Adults' mathematical self-concept - dependent on gender?

Kjersti Lundetræ

The National Centre for Reading Education &Research,

University of Stavanger, Norway

kjersti.lundetre@uis.no

Data from the Adult Literacy and Life Skills Survey (ALL) are used to examine whether gender affects Norwegian adults' mathematical self-concept and feelings in practical maths situations. The ALL-data presented indicate that men in general are more likely than women to state that they are good with numbers and calculations. The gender differences are biggest at the lowest skill levels. 20 percent more men than women at level 2 agree that they are "good with numbers and calculations". Furthermore, about twice as many women as men at the three highest levels state that they feel anxious when figuring such amounts as discounts, sales tax or tips. Hierarchical regression analyses show that numeracy skills are the most decisive variable for both mathematical self-concept and feelings in practical maths situations, while gender adds very little when controlled for numeracy skills.

Introduction

Mathematics is considered an important area of skills, which can affect the individual's opportunities in education, employment and everyday life. Private economy, shopping, estimation of materials for redecoration, acquiring information and helping children with homework are only some of the areas where mathematical skills are essential. These skills are also decisive in enabling each individual to adapt to an ever-changing society and labour market (Statistics Canada & OECD, 2005).

For a long time, mathematics has been considered a masculine subject. In the Norwegian curriculum from 1939 (N-39), boys had more weekly lessons in arithmetic than girls, and it wasn't until the curriculum M-74 was introduced in 1974 that it was intended that all girls and boys in Norway should have equal teaching in mathematics in primary and lower secondary education (Lundetræ, 2005). We cannot rule out that the differences in the curriculums also reflect the prevailing attitude towards mathematics and gender in society. These socio-political constructed differences can have influenced women's and men's attitudes and skills in mathematics. We know that far more men than women participate in mathematics in higher education (Utdannings- og forskningsdepartementet (UFD), 2005), while there are no gender differences when it comes to examination marks in mathematics in the 10th grade (Utdanningsdirektoratet, 2006). Research indicates that the attitudes towards the subject are the biggest gender difference in mathematics (Tatre & Fennema, 1995), which also can affect further participation when the subject becomes voluntary. In an American study, Tatre and Fennema (1995) found that "Confidence in learning mathematics is the affective most consistently related to mathematics achievement" (p. 212).

Aim of the paper

After having worked with the data gathered in connection with ”Adult Literacy and Life Skills Survey” (ALL), and studied gender differences in numeracy skills in the adult population (Lundetræ & Gabrielsen, 2006), I wish to have a closer look at how Norwegian women and men experience their own mathematical skills. The aim of this paper is therefore to study adults’ assessment of their own mathematical skills. First and foremost it is of interest to see whether women and men assess their mathematical skills differently, but it is also interesting to see whether they have different feelings about mathematics.

The data gathered in connection with ALL can suggest some answers to these questions. ALL was carried out in 2003, and is a follow-up to the International Adult Literacy Survey (IALS), where 22 countries participated from 1994-1998. IALS and ALL were both coordinated by Statistics Canada and OECD. Norway is one of six participating countries in the first round of ALL. The performance of 5400 Norwegian adults aged 16 to 65 in the domains of Prose and Document Literacy, Problem Solving and Numeracy were assessed in ALL, in addition to the large amount of information gathered through a background interview. In Norway, the Reading Centre, University of Stavanger, on assignment from the Department of Education- and Research, led the survey.

To examine how 16-65-years old consider their own self-confidence in mathematics, I will take as my basis their responses to two of the items presented in ALL. The first item is: ”I’m good with numbers and calculations.” I assume that those who agree with this claim also consider themselves to be good with mathematics. The second item, ” I feel anxious when figuring such amounts as discounts, sales tax or tips”, can also tell us something about adults’ mathematical emotions. The responses to the first item tell us something about the mathematical self-concept, defined by Skaalvik and Skaalvik (2004) as ”the general feeling of doing well or poorly in mathematics” (p. 244), based on Marsh’s (1990) modified version of the “Self Description questionnaire”, and items such as “I always do well in mathematics”. The second question is close to Rounds & Hendel’s “numerical anxiety”, referring to “everyday concrete situations requiring some form of number manipulation” (1980, p. 142). Evans (2000) also uses this term in his work on adults’ mathematical thinking and emotions.

Literature survey

As a background for the discussion of results, a brief review of mathematics and gender in Norwegian curriculums, current literature about men and women’s mathematical skills, and also their attitudes towards this subject will be presented.

Mathematics and gender in the curriculum

Different factors may have contributed to forming the adult population’s relationship/attitude to mathematics. The prevailing attitudes towards mathematics in society, parents, experiences, teachers and school are some of these factors. The school is an important arena in society where we achieve knowledge, skills and attitudes. Therefore, it is interesting to see what the current curriculums say about mathematics and gender. Basic mathematics teaching takes place in the compulsory primary and secondary school, which are the only compulsory school in Norway. Accordingly, I will concentrate on these curriculums.

