Upper secondary school students' gendered conceptions about affect in mathematics

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This study explores upper secondary school students' conceptions about gender and affect in mathematics. Two groups of students from Swedish Natural Science Programme each answered a questionnaire; the first with a focus on boys and girls in general and the other with a focus on individuals themselves. The results from two questionnaires were compared. The first questionnaire revealed a view of rather traditional femininities and masculinities, a result that did not repeat itself in the second questionnaire. There was a discrepancy between traits students ascribed as gender different and traits students ascribed to themselves.

A body of research has pointed out the importance of achievement-related, motivational, and other self-beliefs and their influence on goal-settings and performance (Guimond & Roussel, 2001; Pajares, 2003; Stage & Kloosterman, 1995; Valentine, DuBois & Cooper, 2004; Zimmerman, Bandura & Martinez-Pons, 1992). What you think about yourself and your ability plays a part when solving mathematical problems. Previous research has indicated that decision making in mathematical reasoning is often based on beliefs about safety e.g. this algorithm is safe, expectations e.g. I'm supposed to solve this task with this algorithm, and motivation, often negative, e.g. I can't construct my own reasoning (Sumpter, in press). One of the questions arising from this study is whether these beliefs are considered female, male or gender-indifferent.

In mathematics, gender-stereotyping is often favouring male despite equal performance (Kimball, 1994, 1995; Walkerdine, 1998; Öhrn, 2002). There is a difference regarding what is gender stereotyped and what is reported in terms of grades and performances. In Sweden, even though there is an explicit equity goal in society, mathematics especially at higher levels is still an unbalanced area (Brandell et al., 2005; Brandell & Staberg, 2008).

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There is evidence that a view of mathematics as a male domain exists among students at upper secondary school in Sweden, particularly at the Natural Science programme. Brandell and Staberg (2008) concluded that positive motivational beliefs such as mathematics being joyful and a subject you will need for the future are considered male. Boys are thought of as successful in mathematics and therefore logical and clever. Girls are considered diligent and hard working, but since they have to work more and harder than boys, they are not as bright.

Looking at international research on gender differences in self-concept such as achievement-related beliefs, motivation and performance expectations it is equally pro-male; differences in self-evaluation are consistent with a traditional gender stereotypes favouring boys (Jackson, Hodge & Ingram, 1994), and male students are reported to have higher self-concepts, performance expectations and a positive intrinsic motivation (Skaalvik & Skaalvik, 2004). Girls rate their ability lower and are more likely to attribute success to luck and their failure to low ability (Stipek & Gralinski, 1991). Males indicate higher self-esteem although sometimes the differences are small (Kling, Hyde, Showers & Buswell, 1999). These results are in line with Swedish research (e.g. Brandell, Leder & Nyström, 2007; Brandell & Staberg, 2008; Palmer, 2010; Öhrn, 2002), though little is known about upper secondary school students' conceptions about affect in mathematics.

Combining the above results and with a focus on beliefs about safety, motivation, and expectations, in this study I investigate upper secondary school students' conceptions about these specific areas of beliefs. The research questions posed are: (1) How do upper secondary school students gender stereotype beliefs about safety, expectations and motivation? and (2) How does the gender stereotyping differ to traits students ascribe to themselves? This will be investigated by looking at students' from the Swedish Natural Science programme ranking of statements describing beliefs about safety, motivation, and expectations. The focus is on how some students perceive their identities compared to how some students understand female and male gender construction in school context. In order to investigate this, we need a gender perspective that deals both with the social construct of gender stereotyping and the process of forming the individual identity.

Theoretical framework

Gender perspective

The chosen perspective is on the result of having a specific gender in a specific situation. This is in contrast to, for example, seeing boys and girls as different independent of the context, or to see sex-differences as a biological difference. Gender is then thought of as an "analytic category which humans think about and organize their social activity rather than as a natural consequence of sex difference" (Harding, 1986, p. 17). This is different than just a division of people into "boys" and "girls", i.e. a categorization of sex (Hammström, 2005). People have through history assigned gender to non-human entities such as ships, countries and hurricanes. Here, I see the assignment in two ways: (1) you can attribute a gender to an object, characteristics or an action (e.g. a ship is female) or (2) you can attribute an object, characteristic or an action to a gender (e.g. boys are more likely to use the graphic calculator). In both these cases, an element (object, characteristics or action) is identified and picked out as typical with the assignment to a specific gender (Harding, 1986). This identification, put in a social context, includes self-identity (Tajfel & Turner, 1986) creating an individual's gender identity (Steele, 1997).

