Gender Role Stereotypes in the Perception of Mathematics: An Empirical Study with Secondary Students in Germany

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Abstract Findings from international educational studies such as TIMSS or PISA show that gender differences in mathematical achievements are now only marginal, or have completely vanished in many countries. Nevertheless, beliefs about the higher achievements in mathematics by boys are still widespread. In this chapter the results of a study of students' views of gender-role stereotyping in mathematics are presented. For this study, 1244 German students from lower and upper secondary level (11–17 year olds) were tested using instruments developed by Forgasz and Leder concerned with gendered views of mathematics and mathematics education. The study clearly shows that as they grow up, boys as well as girls in contemporary Germany still have doubts concerning the equal mathematical performances of girls and boys, and internalise gendered stereotypes of girls being less talented and interested in mathematics, influenced by gender-role stereotypes within society, where mathematics is still described as a male domain.

1 State of the Art

In the last few years, research results have been presented which point out that there are almost no differences in mathematical achievements between boys and girls in primary and secondary schools. For example, the often quoted study by Hyde et al. (2008), in which 7 million students from age 7 to 17 were tested, found that generally there is no evidence for gender differences in mathematics favouring males today. On the other hand, in a re-analysis of the PISA studies from 2003 and 2006 by the OECD (2009) a general gender pattern of males outperforming females in the combined mathematics scale and every subscale was reported, with only a few countries as exceptions; similar results were reported in the European report on gender

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differences in educational outcomes (Eurydice 2010). However, while performance differences in mathematics tend to be modest, affective data from PISA 2003 and 2006 reveal remarkable gender differences in students' attitudes and approaches towards mathematics, in their levels of interest in and enjoyment of mathematics as well as in their self-related beliefs, emotions and learning strategies. For example, in most countries, participating in PISA 2006, females tended to report lower mathematics-related self-efficacy than males. While males tended to have a more positive view of their abilities than females, females described significantly more feelings of anxiety, helplessness and stress in mathematics classes.

Similar results have just been reported from a re-analysis of the PISA and TIMSS studies. It was concluded that internationally, gender differences in mathematics achievements are no longer pronounced. However, there still exist remarkable differences between females and males concerning their self-confidence in mathematics and their instrumental motivation in mathematics, that is, males seem to be more motivated to learn mathematics because they believe that mathematics will help them in their later careers (Else-Quest et al. 2010).

The role of teachers' and parents' stereotypes was analysed in extensive research by Tiedemann (2000, 2002). He reports various stereotypical teacher beliefs, for example, beliefs that girls think less logically than boys, and that mathematics is more difficult for girls. Teachers' gender stereotypes influence their gender-differentiated attributions of students' mathematical developments. For example, with regard to girls, teachers attributed unexpected failure more often to low abilities and less often to a lack of effort than with boys. Similar biasing effects of parents' gender stereotypes on their children's mathematical abilities relate to the children's self-perceptions of their mathematical abilities.

In their overview of 30 years of international research on gender issues in mathematics education, Leder et al. (1996) emphasised the high impact of affect, which does not seem to be limited to particular countries. They describe, amongst others, the following research results:

- Gender differences are more prevalent among older students and seem to increase as students progress through school;
- Mathematics continues to be viewed as a male domain, more by males than by females;
- Compared to males, females are more likely to attribute mathematical failure to a lack of ability rather than to a lack of effort;
- External sources such as parents, peer groups, socialisation patterns, and the media are strong influential factors on students' beliefs, and quite often emphasise gender-role stereotypes concerning mathematics.

These research results coincide with claims dating back to the 1970s and 1980s when, in the context of the Women's movement, much research was being conducted to identify factors contributing to gender differences favouring males in participation patterns in mathematics and in mathematical achievements. Stereotyping of mathematics as a male domain, that is, mathematics being more suitable for males than for females, was identified as one explanatory factor (e.g., Fennema 1974). In

this context, Fennema and Sherman published their *Mathematics Attitude Scales* (Fennema and Sherman 1976) which consisted of nine subscales, including one on *Mathematics as a male domain*; this subscale has been widely used to assess the extent to which respondents regard mathematics as a male domain. Based on critiques concerning the anachronistic wording of some items and the underlying assumption of the subscale (Forgasz et al. 1999), Leder and Forgasz (2002) developed two new instruments—*Mathematics as a gendered domain* and *Who and mathematics*, in an attempt to overcome the limitations of the original scale. These new scales have been widely used in many studies around the world and have shown remarkable, even unexpected, cultural differences in the gendered beliefs about mathematics; but they have also produced some contradictory results.

In their study of Australian lower secondary students using the two instruments, Leder and Forgasz (2002) report that the majority regard mathematics as being a gender-neutral domain, and that boys find mathematics difficult and boring and need much more help than girls. Forgasz and Mittelberg (2008) found that Australian students challenge the traditional stereotype of mathematics as a male domain to a greater extent than their samples of Israeli Jewish and Israeli Arab students, and that the Israeli Jewish students' views were more consistent with the traditional gender stereotype than the Israeli Arabs' views. Brandell and Staberg (2008) report that Swedish secondary students perceive mathematics as a male domain, that older students hold more strongly gendered views than younger students, and that of all participating subgroups, boys in a science programme had the strongest beliefs that mathematics was a male domain. In a comparison of Australian and Swedish data, it was identified that Swedish students were less inclined to view mathematics as a female domain than Australian students of the same age (Brandell et al. 2007).

Against the background of this debate, in this chapter the situation in Germany concerning the acceptance of gendered views of mathematics among German students at different age levels is reported. The study focused on the following: whether mathematics is still seen as a male domain by German students from lower and upper secondary level; whether there are differences between males and females in their gendered views of mathematics; and whether these stereotypes are age-dependent. The chapter is based on the joint master thesis of Hoffstall and Orschulik (for details, see Hoffstall and Orschulik 2009).

2 Design of the Study

2.1 Description of the Instrument and Data Analysis

The study is based on a slightly modified version of the questionnaire *Who and Mathematics* by Leder and Forgasz (2002). The second instrument *Mathematics as a Gendered Domain* by Leder and Forgasz was not used in the study due to time restrictions. The questionnaire *Who and Mathematics* was modified as follows:

First, the statements from Leder and Forgasz (2002) were changed into questions. For example, the original item "Mathematics is their favourite subject" was

changed to "Whose favourite subject is mathematics?" The answer options were left unchanged and were as follows:

- Boys definitely more than girls;
- Boys probably more than girls;
- No difference between boys and girls;
- Girls probably more than boys;
- Girls definitely more than boys.

