace and with special depth, and that have offered extension courses as well as university courses in mathematics (Mattsson & Bengmark, 2010). For many years these programs, addressing self-selected gifted students in mathematics, have gained very little attention in education policy, although these programs have offered, and still offer, similar activities as the newly established cutting-edge programs in mathematics. The major difference is that all the cutting-edge programs have national recruitment (see *ibid.* for a more detailed discussion about the benefits of national recruitments). Hence, studying these earlier, long-running, gifted

mathematics programs could give valuable insight when developing the cutting-edge programs.

From a national perspective, there is a need for research on the demographic representations for gifted students that takes into consideration relevant comparison groups, the subject specificity of the program, as well as the earlier programs for gifted students. Such studies will contribute to a more well-established discussion about the representations in these programs. This study aims to fill this gap for gifted programs in mathematics in the Swedish Upper Secondary School. Moreover, in Sweden, in gifted programs in mathematics it is in principle self-selection among students with high overall grades. Thus the findings will contribute to the international discussion about the relationship between civic culture and representations in gifted programs in the specific subject of mathematics.

The study is done by comparing representations of the students' gender, geographical origin and parents' educational level in purposively selected gifted programs in mathematics with the representations of the corresponding factors in comparison groups.

Mathematical tracks, cutting-edge programs and cutting-edge programs in mathematics

The gifted programs in mathematics in Upper Secondary School, including the cutting-edge programs in mathematics, cannot be compared with the special schools for gifted mathematics students such as the Gymnasiums in Hungary, the Kolmogorov's schools in Russia (Vogeli, 1997), the Center for Talented Youth at John Hopkins University in the U.S. (<http://cty.jhu.edu/about/index.html>), or the Mofet schools in Israel (<http://www.mofet-il.org/884/>; Ratner, 2008), where the subject of mathematics permeates many activities in these schools at large. Instead, the Swedish students in the gifted mathematics programs follow the national Natural Science Program, (Naturvetenskapsprogrammet, NV), which is

entered by some 10 000 students every year. As all the other national programs at the Swedish Upper Secondary School, the NV is a three year program. However, the NV is a theoretically intensive program, including more advanced studies in chemistry, biology, physics and mathematics as compared to the other national programs in Upper Secondary School. Thus, students in gifted programs in mathematics also need to take fairly advanced studies in all of the subjects of Natural Sciences. Gifted mathematics students can belong to different student groups during the other classes, but from the first year on they take their mathematics lessons in special groups. It is hard for a student to join this special mathematics group if he or she has not participated from the very start of the first year. Thus, the Swedish gifted mathematics programs could be seen as high-ability tracks (Feldhusen & Moon, 2004; Fiedler, Lange & Winebrenner, 2002) in mathematics.

In this article, ‘mathematical tracks’ will denote these earlier as well as newly-established Swedish gifted programs in mathematics. When reference is made only to the newly-established *national* gifted programs in mathematics, the term ‘cutting-edge programs in mathematics’ is used. By ‘cutting-edge programs’, on the other hand, we refer to the cutting-edge programs in *all* subjects areas (Mathematics, Natural Sciences, Humanities, and Social Studies) in Sweden. In the following the expression ‘gifted program’ is used as an umbrella term which includes different kinds of gifted programs.

Literature overview

Gender

Studies from the U.S., where gifted programs have been running for many years, give evidence of females being under-represented in accelerated gifted programs in mathematics (Fox & Soller, 2007). One major reason for this is that the highest achieving females score lower than the highest performing males on the mathematics part of tests like SAT-M, ACT

and EXPLORE, and these scores often act as the basis for the identification of giftedness (see e.g. *ibid.*, Olszewski-Kubilus & Lee, 2011). Even though there are studies indicating that the gender gap, that has been noted for many years (Lubinski & Benbow, 1992), has decreased over the years, from 12:1 to 3:1 males per female scoring over 700 points on the SAT-M test (Brody & Mills, 2005), males still outperform females on mathematic tests at very advanced levels (Olszewski-Kubilus & Lee, 2011; Lacampagne, Campbell, Herzig, Damarin & Vogt, 2005).