Gender is asymmetrical; human thought, social organisation and individual identity and behaviour are categorised in an order making some more a "boy-thing" or a "girl-thing". This is a fundamental structure – a process – that is constantly reproducing and changing itself with three aspects (Harding, 1986): (1) gender symbolism or gender totemism, (2) gender structure and (3) individual gender or gender identity. By using these three aspects, it is easier to separate what is related to the structure (e.g. younger children are taught by women, the majority of the professors in mathematics are men), to the symbols in thoughts, word and pictures (e.g. males are considered as being more logical than females), and to the individual gender. The structure confirms the symbolism, which then supports the structure. Both will influence the individual's choices (Eccles & Jacobs, 1986); even though most teachers at a lower level are female, and girls will perform as good or better than boys at compulsory school, the overall system through textbooks, teacher education and teaching practice will affect the students' view not only of mathematics as a subject but also of who could be a mathematician.

When developing your own gender identity you have to deal with the norm of gender equality that exists in the Swedish society but also with the traditional discourses of masculinity and femininity in mathematics education that coexist at the same time. These different discourses function side by side. It is in this context that boys and girls develop their gender identities by facing, often contradictory, images and negotiate them to a personal identity (Volman & Ten Dam, 1998). This negotiation includes behaviour such as coping strategy meaning that as a member of a group that is experiencing domination of another group you will find ways to cope in such situation. Several theories discuss social processes of this kind such as social dominance theory (Sidanius & Pratto, 1999) or system justification theory (Jost & Banaji, 1994). What they have in common is the aim to understand sub-groups' behaviour when power is implicitly or explicitly expressed. As stated earlier, students at upper secondary school in Sweden especially at the Natural Science programme perceive mathematics as a male domain (Brandell & Staberg, 2008), which means that the structure, the symbols and the identity are all more likely to be pro-male. It would be probable to expect that several different group behaviours exist in such environment.

Self-evaluation

One part of your self-identity (or self-concept) is how you view yourself and your capacity (Devos & Banaji, 2003). Looking at self-concept from a gender perspective, it is often favouring males (Jackson, Hodge & Ingram, 1994) and achievement-related beliefs are also pro-male (Stipek & Gralinski, 1991). Boys are found to have higher intrinsic motivation, which is connected to self-concept, than girls (Skaalvik & Skaalvik, 2004). A measure of self-identity is self-evaluation (Devos & Banaji, 2003). This measure is not just about grades but more about how you perceive yourself in relation to a social context. Previous research, both national (Brandell et al., 2005) and international (e.g. Fredericks & Eccles, 2002; Kimball, 1994), have reported that boys are more likely to rank themselves higher compared to girls. This higher evaluation can be made even though the students have exactly the same grade and performance (Jakobsson, 2000).

Conceptions and gender stereotyping

This study aims to investigate students' conceptions about specific beliefs. Thompson (1992) describes conceptions as "conscious or subconscious beliefs, concepts, meanings, rules, mental images, and preferences" (Thompson, p. 132). Conception is then a general concept including several aspects of affect. I follow this description and conception is defined as an abstract or general idea that may have both affective and cognitive dimensions, inferred or derived from specific instances. Hence, students' conceptions consist of their belief system, c.f. Green (1971), values and attitudes reflecting their experiences. Their conceptions will be studied by looking at if and how they gender stereotype statements and how they rank the truthfulness of these statements. Gender stereotyping is identified with the ranking of the statements as female or male (Forgasz, Leder & Kloosterman, 2004).

Method

Method of data collection

The data comes from two questionnaires. They are two forms of one instrument. Both questionnaires consist of 24 statements (see appendix A) all given as arguments for decisions made during school task solving by year two students (age 17) from the Natural science programme in Swedish upper secondary school. Eight classes from the Natural science programme from four different schools at three different locations participated (north/ middle/ south of Sweden; small/ medium/ big town), a total of 180 students (102 boys and 78 girls). The schools were randomly selected in terms of locations but had to fulfil the following criteria: (1) state run schools and (2) big enough to have two full size classes in the same year. Two schools were selected from the bigger town in order to provide variation within the city. The students had all completed a first course in calculus: seven of them in year two and one class in year three.

The first questionnaire, *Who and affect in mathematics*, aims to look at if students rank statements being more likely to be true for girls or for boys, or whether there is no gender difference. This questionnaire highlights what traits the students ascribe to different groups and the focus is how they understand female and male gender construction. Half of the classes (one class from each of the four schools, 44 boys and 44 girls) were asked for each statement to select one of the following responses to the question "Who is more likely to think this?": BD – boys definitely more likely than girls, BP – boys probably more likely than girls, ND – no difference between boys and girls, GP – girls probably more likely than boys, and GD – girls definitely more likely than boys.