There is no doubt that there have been great changes in the school, from the time when the 65-year old respondents in ALL started school until the youngest 16-year old respondents finished compulsory secondary school. The oldest respondents in ALL were taught according to curriculum N-39 (see table 1). N-39 operated with different time schedules for boys and girls, and according to this plan, the girls had 30 hours' arithmetic a week (divided on seven years), but 28 if they learned English in the sixth and seventh grade. The boys had 31 hours' arithmetic independent of their English lessons. Instead, they were given fewer hours in craft subjects (KUD, 1939). In addition to the reduced number of hours they were taught mathematics, the attitudes towards girls and mathematics reflected in this curriculum may have influenced girl's mathematical achievement and opinion of their own abilities and skills.

Table 1. Overview over curriculum in 7th grade for Norwegian 16-65-year olds per 31.12.2002. (The numbers in the curriculum names refer to the year the curriculums were introduced.)

Curriculum in 7th grade	N-39	L-60	M-74	M-87	L-97
Age per 12.31.2002	56-65	42-55	29-41	19-28	16-18

As the preliminary curriculum from 1960 and the 9-year compulsory school was gradually introduced towards the 1970s, the girls received the same amount of mathematics lessons as the boys. Beyond this, gender is not mentioned in connection with mathematics in this curriculum, and it can't be excluded that the attitudes from N-39 still existed in school.

With M-74, a new era started in the Norwegian school with regard to equal status between boys and girls. Equal status was an important theme that filled approximately 1 ½ pages in the general section. It was made clear that everybody had a right to an equal number of lessons, and equal teaching in the compulsory subjects. It was also made clear that there should be "the same expectations to both genders" (KUD, 1974, p. 23, my translation). When the M-87 was introduced, women and men had in principle more equal status in society, and it was taken for granted that girls and boys should have equal teaching. The equal status concepts from M-74 were continued, and tasks and examples were to be taken from both girls' and boys' experience and field of interests. In L-97, it was emphasized that:

The practical applications, examples and methods chosen are meant to ensure that girls and boys alike, and pupils with different cultural and social backgrounds, have the opportunity to experience a sense of belonging and to develop favourable attitudes to the discipline (KUD, 1999, p. 153).

Mathematical skills and gender

As reflected in the development of the curriculums in mathematics and the present literature, it seems that through generations a generally accepted view has been that mathematics is a discipline first and foremost for boys, and that boys perform better than girls in mathematics (Ernest, 1991; Harris, 2000; Walkerdine, 1998). During the past 30 years, a lot has happened in this field. In the 1970s, equal status seriously became a subject of public concern, and a part of curriculums and textbooks. These changes are also reflected in the education statistics. 30 years ago, very few girls studied mathematics. In 1978, 5 percent of mathematics students were women, while the number had increased to 24 percent in 1989, and 29 percent in 1995 (Hag, 1996, 1998). It looks as if this progress has stagnated, and today still far more men than women learn advanced mathematics (UFD, 2005).

In Norway, mathematics is a compulsory subject in both primary and lower secondary education and the first year of upper secondary education and training. In TIMSS 2003 (Trends in International Mathematics and Science Study), where a survey was made of pupils in the 8th grade, no significant differences between girls' and boys' mathematical skills were found, only a tendency for girls to achieve a little better than boys. For the girls, this is progress from 1995 (Grønmo, Bergem, Kjærnsli, Lie & Turmo, 2004). In PISA (Programme for International Student Assessment) 2003, where the mathematical skills of 15-years olds were surveyed, the boys achieved 1/10 of a standard deviation better than the girls, which is a very small difference. While the boys achieved best in the field of "Uncertainty" and "Space and shape", the girls achieved best on "Quantity". Therefore, how the test is constructed can be of importance with a view to determining which gender performs best (Kjærnsli, Lie, Olsen, Roe & Turmo, 2004). Gender differences in "Space and shape" found in PISA 2003 are confirmed by Nuttall, Casey and Pezaris (2005). They state that there are cognitive gender differences in some spatial tasks such as mental rotation, which "involves the ability to look at a picture of an object and visualize what it might look like when rotated in three-dimensional space" (Nuttall et al., 2005, p. 122).

Data from the Norwegian Directorate for Education and Training (Utdanningsdirektoratet, 2006) show that in recent years, there are no differences in marks of Norwegian girls and boys in the 10th grade school-leaving examination. Lødding (2004) found a tendency for girls in the 10th grade to obtain higher average marks in mathematics than boys. The girls have 3.49 in final marks (N=4744) and the boys 3.43 (N=4942). Still there are far more boys than girls continuing with the subject when it becomes optional after one year in upper secondary education and training. This is also the case for pupils with good marks. 63.1 percent of male students had mathematics for 3 years in upper secondary education and training before they started mathematically-demanding studies, while this is the case for only 44.7 percent of female students. Probably, this is also one of the reasons why female students perform pronouncedly more poorly than male students in the Norwegian Mathematics Council's investigation of basic skills in mathematics for students starting mathematically-demanding studies in Norway. Men score 52.8 percent, while women score 41.3 percent (Rasch-Halvorsen & Johnsbråten, 2006).