Additionally, the original statements "Tease boys if they are good at mathematics" and "Tease girls if they are good at mathematics" were complemented by the questions "Who likes boys who are good at mathematics" and "Who likes girls who are good at mathematics". Question 23 in the original, "Are not good at mathematics" was changed to positive wording: "Who is good at mathematics?". In addition, the open-ended question, "Who do you think achieves more in mathematics? And why?" was added in order to obtain additional insights into the students' gender stereotypes concerning mathematics.

The questionnaire contained the following questions—for easier comparison with the results of the original studies, the order of the items is retained below; the questionnaire, as it was used in this study, is found in the appendix:

1. Whose favourite subject is mathematics?
2. Who thinks that it is important to understand the work in mathematics?
3. Who is asked more questions by the mathematics teacher?
4. Who gives up, when he/she finds a mathematical problem is too difficult?
5. Who has to work hard in mathematics to do well?
6. Who enjoys mathematics?
7. Who cares about doing well in mathematics?
8. Who thinks he/she did not work hard enough if he/she does not do well in mathematics?
9. Whose parents would be disappointed when he/she does not do well in mathematics?
10. Who needs mathematics to maximise future employment opportunities?
11. Who likes challenging mathematical problems?
12. Who is encouraged to do well by the mathematics teacher?
13. Who do mathematics teachers think will do well in mathematics?
14. Who thinks that mathematics will be important in his/her adult life?
15. Who expects to do well in mathematics?
16. Who distracts other students from their mathematics work?
17. Who gets the wrong answers in mathematics?
18. Who finds mathematics easy?
19. Whose parents think that it is important for him/her to study mathematics?
20. Who needs more help in mathematics?
21. Who teases boys if they are good at mathematics?
22. Who worries if he/she does not do well in mathematics?
23. Who is good at mathematics?
24. Who likes using computers to work on mathematics problems?

25. With whom do mathematics teachers spend more time?
26. Who considers mathematics to be boring?
27. Who finds mathematics difficult?
28. Who gets on with his/her work in class?
29. Who thinks mathematics is interesting?
30. Who teases girls if they are good at mathematics?
31. Who likes boys who are good at mathematics?
32. Who likes girls who are good at mathematics?
33. Who do you think achieves more in mathematics? And why?

Furthermore, as in the original instrument, the students' perception about their proficiency in mathematics was assessed (with the five choices: excellent, good, average, below average, weak).

In contrast to Leder and Forgasz (2002), the questionnaire had no title in order to leave the aim of the questions open. Only one introductory sentence was used at the beginning of the questionnaire to inform the students about the topic. Additionally, the possible answers were enriched by small avatars to help, especially the younger, students understand the possible answers. The complete translation of the questionnaire is found in the appendix.

As Leder and Forgasz (2002) point out in their description of the instrument, the statements in this questionnaire are to stand alone and cannot be combined to form a scale or a subscale. We therefore used the approach developed by Leder and Forgasz (2002) in their introduction of the instrument and used in other studies (e.g., Forgasz and Mittelberg 2008). We arranged the possible answers on a (pseudo) interval scale from 1 (boys definitely more than girls) to 5 (girls definitely more than boys) which allowed the calculation of mean scores on each item and the 'distance' of these average scores from the neutral value of 3, meaning no difference between boys and girls. Mean scores lower than three show that, on average, students believe that 'boys are more likely than girls to exhibit the behaviour described in the item or hold the beliefs', whereas mean scores above three indicate that, on average, students believe that 'girls are more likely than boys to fulfil the described expectation'. Several statistical tests of significance were carried out: one-sample t-tests were conducted on the mean scores to test for statistically significant differences from the neutral value 3, at the $p < .05$ level, the score indicating no gendered view of mathematics and mathematics teaching Independent samples t-tests were conducted to examine the significance of the differences in mean scores by gender and by age group at the .05 level of significance.

The analysis of the open-ended question was done qualitatively, adopting methods of grounded theory. Codes were developed on the basis of the responses provided, and the distributions were then analysed.

The changes made to the original instrument were minor and do not affect the validity of the administered questionnaire. The use of additional items does not create difficulties because the instrument does not function as scale and the statements are treated as stand-alone items. Furthermore, the two additional questions only confirmed aspects already covered by other items in the questionnaire. The change in the direction of the wording of item 23 is considered in the analysis and yielded

the anticipated results. The change in the formulation of the items from statements to questions would not challenge any deeply rooted beliefs about mathematics as a gendered domain. However, in the analyses and discussion that follow, it has to be recognised that additional validity tests were not conducted.

2.2 Description of the Sample

In total, 1244 students participated in the study at the end of the school year 2008. These students represented two different age groups, 11–12 year olds and 15–17 year olds. The former consisted of 646 students from years 5–7, of which only 639 responses could be analysed; the latter comprised 598 students from years 9–11.

For the composition of the sample special care was taken regarding the distribution of the students from different school types in order to obtain a sample as representative as possible of the German school system. It is important to know that Germany has a tripartite school system in the lower secondary school, with the lower type secondary school (so-called Hauptschule) as the school for generally lower-achieving students, the intermediate type secondary school (so-called Realschule) for average students, and the higher type secondary school (so-called Gymnasium) for the higher-achieving students. In addition, there are also comprehensive schools in the federal states in Northern Germany. The distribution of the participating students by school type is shown in Table 1.

In this study a total of 48% participating students attended a higher type secondary school, 27% an intermediate type secondary school, 13% a lower type secondary school, and 12% a comprehensive school. This is a good representation of the situation in Germany, where 41.3% attend a higher type secondary school, 23.9% attend an intermediate type secondary school, 16.3% a lower type secondary school, and 18.5% a comprehensive school (Autorengruppe Bildungsberichterstattung 2010).

As well as similarities and differences by age groups, with evidence of changes in beliefs during adolescence, similarities in the beliefs of males and females and persistent gender-specific differences are the focus of the study.

The sample consisted of 581 boys and 663 girls (11–12 year-olds: 310 girls, 336 boys; 15–17 year-olds: 353 girls, 245 boys), a relatively balanced gender distribution (47% male and 53% female). [It should be noted that responses from all boys but only 656 girls could be analysed.]

The participating schools were in the city of Hamburg, as well as in the bordering federal states of Schleswig-Holstein and Niedersachsen (Lower Saxony). As Schleswig-Holstein and Niedersachsen are rural and provincial states, compared to the metropolitan area of Hamburg, the sample comprised a representation of an urban area as well as rural regions. Furthermore, it can be assumed that the sample is an appropriate representation of the socio-economic background of students in Northern Germany because the schools are situated in socially disadvantaged quarters as well as in areas with an average or high social structure. The high proportion

Table 1 Frequency and percentages of participating students by school type

	Lower type secondary school	Intermediate type secondary school	Higher type secondary school	Comprehensive school	Total
11- to 12-year olds	82	200	277	87	646
	12.7%	30.9%	43.0%	13.4%	100.0%
15- to 17-year olds	75	136	323	64	598
	12.6%	22.8%	54.1%	10.6%	100.0%
Total	157	336	601	150	1244
	12.6%	27.0%	48.3%	12.1%	100.0%

of immigrants to Germany is also represented in the sample. Although the sample represented central aspects of the situation in German schools, it still has to be regarded as a convenience and not a fully representative one.