The second questionnaire, *Me and affect in mathematics*, aims to look at how students rank the statements from their own standpoint. The focus of this questionnaire is on what traits the students ascribe to themselves, highlighting how they as individuals perceive themselves as mathematics students. The other four classes (58 boys and 34 girls) were asked to select one of the following options for each statement that describe their own standpoint most correctly: AT – absolutely true, MT – mostly true, N – neutral, PT – partly true, and NT – not true.

The inspiration for these questionnaires comes from Leder and Forgasz' instruments *Who and mathematics* and *Mathematics as a gendered domain* that were developed from Fennema-Sherman's *Mathematics Attitudes Scales*, MAS (Leder & Forgasz, 2002). These instruments give the opportunity to see mathematics not just as a male domain but also as female or neutral. The *Who and mathematics* instrument measures if and to what extent the students stereotype the statements as gendered. The second questionnaire measures how true the students rank the statements, providing the possibility to compare boys' and girls' results. In this version the middle option was changed; instead of "Not sure (NS)" the students were given the opportunity to be neutral about a statement. If they were unsure about a statement, they could leave it blank.

Both questionnaires also included a question about the respondent's gender and a question about self-evaluation. The first question allows me to categorize the students into "boys" and "girls" working as a basic division of sex. It should be emphasized that within the chosen perspective of gender this includes only the individual's own identification of gender and not the biological sex, and that biological sex was not investigated. The second question allows me to use the measure of self-evaluation when looking at gender differences in relation to the other instruments, but also possible gender differences – or sex-differences following Hammarström (2005) – in students' self-evaluation.

Two pilot studies were made in order to test to test the instrument. The questionnaires were handed out by the teachers. Two respondents did not indicate sex /gender and are not included in the study.

Method of analysis

The goal of the analysis is to present and highlight students' gendered conceptions of specific beliefs. The analysis was conducted in two steps. First, an analysis of the differences between girls' and boys' responses was made. For each of the statements, the responses were gathered. Instead of using parametric statistical methods as Brandell et al. (2005) and Leder and Forgasz (2002), I use non-parametric statistical methods since the questionnaires do not indicate how big the steps are and the assumption of normally distributed data is not justified. For *Who and affect in mathematics* the five answer categories were condensed into three: "Boy", "No difference", and "Girl". This allowed me to identify gender stereotyping although not to investigate the extent to which it was made. The gender stereotyping is here defined as if the students rank the statements as female or male. The option neutral was no ranking at all. The largest proportion of responses was identified. If the statement had the largest proportions of respondents choosing "No difference", the statement was considered as not gender stereotyped. The statements that had the largest proportion of responses in the male or female category were picked out for further investigation. A sign test was made to test the null hypothesis that the respondents are equally likely to choose boy or girl (i.e. if the gender stereotyping was significant). If $p<0{,}05$ we reject this null hypothesis. Then, a comparison of boys' and girls' responses was made making it possible to analyse similarities and differences between the two groups.

The responses to *Me and affect in mathematics* were condensed into three: "True", "Neutral", and "Not true". In order to compare girls' and boys' responses, Fisher's exact test was made. In contrast to the sign test, which identifies whether answers tend towards particular stereotyping, the Fisher's test explicitly tests whether statements differ between girls and boys. This test calculates the probability of all possible outcomes in an experiment given a null hypothesis that there is no difference between the treatments. It then calculates which of these outcomes are more or less "extreme" compared to the experimental outcome and sums the probability of all these more extreme outcomes. This calculation can be done either as a one- or two-sided test. The two-sided test, which I apply here, is more general in that it tests both whether (1) the data is more equally distributed amongst outcomes than expected and (2) whether the data is less equally distributed amongst outcomes than expected. A one-tailed test only measures the second of these possibilities. The two sided test is also stricter than the one sided test, so that if the two sided test is significant then the one sided test is also significant. In the test applied here, boy and girl were used as treatments and "True", "Neutral", and "Not true" as outcomes. The p-value is the probability that this outcome would have occurred given the null hypothesis that there is no difference between boys and girls. If $p < 0,05$ we reject the null hypothesis that there is no difference between boys and girls. The statements with $p < 0,05$ were identified. Special cases such as borderline cases were investigated as well.

In the second step, the results from the two questionnaires were compared. This comparison made it possible to analyse the differences between what students gender stereotyped in terms of the traits attributed to groups of people (*Who and affect in mathematics*) and traits boys and girls ascribe to themselves (*Me and affect in mathematics*).