From Russia there are also reports of a large under-representation of females since less than 20% of the participants in schools for gifted mathematics and science students are women (Vogeli, 1997). Further, in Korea there is evidence of severe under-representation of females in schools for gifted mathematics students (Lee & Sriraman, 2012). There are indications of female under-representation in gifted mathematics programs in China (Vogeli, 1997) too. As in the US, research indicates that Chinese male students perform better in mathematics than do female students. A recent study shows that the ratio between male and female in the top five percent Chinese high-school seniors taking the College Entrance Examination was 2,9:1 (Tsui, 2007). There are no gifted programs in the UK (Freeman, 2004). Still, in recent years, there has been increased provision for the gifted in the UK, and the British Government Department for Education and Skills has devised a project designed to identify gifted students (*ibid.*). Using the tests specifically designed for gifted students, top 5%-10% of the cohort, no significant gender difference in mathematical performance was found among nine or thirteen year old students that were selected as gifted mathematics students by their teachers (*ibid.*). This result differ from the achievement trend in English nation-wide public examinations in mathematics, as males seem to outperform females at the higher levels on these tests (Hargreaves, Homer & Swinnerton, 2008).

In Sweden, males' and females' performance are in line with each other at the higher grade levels on the national tests in mathematics for grade nine (Swedish National Agency for Education, 2010b, 2011b, 2011c) as well as on all the national course tests in mathematics for Upper Secondary School (Swedish National Agency for Education, 2010c, 2011d, <http://www.edusci.umu.se/np-pb/np/resultat/>). Also, females get slightly higher grades in mathematics than do males in ninth grade as well as in Upper Secondary School (Swedish National Agency for Education, 2011e, 2011f). Moreover, there are on average about as many males as females in the Swedish cutting-edge programs (Swedish National Agency for Education, 2011a). However, when looking at data in detail it becomes clear that the gender distribution in the cutting-edge programs in mathematics indicates an under-representation of gifted mathematics female students also in Sweden, since only 33% (in 2010) and 26% (in 2011) of the first year students in these programs were females (Swedish National Agency for Education, 2010a, 2011a). Still, these data have not been analyzed in comparison with data on gender distributions in different comparison groups.

Origin

In international research many different terms are used to denote the genetic, cultural and/or geographical origin, of an individual, with 'ethnicity' and 'race' being two of the most common (see e.g. the terminology used in McBee, 2010; Yoon & Gentry, 2009; Ford & Grantham, 2003; Robinson, 2003, and Donovan & Cross, 2002). The definitions of origin are not always clear and terms are sometimes used interchangeably. This makes it hard to make comparisons between different studies focusing on students' origin. Still, a brief presentation of different research findings gives a general idea of the research field.

Researchers emphasize the importance of, but also the difficulty in, reaching ethnic or racial equality in gifted education (Borland & Wright, 2000). Repeated studies from

the U.S. show that certain minority groups such as Hispanic, African American and Native American students are, and have been, under-represented in gifted programs for a long time (Yoon & Gentry, 2009; Ford, 2003). The same studies also show that Asian or Pacific Islander and White students have been over-represented during this time. Other research indicates that ethnic minority groups are under-represented in gifted programs in Australia (Garvis, 2006), at advanced level of studies in mathematics in Israel (Mulat & Arcavi, 2009), and in the ranks of the gifted and talented in New Zealand (Reid, 2006).

The Swedish vital statistics speak in terms of geographic background in which the country of birth of an individual, or the country of birth of the parents of an individual, forms the basis of the ascription of an individual to a specific geographical origin (Statistics Sweden, 2010). Following this convention, ‘origin’ in this study refers to geographic origin.

In Sweden, reports (Swedish National Agency for Education, 2010a, 2011a) focus on the geographical origin of students in cutting-edge programs. However, none of the Swedish reports present the representations of origin in mathematical tracks separately. Moreover, as findings lack any comparison between different student groups, the results tell us very little about the conditions in the Swedish cutting-edge programs.