3 Central Results of the Quantitative Study

A central finding of the study is that students still have very stereotypical attitudes towards mathematics and regard it as a male domain. This gender stereotyped perception of mathematics can be observed in both age groups, but was more marked among the older students. Thus, in the answers from 15–17 year-olds, many gender stereotypes were found, while the opinions of the 11–12 year-olds were much less characterised by gender stereotypical understandings with respect to mathematics learning.

Using the evaluation method described in Sect. 2, mean scores were calculated for each item, separately for all boys and girls in the sample, as well as by gender within age group. Independent groups t-tests were conducted on the mean scores to test for statistically significant differences. Table 2 shows the results which are quite striking. The data clearly show that gender stereotyped perceptions of mathematics increase with age. Overall, on 16 of the 32 items, significant differences between males and females can also be seen, with 17 items in the younger age group, decreasing to 11 items in the more mature group.

If the data are examined in more detail, not from the perspective of gender differences in the thinking of the students but in terms of gender stereotyped views, the following results emerge:

- Opinions on girls' and boys' capabilities in mathematics (questions 22 and 23), and the relevance of mathematics to their future careers (questions 10 and 14) show differences by age. In general, all students rated boys' capacity in mathematics higher than girls' (question 23), with an increasing tendency in favour or boys among older students.

Table 2 Means, standard deviations, and *t*-test results for questionnaire items by gender and age group

	11–12 year olds					15–17 year olds					11–17 year olds				
	Males ($N = 336$)		Females ($N = 303$)		t	Males ($N = 245$)		Females ($N = 353$)		t	Males ($N = 581$)		Females ($N = 656$)		t
	Mean	SD	Mean	SD	sig. level	Mean	SD	Mean	SD	sig. level	Mean	SD	Mean	SD	sig. level
Item 1	2.61	.93	2.75	.87	−1.9	2.18	.84	2.27	.77	−1.3	2.43	.92	2.49	.85	−1.3
Item 2	3.05[a]	.95	3.43	.86	−5.2[c]	2.85	.99	3.12	.85	−3.4[b]	2.97[a]	.97	3.26	.87	−5.6[c]
Item 3	2.91[a]	1.15	2.80	.90	1.4	3.02[a]	1.03	2.87	.89	2.0[a]	2.96[a]	1.11	2.84	.90	2.2[a]
Item 4	3.16	1.15	2.98[a]	1.15	2.0[a]	3.26	1.17	3.42	1.06	−1.7	3.20	1.16	3.22	1.12	−.2
Item 5	2.97[a]	1.07	3.07[a]	.88	−1.3	3.41	.95	3.35	.83	.8	3.15	1.05	3.22	.87	−1.1
Item 6	2.80	1.05	2.76	.97	.5	2.42	.87	2.39	.79	.4	2.64	.99	2.56	.90	1.4
Item 7	2.87	.97	3.39	.96	−6.8[c]	2.75	.95	3.02[a]	.91	−3.4[b]	2.82	.96	3.19	.95	−6.8[c]
Item 8	3.33	1.01	3.51	1.04	−2.3[a]	3.65	.96	3.69	.94	−.4	3.46	1.00	3.61	.99	−2.5[a]
Item 9	2.91[a]	.98	3.12	.86	−2.8[a]	2.87	.77	2.97[a]	.76	−1.6	2.90	.90	3.04[a]	.81	−2.5[c]
Item 10	2.57	1.00	2.82	.81	−3.5[c]	2.42	.79	2.54	.75	−1.9	2.50	.92	2.67	.79	−3.4[c]
Item 11	2.66	1.05	2.60	.94	.7	2.27	.97	2.28	.86	−.1	2.49	1.03	2.43	.91	1.1
Item 12	3.09[a]	.97	3.17	.81	−1.0	3.24	.89	3.09	.82	2.0[a]	3.16	.94	3.13	.81	.6
Item 13	2.77	.96	3.06[a]	.84	−4.1[c]	2.58	.90	2.65	.76	−1.0	2.69	.94	2.84	.82	−3.0[c]
Item 14	2.61	.96	3.08[a]	.89	−6.5[c]	2.38	.76	2.58	.78	−3.1[a]	2.51	.89	2.82	.87	−6.0[c]
Item 15	2.76	.98	3.21	.99	−5.7[c]	2.47	.84	2.76	.91	−3.9[c]	2.64	.93	2.96[a]	.97	−6.0[c]
Item 16	2.43	1.27	2.39	1.21	.4	2.53	1.18	2.45	1.14	.8	2.47	1.23	2.42	1.18	.7
Item 17	3.02[a]	1.05	2.82	.78	2.7[a]	3.27	.96	3.16	.75	1.5	3.13	1.02	3.00[a]	.78	2.3[a]
Item 18	2.55	1.11	2.71	.96	−1.9	2.26	.85	2.27	.79	−.2	2.42	1.02	2.47	.90	−.8

(*continued on the next page*)

Table 2 (Continued)

	11–12 year olds					15–17 year olds					11–17 year olds				
	Males ($N = 336$)		Females ($N = 303$)		t	Males ($N = 245$)		Females ($N = 353$)		t	Males ($N = 581$)		Females ($N = 656$)		t
	Mean	SD	Mean	SD	sig. level	Mean	SD	Mean	SD	sig. level	Mean	SD	Mean	SD	sig. level
Item 19	2.88	.87	3.17	.68	−4.8[c]	2.97[a]	.79	2.97[a]	.61	.0	2.92	.84	3.07	.65	−3.4[b]
Item 20	3.21	1.13	3.20	.99	.1	3.59	.87	3.56	.85	.5	3.37	1.04	3.39	.94	−.3
Item 21	2.89[a]	1.18	2.76	1.12	1.5	2.75	1.05	2.68	.87	.9	2.84	1.13	2.72	1.00	1.9
Item 22	3.21	1.03	3.53	1.00	−4.0[c]	3.27	.92	3.51	.86	−3.2[b]	3.24	.98	3.52	.93	−5.2[c]
Item 23	2.54	1.04	2.89[a]	.96	−4.6[c]	2.22	.89	2.51	.83	−4.1[c]	2.40	.99	2.69	.91	−5.3[c]
Item 24	2.37	1.09	2.56	1.04	−2.2[a]	2.21	1.00	2.27	.94	−.9	2.30	1.06	2.41	.99	−1.8
Item 25	3.34	.95	3.02[a]	.86	4.3[c]	3.29	1.01	3.06[a]	.92	2.7[a]	3.32	.98	3.04[a]	.89	5.0[c]
Item 26	2.77	1.19	3.02[a]	1.07	−2.7[a]	3.19	1.11	3.50	.91	−3.6[c]	2.94[a]	1.18	3.28	1.02	−5.2[c]
Item 27	3.26	1.06	3.25	.89	.2	3.56	.94	3.68	.83	−1.5	3.39	1.02	3.48	.88	−1.6
Item 28	2.69	.95	3.02[a]	.98	−4.4[c]	2.48	.85	2.75	.80	−3.9[c]	2.60	.91	2.88	.90	−5.4[c]
Item 29	2.84	1.04	2.76	1.05	.9	2.40	.85	2.46	.80	−1.0	2.65	.99	2.60	.93	.9
Item 30	2.56	1.01	2.43	.91	1.7	2.70	.93	2.69	.75	.2	2.62	.98	2.57	.84	.9
Item 31	3.21	.97	3.11	.95	1.3	3.23	1.02	3.20	.79	.4	3.22	.99	3.16	.87	1.0
Item 32	2.91[a]	1.00	2.90[a]	.95	.1	2.81	.93	2.82	.73	−.2	2.87	.97	2.86	.84	.2