Results

Self-evaluation

The students were first asked to value themselves as very good (VG), good (G), average (A), below average (BA) or weak (W). To compare girls' and boys' responses, Fisher's exact test (FET) was made. In this test boy and girl was used as treatments and the different grades of evaluation as outcomes. The p-value is the probability that this outcome would have occurred given the null hypothesis that there is no difference between boys and girls. If $p<0{,}05$ we reject the null hypothesis that there is no difference between boys and girls. All figures have been calculated in percentages (presented in brackets) to allow comparisons (table 1).

Table 1. *Students Self-evaluation, n (%)*

n total	VG[1]	G	A	BA	W	FET[2]
Girls, **76**	8 (10,3)	35 (46,2)	29 (38,4)	3 (3,8)	1 (1,3)	p<0,01
Boys, **102**	32 (31,4)	37 (36,3)	24 (23,5)	5 (4,9)	4 (3,9)	

Note. 1. Levels: very good (VG), good (G), average (A), below average (BA) or weak (W).
2. Fisher's exact test.

The result from Fisher's exact test show that there is a difference in boys' and girls' evaluation. In Sweden, grades at this level are to girls' advantage (Brandell et al., 2005) and there is no reason to believe that girls perform worse at the studied schools. However, self-evaluation is not only about performance; it is about how you see yourself and your capacity. According to Table 1, boys are more likely to evaluate their own performance in mathematics higher than girls. This is similar result to previous research (Brandell et al., 2005; Kimball, 1994).

Who and affect in mathematics

For *Who and affect in mathematics*, most of the statements were ranked as "No difference". Three students (3,4 %) answered only "No difference" for this instrument, all of them girls. Seven statements had some gender differences and are presented in table 2. All figures have been calculated in percentages to allow comparisons. The response category that got the largest proportions of the responses is highlighted with bold text. B stands for "Boys", ND for "No difference", G for "Girls" and *p* the results from the sign-test.

Me and affect in mathematics

The statements showing gender differences according to Fisher's exact test are presented in table 3 with an addition of a statement that was borderline. T stands for "True", N for "Neutral", NT for "Not true" and the column FET presents the results from Fisher's exact test. The category that got the largest proportions of answers is indicated with bold text. All figures have been calculated in percentages to allow comparisons.

Table 2. *Who and affect in mathematics, n (%).*

Statement		B	ND	G	*p*
S3: The graphic calculator saves time and work.	Girls	**23 (52,3)**	18 (40,9)	3 (6,8)	<0,01
	Boys	**24 (54,5)**	19 (43,2)	1 (2,3)	<0,01
S8: My own reasoning is not a safe strategy.	Girls	5 (11,4)	14 (31,8)	**25 (56,8)**	<0,01
	Boys	9 (20,5)	**19 (43,2)**	16 (36,3)	0,23
S9: It is important to remember every step of a method.	Girls	2 (4,5)	20 (45,5)	**22 (50)**	<0,01
	Boys	2 (4,6)	**24 (54,5)**	18 (40,9)	<0,01
S15: The graphic calculator is fast and efficient.	Girls	13 (29,5)	**28 (63,6)**	3 (6,8)	0,02
	Boys	**22 (50)**	18 (40,9)	2 (4,6)	<0,01
S20: You should finish a task before starting with a new one.	Girls	4 (9,1)	14 (31,8)	**26 (59,1)**	<0,01
	Boys	5 (11)	13 (29,5)	**24 (54,5)**	<0,01
S23: You work with a mathematical task a limited amount of time. If not solved [within time limit], you take a new task.	Girls	15 (34,1)	**21 (47,4)**	8 (18,2)	0,21
	Boys	**21 (47,7)**	17 (38,6)	4 (9,1)	<0,01
S24: The safest method is the one that the teacher has presented.	Girls	5 (11,4)	**23 (52,3)**	16 (36,3)	0,02
	Boys[1]	4 (9,1)	16 (36,4)	**22 (50)**	<0,01

Note. Total number of boys: 44, total number of girls: 44.
1. Two boys (equivalent to 4,5 %) chose not to answer.

Table 3. *Me and mathematics, n (%).*

Statement		B	ND	G	*p*
S6: Answers to mathematical tasks often look similar.	Girls	6 (17,6)	9 (26,6)	**19 (55,9)**	0,05
	Boys	19 (32,7)	**22 (37,9)**	17 (29,3)	
S8: My own reasoning is not a safe strategy.	Girls	6 (17,6)	3 (8,8)	**25 (73,6)**	0,02
	Boys	4 (6,9)	18 (31,3)	**36 (62,6)**	
S11: Mathematical tasks should be solved with a specific method.	Girls[1]	11 (32,3)	8 (23,5)	**14 (41,2)**	0,13
	Boys	**28 (48,3)**	17 (29,3)	13 (22,4)	
S20: You should finish a task before starting with a new one	Girls	7 (20,6)	9 (26,5)	**17 (50)**	0,02
	Boys	**29 (50)**	12 (20,7)	17 (29,3)	

Note. Total number of boys: 58, total number of girls: 34.
1. One girl (equivalent to 2,9 %) chose not to answer.