Parents’ educational level

Research has shown a correlation between socio-economic status (SES) and representation in gifted programs in mathematics as well as achievement in the subject. For students in gifted programs (see e.g. McBee, 2006; Borland & Wright, 2000) as well as for students in ordinary classes (Preckel, Goetz, Pekrun & Kleine, 2008) the correlation between high family SES and high representations among the ones considered mathematically gifted are confirmed. There are, however, many ways of choosing socio-economic factors (see e.g. Nam & Powers, 1983;

Erikson, Goldthorpe & Portocarero, 1979) which make up the measure of SES. Parents' academic background, parents' title of occupation, full- versus part-time occupation, and family income are commonly used socio-economic factors in educational studies. In studies connected to equal value in schools in Sweden, where the education is free of charge, it is the first two factors mentioned that are most often used to make up a measure of class or social group (Tallberg-Broman, Rubinstein-Reich & Hägerström, 2002).

In this study the 'parents' educational level' is used as the measure for SES. This measure was chosen because the register on parents' level of education is more reliable than the register of parents' occupation, and on the fact that students with well educated parents are the ones who generally do the best in the Swedish school system (*ibid.*) Also, parents' experience and knowledge of the educational system are said to influence the culture of their children's up-bringing, by highly valuing education (*ibid.*). Moreover, numerous studies from the US show that the talent search participants in mathematics at the CTY have very well-educated parents (Brody & Mills, 2005). Parents' educational level has also been selected as the most important factor when evaluating the SES among Swedish cutting-edge program participants (Swedish National Agency for Education, 2011a). Drawing from the results in this evaluation the Swedish National Agency for Education also states that there is an over-representation of students with highly educated parents in the cutting-edge programs (Swedish National Agency for Education, 2010a, 2011a).

Method

Comparison groups

In this study, since participation in the Swedish mathematical tracks in Upper Secondary School is often tied to participation in the National Natural Science Program (NV) (Swedish statute-book, 2008), data on representations in mathematical tracks are compared with data

on demographic representations in the NV. Since different regions show different distributions with respect to geographical origin and educational level among the citizens, and has created “a school structured by class and ethnicity” (Tallberg-Broman, Rubinstein-Reich & Hägerström, 2002, p 26), we chose to define one comparison group as all the students studying in the NV parallel to the students in mathematical tracks in each selected school with a mathematical track.

In order to give further reference levels for data in this study, representations of gender and geographical origin are also presented for two other comparison groups as well, including *all* students ($n=45,213$) in the NV in Sweden, and Swedish citizens ($n=520,307$) in the corresponding age group. In addition, the educational level of the parents of students in mathematical tracks is compared with data for all Swedish citizens ($n_{\text{men}}=1,238,448$ and $n_{\text{women}}=1,207,580$) in the corresponding age group.

Sampling

The target population of this study is the mathematical tracks in the Swedish Upper Secondary Schools. Since there is no comprehensive list of schools in the target population it was not possible to select schools randomly. Instead, schools were selected from the list of 31 schools that, in 2009, applied for starting cutting-edge programs in mathematics. From that list of applicants five schools were purposively selected. These schools were considered the most appropriate for the sample since they either:

- (1) Offer a national recruiting cutting-edge program in mathematics, or
- (2) Have offered another mathematical track for more than ten years.

Students who studied in mathematical tracks were identified in each selected school.

In the spring of 2010, this included 158 students spread over 11 classes, of which five classes were from the first year, three from the second year and three from the third year of Upper Secondary School. The comparison group of students who studied in the parallel NV included 1235 students. Lists of personal identity numbers for the students in the mathematical tracks as well as for the students in the parallel NV were collected in order to obtain data from Statistics Sweden.

Data collection

On request, Statistics Sweden compiled data on mathematics, as well as comparison group students' gender, geographical origin and parents' geographical origin, and parents' educational level by linking and matching files from the *Total Population Register* (TPR) and the *Swedish Register of Education* (SRE). Data on education refer to parents' highest educational level reached in January of the year the students entered their first-year studies in Upper Secondary School.