In a survey of adult students' experiences with mathematics, their performance and feelings about mathematics, Evans (2000) found that there were gender differences in school mathematics performance for the mature students (+21) and in practical maths performance. When it comes to the adult population in general (16-65 years), the results from ALL display significant gender differences in numeracy skills in favour of men within all educational levels (Lundetræ & Gabrielsen, 2006).

Gallagher and Kaufman (2005) claim that "Indeed, individual differences in ability and achievement *within* gender are probably much larger than the differences *between* gender" (p. 316). The British researcher, Fennema (1996, p. 14), made the following list in an attempt to summarize the conclusions she and other researchers have arrived at when it comes to mathematics and gender:

GENDER DIFFERENCES IN MATHEMATICS: 1990

1. Gender differences in mathematics may be decreasing.

2. Gender differences in mathematics still exist in:

- learning of complex mathematics

- personal beliefs in mathematics

- career choice that involves mathematics

3. Gender differences in mathematics vary:

- by socio-economic status and ethnicity

- by school

- by teacher

4. Teachers tend to structure their classrooms to favor male learning.

5. Interventions can achieve equity in mathematics.

The first two points on Fennema's list coincide well with the figures referred to above. The gender differences in mathematics have diminished, even though there still are far more male students studying mathematics at university, and more boys than girls choose mathematics in upper secondary school and training. It would appear that gender differences in interests could provide the best explanation as to why differences still exist (Jacobs et al., 2005). For instance, women to a greater degree choose occupations involving working with people (doctor, teacher, nurse), and seem in general to be less interested in occupations as engineer or electrician.

Mathematics, gender and self-concept

Traditional, mathematics has been a school subject with high status, and according to Linnanmäki (2002, 2004) is the subject that most strongly influences self-understanding. Mattson (1995) describes the meta-learning power of mathematics:

Mathematics education has an extraordinary power to teach the students who they are. It helps the students learn that "I have no problems in school, I'm stupid, I'm intelligent, I'm the kind that will leave the school as soon as possible," and so forth" (p. 16).

Linnanmäki (2002, 2004) found that negative experiences with mathematics are very common, and that the pupils are more concerned about their achievement in mathematics than in any other school subject. We also know that mathematical self-concept is related to academic achievement (Skaalvik & Skaalvik, 2004).

Girls have traditionally lacked good role models, and tasks in mathematics have as a rule been developed by men and have thus to a greater degree been derived from boys' fields of interests. Grevholm (1995, 2004) describes Swedish analyses of books in mathematics in compulsory school, where the books through names and pictures portray the world as if it consists of twice as many men as women. At the same time, the teachers were not aware of the problem. There is no reason to believe that the situation has been much different in Norway.

The GeMa-project (Gender and Mathematics) in Sweden showed that most of the pupils perceived mathematics as gender neutral, even though some older pupils (from 11th grade) of both genders stereotyped mathematics more as a male domain (Brandell, Nyström & Sundquist, 2004). In TIMSS 2003 it was found that Norwegian 8th grade girls scored 0.23 points less than boys in mathematical self-concept in response to the statement "Mathematics is not one of my strengths" on a scale from one to four (Grønmo et al., 2004). For the statement "I learn things quickly in mathematics", the difference was 0.25 points in the boys' favour. When comparing these results with TIMSS 1995, it is clear that these gender differences have diminished in recent years (Grønmo et al., 2004).

Also in PISA 2003, the gender differences in mathematical self-concept are rather clear (Kjærnsli et al., 2004). The Norwegian boys had an average value of 0.15 in mathematical self-concept, while the girls' average value was –0.24. (The mean for the OECD countries is 0 and the standard deviation is 1.)

Knowing that the girls and boys performed approximately equally well, with only about 10 percent of a standard deviation in favour of the boys, the gender difference in mathematical self-concept in PISA is considerable. Kjærnsli et al. (2004) claim that the boys seem to have the most realistic mathematical self-concept, because Norwegian boys and girls score on the average in an OECD connection.

In her research into mathematics, self-concept and gender in the Finnish primary and secondary school, Linnanmäki (2002) found that girls in 8th grade had a poorer self-concept in mathematics than the boys, even though they achieved a little better at assessment tests than the boys. This is also confirmed by Skaalvik and Skaalvik (2004). Lødding's (2004) findings indicate that girls have an incorrect picture of own skills in scientific subjects, because girls must achieve a half mark better in the final assessment in 10th grade than the boys, to express confidence in their mathematical skills. The difference is less between girls and boys with the mark A, than between girls and boys with marks B to E. The girls' belief in their own mathematical skills is therefore generally weaker than boys' with the same marks. An interesting fact is that Lødding (2004) found that this is the other way around when it comes to verbal subjects. The boys have a lower verbal self-concept than the girls. This can indicate that there is no gender difference in self-confidence but instead different self-concepts, which can be explained by social and cultural attitudes as gender stereotyping.