Shaded regions: items with statistically significant gender differences.

Level of statistical significance of independent groups t-values: [a] $p < 0.5$; [b] $p < 0.1$; [c] $p < 0.001$.

The lettered indices: Mean scores not significantly different from 3 (one sample t-test results).

- The students also indicated that girls find mathematics more difficult than boys and need more help (questions 18 and 20). Moreover, it is interesting that the girls, especially in the younger age group, show a more gender-balanced perception. When asked about working habits, the majority of students assume that girls are especially diligent and ambitious, even though they are regarded as having lower competencies in mathematics (questions 5 and 23). Furthermore, the students are of the opinion that boys show greater interest in mathematics than girls, and that boys are more enthusiastic about mathematics (questions 6, 11 and 29). The students also state that girls perceive mathematics as being boring while boys perceive it as being more interesting (question 26). These results show that gender stereotyped perceptions about who is interested in mathematics are deeply rooted in the students' minds and get stronger during adolescence.
- When the relevance of mathematics for students' future lives was considered, it was found that students stress the importance of mathematics, especially for boys' future careers. They see less relevance of mathematics to girls' futures, although—and this of special concern—the younger girls described mathematics as being of greater importance for girls' than for boys' lives, opinions which change during adolescence (questions 10 and 14).

With respect to gender differences in the responses of the participants, the second important finding of the study is that the females held more flexible and open perceptions of gender roles than their male counterparts. This tendency became apparent in students' answers to various questions, such as about the importance of mathematics in their future life (question 14), or about the distribution of mathematical competencies such as "Who is good at mathematics?" (question 23), as well as questions about working habits in class such as "Who gets the wrong answers in mathematics?" (17). The 11–12 year-old girls generally attributed the same skills to boys and girls and often did not show a tendency towards gender stereotyped perceptions regarding the relevance to future careers or working habits. The 15–17 year-old girls, however, held the same gender stereotyped perceptions as the male students. This means that during adolescence female change their perceptions of gender roles. Indeed the 11–12 year-old girls did not perceive their own gender as being better than boys in mathematics, but regarded boys' and girls' abilities comparable (question 5). Among 15–17 year olds, however, the females believed that girls were less capable than boys in mathematics.

The third important finding is that students perceived gender-differentiated interactions in mathematics teaching settings. Students of both age groups sensed gender-dependent expectations of teachers. This was apparent in their response that teachers expect higher mathematics achievements by boys than by girls (question 13). Nevertheless it is striking that in response to the question of who is asked more questions in mathematics classes (question 3), they indicated that there was no gender difference. In contrast, students believed that teachers spend more with girls (question 25), which might result from the teacher's desire to help the girls and encourage them to participate in class (question 12). The students thus notice lower expectations of girls by the teacher (question 13) due to the gender-differentiated interactions in the classroom. One possible explanation for these results might be

Table 3 Self-perceptions of the mathematics achievement

		Excellent	Good	Average	Below average	Weak
11–12 year-olds	Male	10.4%	35.5%	45.1%	5.4%	3.6%
	Female	2.6%	29.7%	52.3%	6.5%	8.5%
15–17 year-olds	Male	13.9%	31.6%	38.9%	10.7%	4.9%
	Female	6.0%	28.1%	44.0%	9.7%	12.2%

that the students trace the more intensive interactions between teachers and female students back to the teachers' assumptions about girls needing more support than boys.

In order to compare the self-perceptions of mathematics achievements by gender, the students were asked about their own mathematical achievements at the beginning of the questionnaire. The results (see Table 3) show that girls generally perceive their own accomplishments in mathematics as being lower than boys' do of their own. This is in sharp contrast to the general better achievements of German girls in school (WZBrief Bildung 2010), and similar to results in mathematics education (see Eurydice 2010). Remarkably more girls than boys from each age group describe their achievements as average, and significantly fewer girls than boys describe their achievements as excellent or good.

In order to compare the results with the results from the original study (Leder and Forgasz 2002) and further studies, the evaluation method developed by Leder and Forgasz (2002) in their study and used by Forgasz and Mittelberg (2008) and by Brandell et al. (2007) was undertaken. The direction of the thinking of the students is evaluated, that is: mean scores significantly smaller than 3 mean that the students believe, on average, that boys are more likely than girls to behave or hold beliefs described in the item; and mean scores significantly greater than 3 mean that they believe girls are more likely than boys to behave like that. A mean around or not significantly distinct from 3 describes the neutral opinion, that is, there is no difference between girls and boys. Leder and Forgasz (2002) refer to earlier research in this field, providing the basis for the development of the instrument, and developed predictions for the direction of the responses for each of the 30 items. Against these predictions the data were evaluated, "male" meaning that the direction of the response was expected to be that males 'are more like than females' to behave or hold beliefs consistent with the item, "female" meaning that females 'are more likely than males' to behave or hold beliefs consistent with the item wording, male/female means that the research findings related to the predictions were mixed.

The results, displayed in Table 4, show a clear tendency for the German students to hold many beliefs concerning mathematics as a gendered domain as expected by Leder and Forgasz (2002).