Data was gathered on distribution of gender and geographical origin for the total population of students in NV in Sweden in 2010 and the Swedish citizens at ages 16-19 years in 2009, from registers at Swedish National Agency for Education (Swedish National Agency for Education, 2011g) and Statistics Sweden (Statistics Sweden, 2010) respectively. Data on the educational level of the Swedish citizens between 40 and 59 years old was attained from Statistics Sweden (Statistics Sweden, 2011). It is reasonable to assume that this group corresponds to the age group of parents for youths at the ages 16-19 years old.

Non-response

Of the 158 students in the selected mathematical tracks, data on 147 students (93,0%) was acquired from Statistics Sweden. Non-response for eleven students is due to a student whose co-ordination number are not included in the national registers, students who asked to be excluded from the study (n=6, four men and two women from four different schools) and

students who belong to the mathematical tracks but whose information was not available when the data collection from Statistics Sweden was done (n=4). However, all 158 students are included in the results for gender distribution.

Of the 1235 in the comparison group of students in the NV in the sample schools, data on 1227 (99,4%) was acquired from Statistics Sweden. Non-response for eight students is due to protected identity (n=6) and wrong personal identification numbers (n=2) on the list that was sent to Statistics Sweden. In the latter cases the gender of the students is still known.

Data analysis

By considering data as randomly selected in time, one-sided tests of significance ($p=0,05$) (see e.g. Milton & Arnold, 2003) were made when comparing proportions for students in the mathematical tracks and in the comparison group of NV students in the sample schools. Since multiple tests that are made on one and the same data affect the total level of significance of the study, only three hypotheses, emerging from the literature, were tested:

- (1) Female students are under-represented in mathematical tracks as compared to in the comparison group.
- (2) Students with foreign background are under-represented in mathematical tracks as compared to in the comparison group.
- (3) Parents of students in mathematical tracks are more highly educated than parents of students in the comparison group.

Data is also analyzed using simple comparison of proportions for students in mathematical tracks with proportions in the larger comparison groups.

Measures

The measures considered in this study are defined as follows.

Gender

Gender means biological sex.

Parent

Parent is defined as biological parent or adoptive parents alternatively.

Origin

The categorization of geographical origin follows the classification of Statistics Sweden in the TPR. Students with ‘foreign backgrounds’ are defined as persons who are foreign born or Swedish-born with two foreign-born parents. A student that is ‘foreign-born’ is born abroad to a mother and a father, neither of them registered in Sweden at the time of the child’s birth. Hence, students with ‘Swedish background’ are born in Sweden to at least one parent who was born in Sweden. Students with ‘unknown origin’ (n=2 in the mathematical track group and n=12 in the comparison group of NV students in the sample schools and) are also included here.

Educational level

Parents’ educational level is based on the Swedish educational nomenclature (Statistics Sweden, 2000) and is aggregated into three groups – more than three years education in Upper Secondary School or higher education, less than or equal to three years education in Upper Secondary School and unknown. The ‘maximum educational level’ for the parents is defined by the parent with the highest educational level. This definition is founded on the idea that the longer educational experience of one of the parents affects a child’s motivation for educational studies in a positive way more than the shorter experience of the educational system of two parents does.

Limitations

This study is based on a purposive sample of schools and thus the results cannot be generalized in a simple way to be applied to the whole target group of Swedish mathematical tracks. The strength of the results from this study lies in use of the comparison groups. This allows for a well-founded discussion, of e.g. the highlighted question of uneven recruitment in mathematical tracks (see e.g. Swedish National Agency for Education 2010a, 2011b), now lacking in Swedish educational studies.

The findings give a snapshot of the demographics of students studying in mathematical tracks today. A more valid knowledge of the demographics among students in mathematical tracks will be gained by repeating this study in the future and comparing findings over time.

The reliability of this study relies on the reliability of the data in the national registers, which can be assumed to be quite high. However, some factors negatively influence the reliability. ‘Parent’ is defined as *biological parents* or *adoptive parents* alternatively. This means that this study is built on data on parents who might not live with their children. This might influence the validity in results about the co-variance of parents’ educational level and students’ representation in the mathematical track. Moreover, there might be incorrect interpretations in the registers of the educational level for parents who have studied abroad.