Skaalvik and Skaalvik (2004) found supportive results for the gender stereotype explanation of gender differences in self-concept in their study of gender differences in mathematical and verbal self-concept in a sample of students in 6th grade, 9th grade, 11th grade and adult students. "In mathematics, male students had higher self-concept in all samples and higher performance expectations in the two oldest samples." (p. 249). This could not be explained by grades. They also found that "Older students had higher verbal than mathematical self-concept regardless of gender" (p. 241). When it comes to numerical maths anxiety, Evans (2000) found a gender difference meaning that women report this to a greater degree.

When mathematics becomes an optional subject, more boys than girls choose mathematics (Hanna & Nyhof-Young, 1995; Jacobs, Davis-Kean, Bleeker, Eccles & Malanchuk, 2005; Lødding, 2004; Mattson, 1995). Lødding (2004) found that this happens even though the proportion of girls and boys leaving secondary school with grades A and B in both science and mathematics are the same (Lødding, 2004). Skaalvik and Skaalvik (2004) write:

One reason why gender differences in academic self-concept and self-efficacy are important is that these constructs are strongly related to academic achievement and variety of motivational indicators (p. 241).

In Norway, most of the academic staff working with scientific subjects in universities and university colleges are men (UFD, 2005).

(…) although girls' performance and self-perceptions of ability suggest that they feel competent in math, they are less likely than boys to find it intrinsically interesting and their parents are less likely to create math-supportive or math-promotive environments for them (Jacobs et al., 2005, p. 260).

Different interests between boys and girls can of course be one reason why girls choose education related to mathematics to a lesser degree than boys, but that can hardly be the only explanation. Steele and Ambady (2006) examined the effect of gender priming on women's attitudes. They found that

women who were subtly reminded of the category female (Study 1a) or their gender identity (Study 1b) expressed more stereotype consistent attitudes towards the academic domains of mathematics and arts than participants in control conditions" (p. 428).

They do not think there are grounds for assuming a permanent change in attitude, but claim that

It seems possible that our culture creates a situation of repeated priming of stereotypes and their related identities, which eventually help to define a person's long-term attitude towards specific domains" (Steele & Ambady, 2006, p. 435).

Jones and Smart (1995, p. 223) write that "Mathematical ability has long been seen as a yardstick for "braininess" and as such it is not seen as a socially acceptable ability to demonstrate in the school culture." They refer to Jones and Jones' study (1989), where girls tell that "clever" was seen as "square" or "boring", and that they therefore, in contrast to the boys, had to hide such talents in upper secondary school. Hanna and Nyhof-Young (1995, p. 9) claim that "Girls who are aware that mathematics will be relevant to their lives and useful in their future careers are far more likely to remain in mathematics courses". Results from TIMSS 2003 show that Norwegian girls are less motivated towards learning mathematics than boys (Kjærnsli et al., 2004). The boys are also more interested in mathematics, more motivated towards learning through competition, and have a higher instrumental motivation than the girls, who are more motivated towards learning through cooperation.

Methods

In what follows, I will briefly describe research design, data collection and validity in the ALL-survey and also the methods I used during the data processing. Statistics Canada, Educational Testing Service (ETS) and OECD are responsible for the ALL-survey. Development of the ALL, methodology, and definition of levels of difficulty are thoroughly described in the international reports ”Learning a Living” (Statistics Canada & OECD, 2005) and ”Measuring Adult Literacy and Life Skills” (Murray, Clermont & Binkley, 2005).

Levels in ALL

ALL employs the same 0-500 scale as its forerunner, IALS. The statistical analyses are based on the item-response-theory (Murray, Clermont & Binkley, 2005), which briefly means that the developers of the study in the light of the pilot can find out how difficult the different tasks are, and decide where on the 0-500 scale they are to be placed. The same scale is also used to place the individuals in the population. The scale is divided into five levels, where level 1 is the easiest. OECD found that participants should score on level 3 or better to be a critical citizen and manage the demands of everyday life (Statistics Canada & OECD, 2005). The score denotes the point where a person has 80 percent chance of successfully completing tasks associated with the same level of difficulty.

Study design

ALL uses a “Balanced Incomplete Block” (BIB) study design, where a large number of tasks in every domain are broken down into smaller task sets or blocks. These blocks are divided into 28 booklets. In numeracy, there are 40 tasks divided into two blocks. Most of the booklets consist of a combination of blocks from two domains, while some booklets have tasks from only one. Every booklet is given to a randomised selection. The design of the study secures a correct result on all the domains on population level, and makes it possible to compare the results between the participating countries.

Data collection

Respondents in the sample

The countries participating in ALL have to draw a probability sample that accurately represents the civilian non-institutionalized population aged 16 to 65. In Norway, Statistics Norway (SSB) draw a sample of 10.008 persons, with a drop-out rate of 43 percent. Still, this is considered a good enough response frequency to give reliable answers with a very small uncertainty (Gabrielsen, Haslund & Lagerstrøm, 2005).

Table 2 shows that relatively more 16-20 year olds than 21-25 year olds participated in the survey. There are also fewer 60-65 years old than the population indicates. To make the results representative, Statistics Norway (SSB) has weighted the data. As we see from table 3, the gender distribution in the sample is good.