For 21 items out of the 30 items for which there were predictions, the expected direction of the beliefs was evident. This result is in contrast to the results of the study by Leder and Forgasz (2002) carried out with 838 Australian 13–16 years old students, for which only 8 items matched predictions. Leder and Forgasz (2002)

Table 4 Predictions for gender differences from Leder and Forgasz (2002), and findings from this study

Item		Prediction	Findings (11–17 year olds)	
			Mean	Direction
1.	Whose favourite subject is mathematics?	male	2.46	male
2.	Who thinks that it is important to understand the work in mathematics?	female	3.13	female
3.	Who is asked more questions by the mathematics teacher?	male	2.90	male
4.	Who gives up, when he/she finds a mathematical problem is too difficult?	female	3.21	female
5.	Who has to work hard in mathematics to do well?	female	3.19	female
6.	Who enjoys mathematics?	male	2.60	male
7.	Who cares about doing well in mathematics?	male/female	3.02	nd
8.	Who thinks he/she did not work hard enough if he/she does not do well in mathematics?	male	3.54	female
9.	Whose parents would be disappointed when he/she does not do well in mathematics?	male	2.97	nd
10.	Who needs mathematics to maximise future employment opportunities?	male	2.59	male
11.	Who likes challenging mathematical problems?	male	2.46	male
12.	Who is encouraged to do well by the mathematics teacher?	male	3.14	female
13.	Who do mathematics teachers think they will do well in mathematics?	male	2.77	male
14.	Who thinks that mathematics will be important in his/her adult life?	male	2.67	male
15.	Who expects to do well in mathematics?	male	2.81	male
16.	Who distracts other students from their mathematics work?	female	2.45	male
17.	Who gets the wrong answers in mathematics?	male	3.06	female
18.	Who finds mathematics easy?	male	2.45	male
19.	Whose parents think that it is important for him/her to study mathematics?	male	3.00	nd
20.	Who needs more help in mathematics?	female	3.38	female
21.	Who teases boys if they are good at mathematics?	male	2.77	male
22.	Who worries if he/she does not do well in mathematics?	male/female	3.39	female
23.	Who is good at mathematics?	male	2.56	male
24.	Who likes using computers to work on mathematics problems?	male	2.36	male

(*continued on the next page*)

Table 4 (Continued)

Item		Prediction	Findings (11–17 year olds)	
			Mean	Direction
25.	With whom do mathematics teachers spend more time?	male	3.17	female
26.	Who considers mathematics to be boring?	female	3.12	female
27.	Who finds mathematics difficult?	female	3.44	female
28.	Who gets on with his/her work in class?	female	2.75	male
29.	Who thinks mathematics is interesting?	male	2.63	male
30.	Who teases girls if they are good at mathematics?	male	2.59	male
31.	Who likes boys who are good at mathematics?	np	3.19	female
32.	Who likes girls who are good at mathematics?	np	2.87	male

Shaded items: study findings consistent with predictions from previous research.
np = no prediction; nd = no direction.

interpreted that finding as an indication of a strong change in the belief system of the Australian students, that is, far more balanced in their thinking about mathematics and gender than expected from previous studies. They wrote:

> The findings described above suggest that students now believe that it is girls rather than boys who are more capable mathematically, enjoy mathematics, find it interesting and challenging, and whom teachers expect to succeed. The students now consider boys more likely than girls to be bored by mathematics, have to work hard to do well, give up when things get difficult, find mathematics difficult, and to need more help. Students believe that parents no longer favor their sons with respect to who they believe need mathematics, and who would disappoint them if they did not do well. These views are in stark contrast to those reported in earlier work in this field. (p. 8)

As was shown in Table 2, independent groups *t*-tests were conducted on the 32 items used in this study to test for statistically significant gender differences in the students' responses. One sample *t*-tests were conducted on the mean scores to determine if they were not significantly different from 3 (indicated with an asterisk on Table 2). For only 3 items did the males indicate a neutral position; these items referred mainly to classroom interactions; females were gender neutral on 4 items related to expectations concerning mathematics and classroom interactions. In the Australian data there were 7 and 5 items that males and females respectively took neutral, non-gendered, positions.

Again, following the evaluation method described by Leder and Forgasz (2002), the graph in Fig. 1 illustrates the direction of students' responses, and the strength of the beliefs held. The vertical axis, through the value 3, represents the gender neutral position, that is, no difference between boys and girls. The bars to the right of this axis reflect beliefs expecting the described behaviour to be more likely to be exhibited by girls, bars to the left beliefs expecting the described behaviour to be more likely to be exhibited by boys. One striking result is the uniformity of the

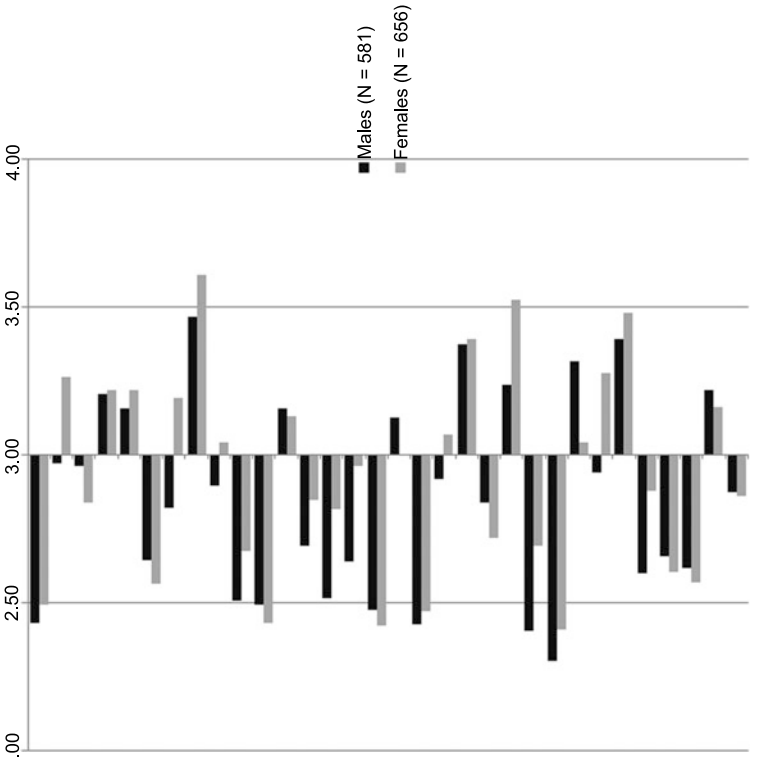

Fig. 1 Means scores for males and females for the 32 items of the test

answers by males and females which are generally in the same direction about which group (boys or girls) was more likely to describe the belief reflected in the items. For only 5 of the 32 items females and males answer in different directions, always in favour of their own gender, namely in questions 2, 7, 9, 19, and 26. Question 17 displays neutral answers by females and a tendency in favour of the girls by the males. Significant differences for both age groups were found on questions about the importance of understanding mathematics (question 2), caring about doing well in maths (question 7), and considering mathematics as boring (26). For two questions on parents' expectations (questions 9 and 19), significant gender differences were only observed for the younger age group; for the older age group both males and females responded similarly, being mainly gender neutral.