Comparing the results – Who and affect in Mathematics and Me and affect in Mathematics

To highlight similarities and differences between the results from the two questionnaires, a comparison was made. First, the statements considered female by one or both groups (table 4).

Table 4. *Comparison of "female" statements, n (%).*

Statement		B	ND	G	T	N	NT
S8: My own reasoning is not a safe strategy.	G	5 (11,4)	14 (31,8)	**25 (56,8)**	6 (17,6)	3 (8,8)	**25 (73,6)**
	B	9 (20,5)	**19 (43,2)**	16 (36,3)	4 (6,9)	18 (31,3)	**36 (62,6)**
S9: It is important to remember every step of a method.	G	2 (4,5)	20 (45,5)	**22 (50)**	**28 (82,4)**	3 (8,8)	3 (8,8)
	B	2 (4,6)	**24 (54,5)**	18 (40,9)	**46 (79,3)**	7 (12,1)	5 (8,6)
S20: You should finish a task before starting with a new one	G[1]	4 (9,1)	14 (31,8)	**26 (59,1)**	7 (20,6)	9 (26,5)	**17 (50)**
	B[2]	5 (11)	13 (29,5)	**24 (54,5)**	**29 (50)**	12 (20,7)	17 (29,3)
S24: The safest method is the one that the teacher has presented.	G[1]	5 (11,4)	**23 (52,3)**	16 (36,3)	**13 (38,3)**	12 (35,3)	8 (23,5)
	B[2]	4 (9,1)	16 (36,4)	**22 (50)**	21 (36,2)	**25 (43,1)**	10 (17,2)

Notes. 1. One girl (equivalent to 2,9 %) chose not to answer (Me and mathematics).
2. Two boys (equivalent to 4,5 %) chose not to answer (Who and mathematics).

Looking at the results from the first questionnaire one statement, S20 (*You should finish a task before starting with a new one.*), was thought of as female by the largest proportion of both groups. But when comparing this result to *Me and affect mathematics* a disparity occurs. According to the second study boys are more likely to rank this statement true. Analysing the responses closely, 27,6 % of the boys say this is absolutely true compared to 2,9 % of the girls stressing the gender difference as well as the difference between the two instruments' results.

Two statements were considered female by the largest proportions of girls in *Who and affect in mathematics*: S8 (*My own reasoning is not a safe strategy.*) and S9 (*It is important to remember every step of a method.*). A large proportion of boys (around 40 %) ranked S8 and S9 as female as well. Comparing this to the results from *Me and affect in mathematics* the majority of girls (and boys) ranked S8 as not true and S9 as true. The result from Fisher's exact test for S8 shows us that the differences between boys and girls lie in the other two response categories, "True" and "Neutral".

The test for S9 gives $p = 0{,}92$ stressing that girls' and boys' responses are rather similar to each other. There is nothing indicating that girls were more likely to find these two statements more false or true respectively. There is a gap between what girls think of other girls and what girls report about themselves.

One statement, S24 (*The safest method is the one that the teacher has presented.*), was by the largest proportion of boys in *Who and affect in mathematics* ranked as female. The largest proportion of boys and roughly one third of the girls ranked this statement as neutral in *Me and affect in mathematics.* The same percentages of girls and boys ranked this statement true, leaving us to find the biggest difference (although still a small one) in the number of students who ranked this untrue: 23,5 % of the girls and 17,2 % of the boys. There is no evidence from *Me and affect in mathematics* that S24 should be more female.

Table 5. *Comparison of "male" statements*

Statement		B	ND	G	T	N	NT
S3: The graphic calculator saves time and work.	G	**23 (52,3)**	18 (40,9)	3 (6,8)	**22 (64,8)**	8 (23,5)	4 (11,8)
	B	**24 (54,5)**	19 (43,2)	1 (2,3)	**42 (72,4)**	8 (13,8)	8 (13,8)
S15: The graphic calculator is fast and efficient.	G[3]	13 (29,5)	**28 (63,6)**	3 (6,8)	**24 (70,5)**	4 (11,8)	4 (11,8)
	B[2]	**22 (50)**	18 (40,9)	2 (4,6)	**42 (72,4)**	10 (17,2)	6 (10,3)
S23: You work with a [...] task a limited amount of time...	G[1]	15 (34,1)	**21 (47,4)**	8 (18,2)	8 (23,5)	8 (23,5)	**17 (50)**
	B[2]	**21 (47,7)**	17 (38,6)	4 (9,1)	8 (13,7)	17 (29,3)	**31 (53,4)**

Notes. 1. One girl (equivalent to 2,9 %) chose not to answer (Me and mathematics).
2. Two boys (equivalent to 4,5 %) chose not to answer (Who and mathematics).
3. Two girls (equivalent to 5,9 %) chose not to answer (Me and mathematics).