Results and discussion

Gender

Table 1 shows the representation of females for the different groups. The test of significance confirms that females are under-represented in mathematical tracks in comparison with the NV group in the sample schools ($p < 0.01$). Data in Table 1 indicates that the under-representation of females also applies in comparison with the gender distribution in the NV-program nationally as well as with the Swedish population between 16 and 19 years old.

Table 1. Representation of females in different groups.

Group of (and number of) individuals	Percentage (number) of females
Students in mathematical tracks (n=158)	29,7 (47)
Students in the comparison group of NV students in the sample schools (n=1229)	44,9 (552)
Students in the NV in Sweden (n=45,213)	48,6 (21,967)
Individuals in the Swedish population, 16-19 years old (n=520,307)	48,6

Since 2001 students in the NV have had the possibility to choose a specialization in mathematics and computer science. This specialization, offered all over Sweden, offers students more mathematics courses during their Upper Secondary School studies as compared to other specializations in the NV. However, there is no university course included in this specialization. Since 2001 less than 23% (n=3,177) of students in this specialization have been female, and during the last six years at most 17% of students have been female (Swedish National Agency for Education, 2011g). Thus, in comparison with the representation in this program, the mathematical tracks have recruited females to a higher degree.

The under-representation of females in mathematics is also visible at under graduate level as well as at graduate level. This stand in contrast to most other subjects at university level in Sweden (Brandell & Staberg, 2008). In the academic year of 2009/2010, only 31,2% (n=10,900) of students studying mathematics at university level were female (Swedish National Agency for Higher Education & Statistics Sweden, 2011a). Only 24,5% of the

students at advanced level were female (*ibid.*). Moreover, among the mathematics graduate students who began their studies in 2001 to 2010, on average 23,5% (n=179) were female (Swedish National Agency for Higher Education & Statistics Sweden, 2011b).

Thus, for years the under-representation of females in studies specializing in mathematics is seen from the beginning of Upper Secondary School and on, although national test scores and school grades show that females are performing just as well as males in mathematics. This low participation of females in advanced mathematics studies could partly be due to the gifted females' competence beliefs and self concepts, as they show less self-confidence, more anxiety, lower interest and motivation in mathematics as compared to gifted males (Heller & Ziegler, 1996/7; Preckel, Goetz, Pekrun & Kleine, 2008). Moreover, it is probably influenced by the socialization practices relating to gender-role stereotypes (see e.g. Hyde & Lindberg, 2007; Preckel, Goetz, Pekrun & Kleine, 2008), such as the stereotypical image of mathematics as a male domain (Lacampagne, Campbell, Herzig, Damarin & Vogt, 2007). Research has shown that students in the theoretical programs in the Swedish Upper Secondary School perceive mathematics as a male domain (Brandell & Staberg, 2008). The strongest belief in this view is shown by males in the NV. Moreover, Swedish Upper Secondary School students believe that males, more than females, need mathematics in order to get good jobs and for their adult life (*ibid.*). Considering that individuals entering Upper Secondary School are at a sensitive age as they are forming their identity, we could probably not expect gifted female students to overlook prevailing socializing practices and gender-linked academic motivation or the fact that females are under-represented in different mathematics studies from Upper Secondary School on, when selecting programs, especially the NV, for future studies. Thus, for many females, enrolling into mathematical tracks might be a huge step to take, especially if they have to move in order to join the program.

Moreover, accelerated mathematics studies are an essential feature of the studies in all mathematical tracks in this study. Research has shown that, for those who were identified as mathematically gifted, females were less likely than males to accelerate their study of mathematics (Fox & Soller, 2007). This raises the question of whether we can argue that the very construction of the mathematical tracks with national recruitment really fulfills the demand (Swedish statute-book, 2010) for programs which are equally accessible regardless of gender.