If the results of the whole German sample, not disaggregated by age group, are compared to the results of the Australian sample (Leder and Forgasz 2002), only a few similarities can be detected. For only 11 out of the 30 questions students answer in the same direction, namely in the area of teachers' behaviours concerning questioning and encouragement (questions 3 and 12), and for parents' expectations, where in both countries males and females indicate higher parental expectations concerning their own gender (questions 9 and 19). Furthermore, males and females in both countries believe that girls would worry more if they do not well in mathematics, and that girls need to work harder (questions 8 and 22); they describe boys as more distracting in class (question 16) and being more inclined towards computers (question 24). In both countries males and females believe that boys and girls who are good at mathematics are teased more by boys (questions 21 and 30). For all other items, differences in the response patterns in the direction of more traditional gendered views on mathematics and mathematics teaching were found for the German students, as discussed above.

A comparison of the results of the German sample with the Swedish sample, comprising 747 students from year nine, reveals a significantly different picture: for 19 of the 30 items the same response pattern occurs. Apart from question 3 "Who is asked more questions by the mathematics teacher?", where the Swedish males showed a slight tendency to refer to girls being favoured in contrast to the Swedish females, as well as the females and males in Australia and Germany, the similarities in the response patterns for the German and the Australian students—described above—are also found in the comparisons of the Swedish and the German students, together with an additional 8 items. These items confirm the above described similarities such as expectations about doing well in mathematics (questions 7 and 15), importance for future life (question 10), and teachers spending more time with girls than with boys (question 25), a belief especially emphasised by boys. Furthermore, males and females in Germany and Sweden agreed that boys prefer challenging problems (question 11) and find mathematics easy (question 18). Even split reactions are sometimes similar, such as the fact that in both countries males refer to boys as finding mathematics boring, whereas the females refer to girls (question 26). However, the intensity of the beliefs of the Swedish students are quite often less strong and tend towards a neutral position, a pattern which is exemplified by responses to item 29, "Who thinks mathematics is interesting?". For this item, significant differences from the neutral position were found in the answers of the German

students, referring to a traditional gendered view on mathematics as boys being more interested in mathematics. Answers with no significant differences between male and female respondents indicate that these traditional gendered views of mathematics are intensified during adolescence. In Sweden the responses go in the same direction, favouring boys, but to a remarkably smaller extent, and in contrast to the Australian students who expected girls to find mathematics more interesting, a view more strongly held by the males than the females.

To summarise, the German students seemed to favour traditional gendered views on mathematics as a male domain in contrast to Australian students who challenged these beliefs and saw girls as more capable and more interested in mathematics. In their responses, the German students were closer to the Swedish students, who also emphasised more traditionally gendered views of mathematics and its teaching; in some areas, the beliefs of the German students seemed to be even more traditional than those of the Swedish students. It is especially interesting that these traditional beliefs about mathematics develop during adolescence, and the females—especially the younger ones—hold less traditional beliefs in some areas.

In the following section describing the qualitative part of the study, more details are provided on the students' thinking about gender differences in mathematics achievements and the development of these beliefs; this helps explain the results from the quantitative study described above.

4 Gender-Specific Differences in the Perception of Mathematics: Qualitative Results

4.1 General Results

A special part of the study consisted of the open-ended questions: "Who do you think achieves more in mathematics? And why?" These questions complemented the multiple-choice questions to allow deeper insight into the reasons for the students' statements. Thereby, not only the gender of those expected to have higher abilities in mathematics would be analysed, but also statements providing reasons for the choice.

Consistent with the results of the 32 questions, it was obvious that mathematics is assessed as a male domain and higher mathematic abilities are attributed to the boys. Regardless of age group, 512 respondents—almost half the sample—declared that boys achieve more in mathematics; 221 decided in favour of the girls, and 378 indicated that there is no gender difference.

The hypothesis that students have stronger stereotypical perceptions of mathematics with increasing age was again confirmed. While the opinions of the 11–12 year-olds were approximately gender-balanced, the 15–17 year-olds strongly tended to favour the boys (see Table 5).

On closer examination, differences between the opinions of the females and the males are clearly noticed for the 11–12 year-olds. However, a relatively balanced

Table 5 Who do you think achieves more in mathematics?

		Boys	Girls	No difference
11–12 year-olds	Male	48.8%	24.1%	27.1%
	Female	30.5%	34.7%	34.7%
	Total	39.8%	29.3%	30.9%
15–17 year-olds	Male	60.2%	8.5%	31.3%
	Female	47.5%	11.6%	40.9%
	Total	52.5%	10.4%	37.1%

opinion distribution can be inferred from the responses of this age group. The whole sample of 11–12 year-olds selected the responses "boys", "girls" and "no difference" with a percentages of 39.8%, 29.3%, and 30.9% respectively. There was only a slight tendency towards the answer "boys". The females' perception of who they believe to achieve more in mathematics appears very well-balanced. Each of the three possible responses was chosen by about a third of them; the response that "boys" achieve more in this subject was chosen by 4% fewer females than those who chose "girls" and "no difference" (34.7% each).

The males' opinions, however, were not so balanced. They seem to be more convinced of themselves and approximated 50% of them identified "boys" as having higher performance in mathematics. Merely a quarter of the male respondents declared that "girls" achieve more; about the same number indicated that there are no differences between boys and girls. Responses to this question again reveal that females possess a more open view and a more flexible perception of gender roles, and that males are more convinced of their own mathematical skills.

The balanced opinions that appear amongst the younger students cannot be observed among the older age group. The overall belief that boys achieve more in mathematics than girls increased by nearly 13% (39.8% for the younger students up to 52.5% for the older group), and the opinion that girls achieve better than boys decreased by 19% (from 29.3% for the younger group, to 10.4% for the older group). Although, the proportion of those students considering girls and boys as equally capable increased, there was a clear overall shift of opinion in favour of boys.

The opinions of the older female students still appear more moderate than those of the male students. An analysis of the changes (see Table 6) shows that, with age, females appear to strongly adopt the gender stereotyped perception of mathematics, and more often decided in favour of boys.

While the male students' perceptions of boys achieving more in mathematics increased by 11.4% (15–17 year-olds compared to 11–12 year olds), the approval of the female students to this statement rose by 17%. A significant difference between the opinion development of the girls and the boys is also reflected in the answer "girls"; a greater variation appears for females (decrease of 23.1 %) compared to the males, whose frequency saying "girls" decreased by only 15.6%.