The statements in table 5 were by one or both groups ranked as male. Statement 3 (*The graphic calculator saves time and work.*) was by the largest proportion ranked as male by both girls and boys. In the second study both groups found this statement true, and Fisher's exact test showed no significant difference with respect to gender. Two statements were by the largest proportion boys ranked as male in *Who and affect in mathematics*: S15 (*The graphic calculator is fast and efficient.*) and S23 (*You work with a mathematical task a limited amount of time. If you have not solved [within this time limit], you take a new task.*). Statement 15 was by most girls and boys ranked as true in the second study and Fisher's exact test showed no significant difference between the responses. But, analysing how true they ranked it there is a minor difference. More boys than girls (34,5 % compared to 17,6 %) said this is absolutely true. There was no difference in girls' and boys' responses for statement 23. Both groups ranked the statement as not true in *Me and affect in mathematics* and the result from Fisher's exact test showed no significant difference.

Table 6. *Comparison of "neutral" statements*

Statement		B	ND	G	T	N	NT
S6: Answers to [...] tasks often look similar.	G[3]	11 (25)	**25 (56,8)**	7 (15,9)	6 (17,6)	9 (26,6)	**19 (55,9)**
	B	13(29,5)	**27 (61,4)**	4 (9,1)	19 (32,7)	**22 (37,9)**	17 (29,3)
S11: Mathematical tasks should be solved with a specific method.	G[1]	4 (9,1)	**24 (54,5)**	16 (36,4)	11 (32,3)	8 (23,5)	**14 (41,2)**
	B[2]	7 (15,9)	**25 (56,8)**	10 (22,8)	**28 (48,3)**	17 (29,3)	13 (22,4)

Notes. 1. One girl (equivalent to 2,9 %) chose not to answer (Me and mathematics).
2. Two boys (equivalent to 4,5 %) chose not to answer (Who and mathematics).
3. One girl (equivalent to 2,3 %) chose not to answer (Who and mathematics).

The statements in table 6 had some indicated gender differences in personal traits according to Fisher's exact test that were not repeated in *Who and affect in mathematics.* Statement 6 (*Answers to mathematical tasks often look similar.*) was by most girls ranked as not true according to the second study. There was no indication of a potential gender difference of this in *Who and affect in mathematics.* The majority of boys and girls (61,4 % and 56,8 % respectively) chose "No difference". The same tendency goes for statement 11 (*Mathematical task should be solved with a specific method.*) which boys according to *Me and affect in mathematics* were more likely to rank as true. In *Who and affect in mathematics* the majority of girls (54,5 %) and boys (56,8 %) chose "No difference".

Self-evaluation and Me and mathematics

In order to find out more about boys' and girls' self-concept, a comparison was made between the results from the self-evaluation and the responses to *Me and affect in mathematics*. Despite girls' lower ranking than boys', focusing on the evaluate part of the instrument, the result from *Me and affect in mathematics* indicates that they are as confident as boys in terms of their capacity passing the courses in mathematics (S14). The was no difference between boys' and girls' responses to this statement and the result from Fisher's exact test showed no significant differences. Turning to the moral view of the goal, S7 (*I should do well in mathematics.*), Fisher's exact test gives a result of p = 1,00 showing no significant differences between girls' and boys' responses. This statement could be interpreted as an intrinsic motivation or an expectation I set on myself. Overall, the results indicate that girls participating in this study are as confident as boys looking at these specific beliefs, but when asking about self-evaluation their ranking is lower compared to boys.

Summary

This study aimed to investigate secondary school students' gender stereotyping of beliefs describing aspects about safety, expectations and motivation, and if this gender stereotyping differs from traits students ascribe to themselves. Most statements in the first study (*Who and affect in mathematics*) were considered neutral by the students. According to the largest proportions of the students there is no difference between boys and girls in these statements, but for seven of the statements some gender differences were identified. Among the statements that were considered gendered, girls seem to be connected to beliefs about aspects of expectations and safety: what you are expected to do and what is considered a safe strategy. This could be seen as a negative motivational belief. Boys are assigned beliefs about what to expect from a graphic calculator. This could work as a motivational belief about why you should use it.