Table 2. Distribution of the respondents' age in ALL.

Age group	Number
16-20	694
21-25	402
26-30	519
31-35	614
36-40	592
41-45	570
46-50	593
51-55	582
55-60	506
60-65	339

Table 3. Distribution of gender

	Number	Percent
Women	2641	48,8
Men	2770	51.2

Data collection

In Norway, SSB gathered the data during 2003. The ALL assessment was administered in homes, and started with a background questionnaire where the respondents were asked a series of questions thought to influence the respondents' literacy and life skills. When the background questionnaire was completed, the participants were presented with a booklet containing six simple tasks from everyday life. If they failed, the interview was broken off, because the tasks over level 1 in all probability would be too difficult. Respondents who passed the core tasks were given one of 28 task booklets. There were no time limits, and the respondents could use a ruler and a calculator for the numeracy tasks. In average, SSB spent approximately 2 hours in each home.

Scoring of tasks

Because ALL is an international, comparative survey, it was very important that the scoring of the tasks was carried out as consistent as possible. Those charged with scoring received an exhaustive introduction to "ALL scoring manual". Next, all the questions were scored by two persons. If there was divergence, they were re-scored by a third person. All the participating countries had to re-score at least 20 percent of the tasks, following given guidelines. In addition, 10 percent of the tasks were re-scored by scorers from a different country. The correspondence had to be at least 90 percent to be accepted.

Validity

When it comes to validity in ALL, this field is too big to go into detail in this paper. Statistics Canada, Educational Testing Service (ETS) and OECD that lead the ALL have however good expertise on big, international comparative surveys. Strict demands are made on the participating countries in regard to representativeness, size of the samples, and how the survey is carried out. In Norway, Statistics Norway took care of this, and all sections in the survey were checked by Statistics Canada and ETS to make sure that the study is fitted to draw conclusions on population level. I refer to ”Measuring Adult Literacy and Life Skills” (Murray et al., 2005) and Lagerstrøm (2005) for more details about validity.

It can be discussed whether it is possible to get a true picture of the population’s proficiencies and attitudes towards mathematics in a survey where the respondents are interviewed and solve pen and paper tasks, instead of acting in a “real life context”. The ALL was anonymous with voluntary respondents, and I see no reason to believe that they didn’t answer to the best of their ability. The numeracy tasks are derived from real contexts, and seem realistic within the limits that task booklets in a big, comparative survey can give. We must also be aware that how a person describes a practical maths situation in words when asked to do so may differ from what they feel in the actual situation. It is important to show caution when dealing with the data, and to be aware that the questions in the background questionnaire are multiple choice. On the other hand, it is hard to see another and more reliable way of gathering such an amount of data.

Data-analysis

During the work with the statistical analysis, I have applied SPSS 13 for Windows, where the ALL data are loaded. Microsoft Excel was used for tables and figures. To give a picture of numeracy skills, how adults perceive their mathematical skills and how they experience situations when figuring amounts etc., I have used descriptive statistics. In addition, multiple regression analysis was applied to investigate the relationship between each of the dependent variables “I’m good with numbers and calculations” and “I feel anxious when figuring such amounts as discounts, sales tax or tips” and the independent variables “gender”, “age”, “numeracy-score” and “total years of schooling”. These independent variables are chosen in the light of theory presented in this paper. When researching whether self-assessment in mathematics is dependent on gender, it is interesting to control for age and numeracy skills. Total years of schooling is also in the model: even though we know that this variable influences numeracy skills, it is also possible that it adds something beyond this.

The main aim in these analyses is to see whether gender adds anything to the dependent variables after numeracy-score, age and total years of schooling have been entered into the analysis. By using multiple regression, it is possible to investigate the relationship between the dependent variables and the independent variables with the effect of the other independent variables statistically eliminated (Tabachnick & Fidell 2007). Multiple regression can also tell how much of the variance in a dependent variable can be explained by the independent variables.

To make use of multiple regression analysis, the dependent variable must be continuous, while the independent variables must be continuous or dichotomous (Pallant, 2005). In this case, I will apply multiple regression analysis, even though the dependent variables are not continuous, but ordinal with the values 1-4. The sample is big (N=5411), and the dependent variables are approximately normal distributed (skewness = 1.03/-0.11; kurtosis = 4.38/2.30 and the variance = 0.65/0.71), I therefore presume that the ordinal dependent variables are nearly metric and continuous and thereby behave as if they were scale.

Analysis and presentation of results

To examine whether men and women's self-assessment of mathematical skills are differently, I look at whether the respondents ”strongly agree”, ”agree”, ”disagree” or ”strongly disagree” in two different statements. How they answer the item ”I'm good with numbers and calculations” can provide good information about how they assess their mathematical skills. Also ”I feel anxious when figuring such amounts as discounts, sales tax or tips” can give information about how comfortable adults are with practical maths.