Table 6 Changes of the answers "boys", "girls" and "no difference" in age comparison

	Male responses			Female responses		
	Age 11–12		Age 15–17	Age 11–12		Age 15–17
"boys"	48.8	$\rightarrow +11.4 \rightarrow$	60.2	30.5	$\rightarrow +17.0 \rightarrow$	47.5
"girls"	24.1	$\rightarrow -15.6 \rightarrow$	8.5	34.7	$\rightarrow -23.1 \rightarrow$	11.6
"no difference"	27.1	$\rightarrow +4.2 \rightarrow$	31.3	34.7	$\rightarrow +6.2 \rightarrow$	40.9

4.2 Analysis of Reasons

The reasons provided by the females and males for their answers are particularly interesting, because they convey attitudes towards mathematics as well as attitudes towards the different capabilities of boys and girls and gender stereotyped perceptions (see Fig. 2).

The explanations for the response that "girls" may achieve more in mathematics than boys were classified into the following nine categories:

- Intelligence;
- Effort;
- Concentration on school in general;
- Ability;
- Concentration/attention;
- Job-related expectations;
- Ambition;
- Interest;
- Logic intellectual power or ability to reason.

It is remarkable that the three most frequently given reasons relate to girls' work habits. Almost two thirds the responses (186 out of 284) included the explanation that girls may achieve more in mathematics because they are more studious, concentrate more during classes, as well as being more ambitious and desiring better grades. The following statements were provided by students in response to the question 'Who do you think achieves more in mathematics?' (translation by the authors):

> Girls because they are more ambitious and more conscientious. (female, 10th grade)
> Girls, because they pay more attention and listen more closely. (male, 6th grade)
> Girls can achieve more. They are more ambitious and keep at a problem until they solve it. (female, 10th grade)

Apart from these three reasons, the frequency of the other categories were lower. For example, only 11% of the students explained that girls' mathematics achievements were due to intelligence (7.4% or 21 entries) or ability (3.9% or 11 entries). The following reasons were found (translation by the authors):

> I think that girls achieve more because they [...] are just clever. (female, 6th grade)
> Yes, I think girls achieve more because mathematics is more in their nature than in boys', and they have greater abilities. (male, 6th grade)

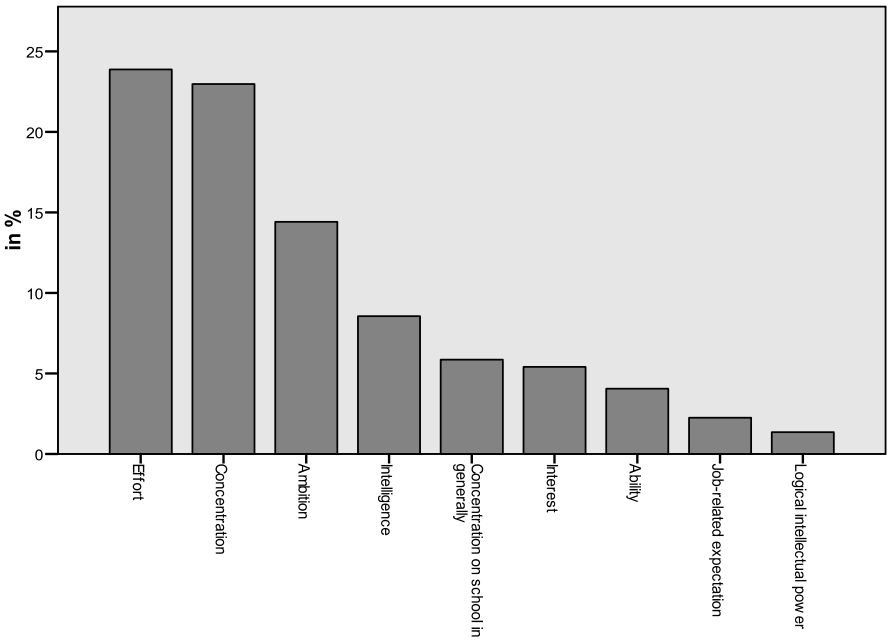

Fig. 2 Distribution of the reasons given to explain why "girls" may achieve more in mathematics

According to what the students wrote, girls' interest in mathematics was not very pronounced. Compared to the other categories, only 4.2% gave this as the reason; this suggests that interest is of little importance in terms of explaining why girls might achieve more than boys.

> I think that girls achieve more in mathematics because girls are more interested (in class). (male, 6th grade)

Similar to the results of questions 10 and 14 concerning the relevance of mathematics to future life and career, very few students connected high mathematical capacities to girls' prospects of future careers. This reason was only named five times and thus accounts for only 1.8% of responses. It must be noted here that careers such as cashier were taken into consideration rather than technical occupations.

> I believe girls because when they are grown up they will have to apply it [mathematics] more often in their occupation e.g., cashier or salesperson in a shop. (female, 6th grade)

The data showed that the reasons given for girls' higher achievements changed with increasing age, because the explanations provided by the older students often referred to the girls' diligence and effort. In particular, "concentration in school in general", "interest", "job-related expectations" and "ability to reason" are no longer provided by the 15–17 year-old students. Indeed, the 11–12 year-old students also rarely gave these reasons, but some nevertheless connected expected performance of girls in mathematics with ability to reason, future career opportunities, or interest. The missing reason, "interest", reveals that both male and female students of

the older age group do not relate girls' high achievement potential with a possible interest in mathematics.

The three most prevalent reasons—"effort", "concentration" and "ambition"—were provided particularly frequently by both the 11–12 year-olds and the 15–17 year-olds. Once again, it became apparent that the 15–17 year-olds offer these explanations more often than the younger students, accounting for 80% of all responses among the older age group. Their proportion in the age group of the 11- to 12-year-olds merely amounts to about 61%. Furthermore, it appears that the percentage growth of the reason "effort" increases significantly from 23.9% up to 40.3%. The 15- to 17-year-old students also often mention the reason "ambition" which increases from 14.4% up to 24.4%.

A contrasting picture was discernible regarding boys. In particular, the categories "interest" and "ability to reason" represented the main reasons provided to explain the better mathematics achievements of boys. The reasons in support of "boys" achieving more could be divided into 18 categories, that is, more reasons featured than the reasons given for "girls". The 18 reasons were (also see Fig. 3):

- Interest;
- Effort;
- Better calculating-skills;
- Females' indifference/boredom;
- Genetic ability;
- Allocation of achievement on sciences and arts;
- Ability to reason;
- Job-related expectations;
- Intelligence;
- Interest/ability in/for computers;
- Concentration;
- Complex thinking of girls;
- Accelerated/clearer understanding;
- Ambition;
- Spatial sense;
- Numerousness of famous male mathematicians;
- Generally better achievements;
- Other.