When comparing the gendered statements to the statements considered neutral in *Who and affect in mathematics* there are some conclusions to be drawn. The statements considered female talk about carefulness: what you should do in order to stay safe. This is further stressed with S8: *My own reasoning is not a safe strategy*. The other three statements in the questionnaires that deal with similar issues, S1 (*A well-known method is the safest one.*), S4 (*If a method I have chosen doesn't work, I choose a new one that feels safe.*) and S17 (*I can't reason to a solution myself.*), were by the largest proportions of students ranked as neutral. This shows that statements describing safety or expressing insecurity are not automatically ranked as female. But to the question why some statements about safety combined with expectations are female and others not, I can not say from this data. One possibility is that these statements, S20 (*You should finish a task before starting with a new one.)* and S9 (*It is important to remember every step of a method.*), both describe what you are expected to do using words as "should" and "important". Thereby, they stress an element of "rule-following".

Two of the three statements ranked as male are about the graphic calculator. They have a positive motivational aspect as to why you should use this tool. There are two more statements about the graphic calculator in the questionnaire that are ranked as neutral by the largest proportions of students, S10 (*The graphic calculator is a safe choice.*) and S16 (*You don't learn as much mathematics if you use the graphic calculator.*). S10 has a positive tone to graphic calculators and S16 has a negative one. It seems possible that it is not the word "graphic calculator" that makes a statement male. But, if it is the motivational aspect that is thought of as male in these cases can not be concluded from this data. Another possible explanation is that S3, S15 and S23 (the three statements ranked as male) are about proceeding quickly when solving tasks. In either case, more research and different type of research is needed.

Summarising the comparison of the results from the two instruments, the discrepancy of how statement 20 (*You should finish a task before starting with a new one.*) was ranked from a general view compared to boys and girls' individual perspective stands out. Both groups were more likely to gender stereotype this statement as female in *Who and affect in mathematics*, but the second study showed a different result. The connection between the graphic calculator and boys that was indicated in the first study did not have the same impact in *Me and affect in mathematics* where girls and boys' response pattern were almost similar including the minor difference in statement 15. Looking at all the statements that refer to the graphic calculator (S3, S10, S15 and S16) the responses are very similar. The view of girls associated with statements about insecurity (i.e. what is considered a safe strategy) and expectations concerning what you are supposed to do did not repeat itself in *Me and affect in mathematics*. There were no indications that girls find these statements more true or untrue than boys or vice versa. As a contradiction we can note that more boys ranked statement 11 (*Mathematical task should be solved with a specific method.*) true than girls. Looking closer at self-evaluation and self-concept, girls appear to be as confident as boys in *Me and affect in mathematics* while evaluating themselves lower.

Discussion

Even though the results from *Who and affect in mathematics* indicated partly similar masculinities and femininities as previous research (Brandell & Staberg, 2008), *Me and affect in mathematics* did not confirm these conceptions. Neither did girls rank statements about safe strategies more truthful than boys, nor did boys find the graphic calculator more useful than girls. There was a gap between what is gender stereotyped and what is ranked from an individual perspective. Also, girls were as confident about their own capacity as boys although not evaluating their performance as highly.

There is of course the possibility that the students were only answering the questions to *Who and affect in mathematics* with girls and boys in general in mind and excluding their own personal situation. This could explain the differences between the results from the two versions of the questionnaire. It could also be a case of different groups of students. Öhrn (2002) concludes that there is a transaction taking place in the classroom where new femininities are taking more space in the educational context. This is not a case of new female gender identities replacing the old ones. Rather, a new type of girl, a more bold and out-spoken one, appears with the quiet girls still existing in the classroom.

Some caution should be applied in interpreting differences between the two instruments, since differences could also arise from variation between schools. I cannot completely rule out the possibility that the four classes answering *Me and affect in mathematics* were dominated by the new type of girls and the four classes answering *Who and affect in mathematics* by the quiet girls. I would not consider this likely, since such an effect would require big differences between the classes chosen. Furthermore, similar gaps between stereotyping and individual perspective have been found in previous research (Brandell &Staberg, 2008; Volman & Ten Dam, 1998). It thus appears likely that the discordances are about the differences between the personal gender identity and the perceived masculinity and femininity, rather than statistical anomalies.

This disparity produces interesting questions. Why do girls downgrade girls' ability such as in S8 (*My own reasoning is not a safe strategy.*), especially when another instrument indicate that girls hold it false from an individual perspective? Why do students continue to hold on to such beliefs? I will now discuss these questions by using different theoretical standpoints.

The gap between beliefs about self and about others should not necessarily be seen as irrational or perceived as a contradiction since, according to the theory of *belief systems*, the relationship between different beliefs does not have to be logical (Green, 1971). In this quasi-logical structure, the arrangement is made by the individual herself according to how she sees them and it could be done without any questioning. Contradictions between beliefs can be allowed since they can be part of different sets of beliefs, and they can also be held with different psychological strength and thereby increasing the distance between them. Therefore, the discrepancy could just be a result from having two different belief clusters.