Women and men's self-assessment of mathematical skills

Figure 1 show that approximately 75 percent of the population agree or strongly agree that they are “good with numbers and calculations”. It is also clear that men and women's self-assessment of mathematical skills are differently. Far more men than women experience that they are “good with numbers and calculations”.

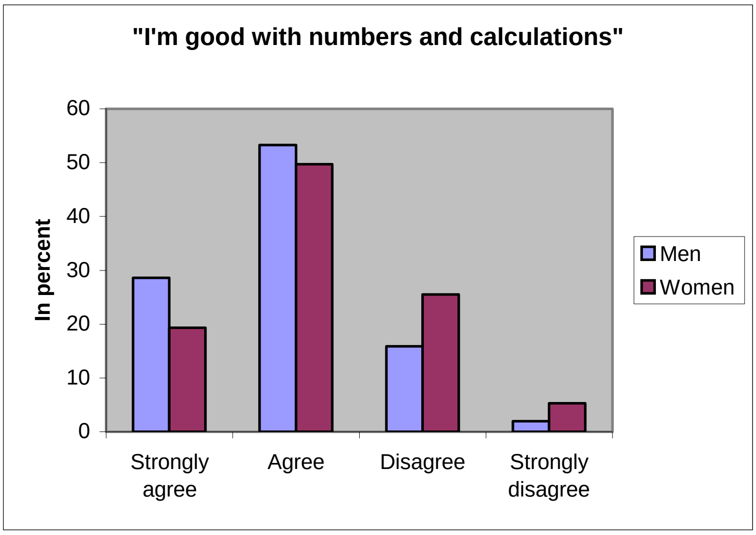

Figure 1. Women's and men's assessment of own mathematical skills.

Table 4 below show that 82 percent of the men and 69 percent of the women perceive themselves as good with mathematics. While about 5 percent of the women ”strongly disagree” that they “are good with numbers and calculations”, only 2 percent of the men say the same.

Table 4. ”I'm good with numbers and calculations”.

	Men %	Cumulative percent	Women %	Cumulative percent
Strongly agree	28.6	28.6	19.3	19.3
Agree	53.3	81.9	49.7	69.0
Disagree	15.9	97.8	25.5	94.5
Strongly disagree	2.0	99.8	5.3	99.8

To supplement this picture, we can look at how comfortable adults feel in practical mathematical situations. As shown in figure 2, most adults state that they don't get anxious in these situations. About 80 percent do disagree with the statement ”I feel anxious when figuring such amounts as discounts, sales tax or tips”.

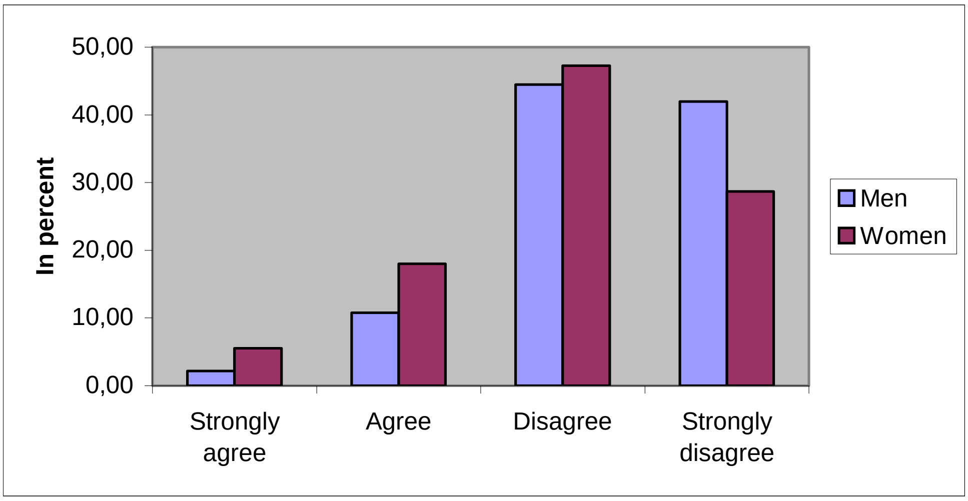

Figure 2. ”I feel anxious when figuring such amounts as discounts, sales tax or tips”.

The gender differences are clearly expressed in this figure, and table 5 show that about twice as many women as men state that they get anxious in these situations. 13 percent of the men and 24 percent of the women say they get anxious when figuring out such amounts as discounts, tax or tips.

Table 5. ”I feel anxious when figuring such amounts as discounts, sales tax or tips”.

	Men %	Cumulative percent	Women %	Cumulative percent
Strongly agree	2.2	2.2	5.5	5.6
Agree	10.7	12.9	18	23.6
Disagree	44.4	57.4	47.1	70.8
Strongly disagree	41.9	99.3	28.6	99.5

Adults' self-assessment of mathematical skills compared to skill level

OECD (Statistics Canada & OECD, 2005) find numeracy skills at level three or better necessary if people are to have the knowledge and skills needed to be a critical citizen and manage mathematical situations at work, at home and in leisure time. Men's numeracy skills are better than women's (Lundetræ & Gabrielsen, 2006). Therefore it can be interesting to see how the population within the different numeracy levels assesses their skills.