In order to reduce the influence of stereotypical views of mathematics and mathematicians, and perhaps increase the female representation in mathematical tracks in Sweden, we need to foster more advantageous attitudes towards mathematics for gifted female mathematics students. This work needs to start at an early age as research shows that older students hold more strongly gendered views than younger (Brandell & Staberg, 2008). Moreover, interventions should also address environmental factors such as teachers and parents (Preckel, Goetz, Pekrun & Kleine, 2008). Thus, in Sweden it might be helpful to support gifted females at a much earlier age, in local gifted programs not only connected to the NV, and in less accelerated mathematics activities.

Origin

In Table 2 the representation of individuals with foreign background is presented for different groups. Since data show that the representation of students with foreign background is slightly higher in the mathematical tracks as compared with the comparison NV group in the sample schools, students with foreign background are not under-represented in mathematical tracks.

Table 2. Representations of individuals with foreign background in different groups.

Group of (and number of) individuals	Percentage (number) of individuals with foreign background
Students in mathematical tracks (n=147)	32,7 (48)
Students in the comparison group of NV students in the sample schools (n=1227)	29,2 (358)
Students in the NV in Sweden (n=45,213)	21,7
Individuals in the Swedish population, 16-19 years old (n=520,307)	16,6

Data from Table 2 also show that we cannot claim that students with foreign background are underrepresented when compared with all the students in the NV nationally nor when compared to the Swedish population between 16 and 19 years. Rather, the data raises questions about the under-representation of students with Swedish background in mathematical tracks.

In Sweden, schools with gifted programs are a fairly new phenomenon and many people consider these schools as “elite schools”. Thus, a first interpretation might be that the extreme expression of egalitarianism that has influenced the Swedish society for so long (Persson, Joswig & Balogh, 2000) influences the non-participation of students with Swedish background in gifted programs. However, a report (Swedish National Agency for Education, 2011a) indicates that 85% of the participants in the national cutting-edge programs in all subjects are of Swedish background. This reflects quite well the representation in the corresponding group of 16-19 year olds in the Swedish population, indicating that students

with Swedish background do not reject special tracks for gifted students per se. Thus, this study raises culturally-related questions about the reasons why students with Swedish background choose not to participate in mathematical tracks as compared to several other subject tracks in the cutting-edge programs.

In this study it is mainly students from Europe (the Nordic Countries excluded), especially from former Eastern European countries, that contribute to the relatively high representation of students with foreign background in mathematical tracks. Further studies are needed to clarify whether this is a trend that will hold over time, and, if so, if this is due to a relatively long tradition of gifted programs and gifted schools in the Eastern Europe (see e.g. Vogeli, 1997; Persson, Joswig & Balogh, 2000).

Parents' educational level

Table 3 presents the maximum educational level for the parents of students in the mathematical tracks as well as for parents of students in the comparison group. The test of significance shows that the distribution of parents with a maximum educational level of more than three years of studies in Upper Secondary School or higher education is higher among parents of students in mathematical tracks than among parents of students in the comparison NV group in the sample schools ($p < 0,05$). Non-response due to lack of information about the educational level of some individuals does not affect the study result.

Table 4 (in the Appendix) shows the educational level of mothers as well as of fathers of students in the mathematical track and in the comparison group respectively. Data indicate that there is a clear distinction in educational levels for mothers as well as for fathers in the group of mathematical tracked students as compared to the corresponding groups in the sample schools. Further comparison with the distribution of the educational level of the Swedish citizens between the age of 40 and 59 shows an even larger distinction.

Table 3. Distribution of maximum educational level of parents of students in the mathematical track and the comparison group respectively.

Maximum educational level of parents	Percentage (number of students in mathematical tracks (n=147)	Percentage (number of students in the sample schools (n=1227)
More than three years of studies in Upper Secondary School or higher education	85,7 (126)	78,6 (965)
Less than or equal to three years of studies in Upper Secondary School 6-19 years old (n=520,307)	13,6 (20)	20,9 (257)
Unknown	0,7 (1)	0,4 (5)

The evaluation of the cutting-edge programs in all subjects show that 68% of the mothers, and 58% of the fathers, of the participating students have more than three years of studies in Upper Secondary School or higher education (Swedish National Agency for Education, 2011a). These numbers could be compared to 76,9% and 68,7% respectively for parents of students in mathematical tracks in this study (see Table 4).