It could also be a question of a *coping strategy* (Volman & Ten Dam, 1998). Given the view of mathematics as a male domain, in order to avoid the risk of being a victim in their female identity with all negative gender symbol attached to it, there is a need to separate the traditional discourse from the personal identity: "Girls are disinclined to identify with 'a group that is lagging behind' " (Volman & Ten Dam, p. 541). I then, as a female student in mathematics, identify myself with non-female attributions such as graphic calculator and being confident and reject insecurity and rule-following. But is this identification just a facade or do I really believe this? This is when self-evaluation becomes interesting. Self-evaluation is not just about the actual grade or performance; it is how *you* value your own performance. It is an additional way of looking at how students view themselves. Just as previous findings (Brandell & Staberg, 2008; Jakobsson, 2000; Kimball, 1994), relative to boys, the female students show indications of evaluating their own performance lower despite the pro-female responses to *Me and affect in mathematics*. Again, the gap becomes perceptible.

Given such stereotypic conceptions, women may feel a pressure to conform to such gender norms including them being led to downgrade their own performances. According to the *system justification theory* it is possible that the stigmatized group adapt the negative assumptions that are stereotyped to them by the dominant group (Jost & Banaji, 1994), that even though girls might feel, think or experience there is no gender difference in the bigger society, it is possible that they incorporate the gender stereotyping that is projected in the sub-domain (mathematics). This would lead to girls rating their ability lower – activating gender stereotypes can lower self-evaluation (Guimond & Roussel, 2001).

Another way of looking at this would be using *social dominance theory* (Sidanius & Pratto, 1999). In a group-based social hierarchy the dominant and hegemonic group (here males) would enjoy the social power and privilege just because of a particular membership in a socially constructed group. This hierarchy is affected by legitimizing myths that "consist of attitudes, values, beliefs, stereotypes, and ideologies that provide moral and intellectual justification for the social practices that distribute social values within the social system" (Sidanius & Pratto, p.45). Events such as an experience in the classroom could then be interpreted as supporting evidence when holding gender stereotypic views (Eccles & Jacobs, 1986). As previous research has indicated (Brandell & Staberg, 2008), male students are more likely to gender stereotype (and to their favour) which could be explained as them holding on to and anchoring the myths.

Considering these theoretical views on social dominance and system of justification, how do you change such stereotypic conceptions? The results from *Me and affect in mathematics* indicate that it is probably not a question about changing individuals' own perception about themselves. Is there a way of boosting girls' confidence when research results indicate that they already are confident? The discrepancy between the two questionnaires could also suggest that in a complex area such as "Mathematics as a gendered domain", one quantitative questionnaire does not provide enough data in order to make broad conclusions. We cannot simply conclude that "mathematics is a male domain" or "girls are confident" implying that research in this area needs to take other measure to account than just ranking of items on a questionnaire. Looking at the bigger picture implies that further research is required.

One if not the most important question with respect to gender and mathematics is why girls avoid careers in mathematics. This question has not been treated in this study, but the results indicate that if we address this question through questionnaires we may obtain different results if we ask about girls in general or if we ask about girls' conceptions about themselves.

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Appendix A

Statements used in the questionnaires.

S1 A well-known method is the safest one.

S2 If you have not solved a task within ten minutes, you have chosen the incorrect method.

S3 The graphic calculator saves time and work.

S4 If a method I have chosen doesn't work, I choose a new one that feels safe.

S5 If I can't remember how to solve it (which method to use), I can't proceed.

S6 Answers to mathematical tasks often look similar.

S7 I should do well in mathematics.

S8 My own reasoning is not a safe strategy.

S9 It is important to remember every step of a method.

S10 The graphic calculator is a safe choice.

S11 Mathematical task should be solved with a specific method.

S12 You can from the answer decide whether you have solved the task correctly or not.

S13 To try to create your own solution to a mathematical task is impossible.

S14 I can pass the courses in mathematics.

S15 The graphic calculator is fast and efficient.

S16 You don't learn as much mathematics if you use the graphic calculator.

S17 I can't reason to a solution myself.

S18 Graphs are helpful if you want to understand a function.

S19 Mathematical tasks often look similar.

S20 You should finish a task before starting with a new one.

S21 The key to success is good memory.

S22 Mathematics is to memorise methods.

S23 You work with a mathematical task a limited amount of time. If you have not solved it[within this time limit], you take a new task.

S24 The safest method is the one that the teacher has presented.

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