As we have seen, a total of 75 percent of the Norwegian population say they "strongly agree" or "agree" with the statement "I'm good with numbers and calculations". Table 6 shows that many people with poor numeracy skills (level 1 and 2) find themselves good with numbers and calculations. 52 percent at level 1 ”agree” or ”strongly agree” in this statement, while 67 percent at level 2 find themselves good with mathematics. We can see that the mathematical self-concept increases with increasing skill level.

Table 6. "I'm good with numbers and calculations" and numeracy level.

%	Level 1	Level 2	Level 3	Level 4/5
Strongly agree	8.6	12.6	24.1	40.2
Agree	43.5	54.3	55.2	49.2
Disagree	37.2	27.1	17.8	10.2
Strongly disagree	10.1	5.7	2.6	0.4

Table 7 shows an even stronger relationship between how comfortable adults feel in practical maths situations and measured numeracy skills, than between self-assessment of mathematical skills and measured numeracy skills. At level 1, about 49 percent feel anxious, while this only is the case with 4.5 percent on the two highest levels.

Table 7. "I feel anxious when figuring such amounts as discounts, sales tax or tips". Numeracy level.

%	Level 1	Level 2	Level 3	Level 4/5
Strongly agree	13.3	4.2	2.4	1.1
Agree	35.3	20.6	9.6	3.4
Disagree	39.3	51.8	49	33.3
Strongly disagree	10.7	22.3	38.6	62.1

Adults' self-assessment of mathematical skills compared to numeracy level and gender

We have seen that numeracy skills are important for adults' self-assessment of mathematical skills and for how comfortable they feel in quantitative situations. Table 8 shows that men and women within the same numeracy level conceive their skills differently. Men perceive themselves as better than women at the same level do. We find the biggest gender difference at level 2, where 74 percent of the men and 62 percent of the women agree that they are good with numbers and calculations. At level 4/5 the gender differences are less, 90 percent of the men and 88 percent of the women agree that they are good with numbers and calculations.

Table 8. ”I am good with numbers and calculations”. Numeracy level and gender.

%		Level 1	Level 2	Level 3	Level 4/5
Agree/Strongly agree	Women	50.4	61.9	75	87.9
	Men	54.8	73.8	83.2	90.2

Table 9 shows that women state that they get anxious when figuring out discounts and so on to a greater degree than men at the same level. 52 percent of the women and 43 percent of the men at level 1 get anxious, while this is only the case for 6.6 percent of the women and 3.4 percent of the men at level 4 and 5. At the three highest levels there are about twice as many women as men who state that they get anxious when figuring out discounts, tax or tips.

Table 9. "I feel anxious when figuring such amounts as discounts, sales tax or tips". Numeracy level and gender.

%		Level 1	Level 2	Level 3	Level 4/5
Agree/Strongly agree	Women	52	28.5	15.8	6.6
	Men	43	20	8.8	3.4

Multiple hierarchical regression, “I’m good with numbers and calculations” and “I feel anxious when figuring such amounts as discounts, sales tax or tips”.

The main aim with the multiple regression analyses is to see whether gender adds anything to the dependent variables after the variables numeracy skills, age and “total years of schooling” enter the analyses. Hierarchical regression analyses (see att. A 4.1 and A 4.2), show the same relationship between both the dependent variables and the independent variables. At the first step, gender and age explain 4 percent of the variance in both the dependent variables. The direct effect of gender is B=-0.26 on ”I’m good with numbers and calculations”, and B=0.30 on ”I feel anxious when figuring such amounts as discounts, sales tax or tips”.

When numeracy skills enter the models, 17 and 22 percent of the variance in the two dependent variables are explained. The total effect of gender (B=-0.15 and B=0.16) is less than the direct output (B=-0.26, and B=0.30), because almost half the gender effect goes via skills. Gender affects skills in the sense that women in general have a little lower numeracy skills than men. In other words, within the same skill level, gender means less, but still has a clear effect beyond what skills can explain. Gender predicts reported anxiety in figuring situations to some greater degree than mathematical self-concept.

Numeracy skills is the variable in the model that best predicts both mathematical self-concept (β=0.39) and numerical anxiety (β=-0.44). "Total years of schooling" is not significant when numeracy skills enters the model. Age, on the other hand, influence both numeracy skills (lower skills) and mathematical self-concept/numerical anxiety. The total effect of age (β=0.13 / β=-0.13) is bigger than the direct effect (β=0.09 / β=-0.08) for both the dependent variables. Older persons perceive themselves as some more clever than the young do, and get some less anxious in practical maths situations.

The regression analyses show that gender and age add something after numeracy skills have entered the analyses, but mean far less than numeracy skills for whether one perceive one self as good with numbers and calculations, or gets anxious in practical maths situations. Gender predicts reported anxiety in practical maths situations to some greater extent than mathematical self-concept. Gender doesn't only lead to a lower mathematical self-concept it also leads to some lower numeracy skills.