The great covariance between a high academic parental educational background and advanced studies in mathematics is also noted among the first year graduate students in

mathematics. Statistics that show the average parental educational background of Swedish graduate students who began their studies between the year of 2004/2005 and 2008/2009 show that the portion of highly educated parents (corresponding to at least three years of Upper Secondary School Studies) is the highest (65%) for graduate students in mathematics as compared to graduate students in other national research fields (Humanities/ Religion, 57%; Medicine, 58%; Natural Sciences, 51%; Social Sciences; Forest/Agricultural Research, 51%; Engineering Sciences, 53%). Thus, in Sweden, it seems that a high parental education is more important for students taking educational paths in advanced mathematics than for students in other advanced subjects.

The strong connection between advanced Upper Secondary School studies in mathematics and studies in the NV is convenient for the organization of mathematical tracks. Nevertheless, it might be one of the reasons for the strongly uneven representation of students with a lower parental educational background in comparison with the educational background of the Swedish citizens between 40 and 59 years old. Thus, one way to open up for the participation of more students with a lower parental educational background in mathematical tracks might be to make it possible to participate in the track while still taking other Upper Secondary School programs than the NV. Still, since this study shows that the distribution of parents with more than three years of studies in Upper Secondary School or higher education is higher among parents of students in mathematical tracks than among parents of students in comparison group of the NV in the sample schools, findings from this study suggests that there must be other reasons for the under representation of students of less educated parents. Further research is needed in order to find out more about the reasons why high parental education is especially shown by students in tracks in the subject of mathematics.

Conclusions

Results from this study confirm that, in mathematical tracks in Sweden, females are under-represented and questions are raised about a possible under-representation of Swedish born students. These results are specific for the subject of mathematics, since they differ clearly from the average distributions of gender as well as of origin taken over cutting-edge programs in all subjects (Swedish National Agency for Education, 2010a, 2011a). Findings from this study also confirm that students with well educated parents are over-represented in mathematical tracks.

The reason for uneven representations in gifted programs are often ascribed to biased conceptions of giftedness, identification procedures and teacher nominations (Bianco, Harris, Garrison-Wade & Leech, 2011; McBee, 2006; Borland & Wright, 2000). However, under-representation of different groups in the Swedish mathematical tracks cannot be ascribed to inequalities in an identification process since it is, in principle, self-selection among students with high overall grades (Swedish National Agency for Education, 2011a). Instead, the findings stress the importance of finding out more about the attitudes towards and the interest in mathematics that influence the students' socializing practice and that affect some students' choice to study and other students' choice not to study in *mathematical* tracks. Thus, the results of this study emphasize the discussion of the influence of the civic culture on the representation of students in gifted programs (as seen in e.g. Preckel, Goetz, Pekrun & Kleine, 2008; Hyde & Lindberg, 2007; Freeman, 2004 and Borland & Wright, 2000).

Finally, findings also suggest that, in Sweden, we need to continue to develop and complement the gifted education in mathematics in order to avoid the current uneven recruitment.

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Appendix:

Table 4. Educational level of mothers and fathers of individuals in different groups.

	Percentage (number) of mothers/fathers of students in the mathematical tracks		Percentage (number) of mothers/fathers of students in the sample schools		Percentage (number) of individuals among the Swedish population 40-59 years old	
	Mother (n=147)	Father (n=147)	Mother (n=1227)	Father (n=1227)	Women (n=1,207,580)	Men (n=1,238,448)
Highest educational level						
More than three years of studies in Upper Secondary School or higher education	76,9	68,7	63,5	61,5	38,3	31,5
Less than or equal to three years of studies in Upper Secondary School	21,8	25,2	35,0	33,0	60,8	67,4
Unknown	1,4	6,1	1,5	5,5	0,9	1,1

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