Summary

The presented data from ALL show that men to a greater degree than women state that they are good with numbers and calculations. This corresponds with Skaalvik and Skaalvik's findings (2004) where males had higher mathematical self-concept in all samples, when controlled for grades. The gender differences are largest at the lowest numeracy levels. 20 percent more men than women at level 2 state that they are good with numbers and calculations.

Adults with numeracy skills at the highest levels agree to a greater degree that they are good with numbers and calculations than those whose numeracy skills are at the lowest levels. This shows that the answers are based on a certain degree of self-insight. The fact that more than half of the respondents with skills at level 1 agree that they are good with numbers and calculations, and thereby might tend to overestimate their skills, can result from their not experiencing difficulties with numbers and calculations. It can also reflect that they come across few situations where good mathematical skills are demanded in everyday life. Some might also have conscious or unconscious strategies, where they leave problems such as reading routes or completing one's tax form to others. When it comes to figuring out discounts, tax or tips, about half of the adults at level 1 and a fourth at level 2 get anxious, in contrast to the two highest levels, where very few get anxious in these situations. It looks as if mathematical skills give self-confidence and security in mathematics related situations.

Evans (2000) found that women have numerical maths anxiety to a greater degree than men do. If we look at how far the respondents in ALL state that they are anxious when "figuring out discounts, tax or tips" or not, the gender differences are obvious. About twice as many women as men at the three highest numeracy levels state that they get anxious when figuring out such things. The use of the word *anxious* might have strengthened the gender difference. It is hardly perceived as very masculine to be *anxious*, and it is possible that men to a lesser degree identify with this phrase. Evans writes that "My first response that, rather than *being* more anxious, women are simply more likely to *express* anxiety, received some confirmation from cross-subject analysis of the interviews" (2000, p. 231). By using the word *stressed* or putting it the other way around, and asking the respondents whether they are *relaxed* or *comfortable* in these situations, the results might be some less divergent.

The ALL data indicate that women have less confidence in their mathematical skills than men at the same level. This corresponds to the findings in PISA 2003 (Kjærnsli et al., 2004) and TIMSS 2003 (Grønmo et al., 2004), where boys expressed more confidence in their mathematical skills than girls. Fennema (1996) writes that gender differences in mathematics still exist when it comes to ”personal beliefs in mathematics” (p. 14). The fact that some women believe that they perform less well in mathematics than they actually do, and feel anxious when calculating, can lead to a Matthew-effect. Women avoid these situations, lose training, and as a consequence of that, get lower skills in the future.

It is encouraging that gender differences in mathematical self-concept are diminishing in the primary and secondary school (Grønmo et al., 2004), and it will be interesting to see whether this will make itself felt in the adult population in the longer term. It is still a big challenge to make mathematics attractive for women when the subject becomes optional, and to make sure that as many as possible learn enough basic skills in mathematics to feel comfortable in common calculation situations. We know that motivation and attitudes towards mathematics can influence their educational and occupational choices and pathways (Skaalvik & Skaalvik, 2004).

Mathematical self-concept should be discussed with adult learners, to make them aware that gender stereotypes affect our self-concept. Women’s self-concept can affect their children, and make it even harder to close the gender gap. Some women may need to hear that it is “proved” that they probably perform better than they think. In the same way, we can tell males that they are probably better at English than they think. Even though the gender differences are small when we control for skills, there is still a big difference between women and men’s mathematical self-concept.

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Appendix

Table A.1. Summary of Hierarchical regression analysis for variables predicting mathematical self-concept. Dependent variable: "I'm good with numbers and calculations." (N=5411)

Variable	B	S.E.	β	Sig.
Step 1				
Gender	-0.26	0.02	-0.16	0.00
Age	0.01	0.00	0.09	0.00
Step 2				
Gender	-0.26	0.02	-0.16	0.00
Age	0.01	0.00	0.08	0.00
Total years of schooling	0.02	0.00	0.11	0.00
Step 3				
Gender	-0.15	0.02	-0.09	0.00
Age	0.01	0.00	0.13	0.00
Total years of schooling	-0.00	0.00	-0.02	0.09
Numeracy	0.01	0.00	0.39	0.00

R^2= .04 for step 1; R^2= .05 for step 2; R^2= .17 for step 3.

Table A 4.2. Summary of Hierarchical regression analysis for variables predicting feelings in practical maths situations. Dependent variable: "I feel anxious when figuring such amounts as discounts, sales tax or tips." (N=5411)

Variable	B	S.E.	β	Sig.
Step 1				
Gender	0.30	0.02	0.17	0.00
Age	-0.01	0.00	-0.08	0.00
Step 2				
Gender	0.30	0.02	0.17	0.00
Age	-0.01	0.00	-0.08	0.00
Total years of schooling	-0.02	0.00	-0.15	0.00
Step 3				
Gender	0.16	0.02	0.09	0.00
Age	-0.01	0.00	-0.13	0.00
Total years of schooling	-0.00	0.00	0.00	0.88
Numeracy	-0.01	0.00	-0.44	0.00

R^2= .04 for step 1; R^2= .06 for step 2; R^2= .22 for step 3.