Of the 605 responses, 110 indicated boys' interest in mathematics as a reason; 75 responses were based on the ability to reason as justifying higher expectations of boys. These two categories accounted for 30% of all reasons given. The following statements are examples:

> I think that the boys achieve more in mathematics because they are just more interested in it. (male, 10th grade)
> I believe that boys achieve more because they have much more pronounced logical thinking and this means that boys achieve correct solutions by thinking, whereas girls use the right formulas. (male, 10th grade)

Career opportunities, accounting for almost 9% of the answers, were more frequently mentioned unlike for "girls". The expectation of "boys" achieving more was

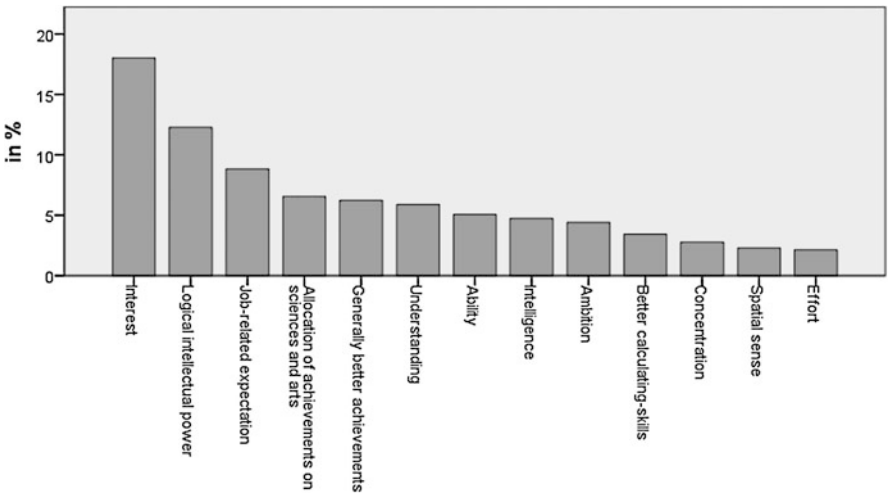

Fig. 3 Distribution of the reasons given to explain why boys achieve more in mathematics

explained in 54 of the 605 reasons as the need for mathematics in boys' occupational careers.

> I think that boys can be expected to achieve more because they will all have occupations which require mathematics. (male, 10th grade)

Less frequent reasons, accounting for 4% to 7% of the responses referred to stereotypical assumptions as well as intelligence. Of the 605 explanations, 40 (6.6%) argued that boys often have better abilities in natural sciences, whereas girls' qualities lie in the humanities and creative areas.

Three further reasons that were mentioned frequently and accounted for 6.3%, 5.9%, and 4.8% respectively, were related to general intelligence, as well as comprehension of mathematics. The reasons, "generally better achievements in mathematics" (38 entries), "better understanding" (36 entries) and "intelligence" (29 entries) were alluded to by a total of 103 students.

> I think boys achieve more in mathematics because they are mostly better. Of course, there are girls who are good at mathematics but boys are still better in the majority of the cases. (female, 6th grade)
> Boys because they have a better understanding in order to solve mathematical and technical problems respectively. (female, 10th grade)
> I do not think that girls achieve more in mathematics because they are not very good at it. Boys often have greater knowledge and are smarter. (female, 6th grade)

The reason "ambition" was identified by only 27 (4.4%) students.

> I think that boys achieve more in mathematics because they do not give up if they do not know a problem. They keep working on the problem until they solve it. (male, 6th grade)

The distribution of reasons for believing that "boys" mathematical achievements were better is displayed in Fig. 3.

These reasons also vary by age group and reveal an increase in stereotypical thinking and that clichés about mathematics are deeply rooted in students' minds. The frequencies of the explanations "ability to reason", "distribution of achievements in sciences and humanities", "better understanding", "genetic ability" and "spatial sense" were noticeably higher for the older age group, whereas the frequencies of the reasons "concentration" and "effort" were lower.

The increase in the reasons related to "ability to reason" are very informative. Males as well as females aged 15–17 named this criterion more often than the younger group, with the frequency increasing from 5.1% to 17.7%. Statements supporting better achievements of "boys" due to superior "spatial sense" increased by only 4%. This is remarkable because the 11–12 year-olds did not take this argument into account at all, it was only provided by the 15–17 year-olds.

Finally, it appears that the reasons for who achieves more in mathematics teaching—boys or girls—are different. The most frequently given reasons for "boys" were: "interest", "ability to reason" and "job-related expectations"; these are barely mentioned in respect to girls. The most frequently given explanations for "girls" were: "effort", "concentration", and "ambition"; these are only occasionally named in regard to "boys". Furthermore, reasons such as "better understanding", "better calculating skills" or "spatial sense" did not occur for "girls" at all.

The varying explanations demonstrate gender specific reasons for high achievements in mathematics. Girls' higher achievements were mainly attributed to effort and diligence, whereas that of the boys were identified as due to intelligence and special mathematical abilities.

Similar to the other items in the questionnaire, it was again noticeable that students' opinions changed for those aged 11–12 and those aged 15–17. The changes were in favour of boys and disadvantaged girls. While attributions of girls' better achievement to effort and ambition in mathematics increased with age, their capabilities and their interest in mathematics receded into the background. The students seem to increasingly internalise gender stereotyped perceptions of mathematics with increasing age. They also assumed different skills and capabilities to be prevalent, but positive appraisal was especially attributed to "boys".

In addition, it was remarkable that there were reoccurring themes within the explanations, clearly indicating that students hold beliefs because they are prevalent and acknowledged by society.

> I think that boys achieve more because girls, from scratch, have the excuse in their minds that 'I am a girl and I don't know and need mathematics'. (male, 10th grade)
> I think boys achieve more because society says so. (male, 6th grade)
> Boys because of stereotypical thinking! (male, 11th grade)

5 Possible Educational Consequences

The results of the study, namely that gender-role-specific stereotypes about mathematics become stronger when students grow up and have effects on the mathematical self-concept, tie in with the results of the various studies described at the beginning of the chapter, such as the OECD study and the newly published meta-analysis

by Else-Quest et al. (2010). Furthermore, the study's findings are consistent with the scientific evidence of marked differences between female and male students in their levels of interest, their instrumental motivation in mathematics and the students' mathematics-related self-efficacy beliefs, self-concepts, and anxiety.

In summary, the study shows that the perception of mathematics as a male domain is still prevalent among German students, and that this perception is stronger among older students. This is either reinforced by the peer-group, parents, or teachers. Compared to the results of the studies by Leder and Forgasz (2002) in Australia, the German students are more traditional than the Australians and reflect traditional positions of mathematics as a male domain. They hold views, which are more similar to the Swedish students, as reported by Brandell and Staberg (2008) and Brandell et al. (2007).

These results show that the stereotyping of mathematics as a male domain is still widespread in today's society. This worsens the learning possibilities for girls, and hinders them from freely choosing a career or a course of studies. It thus appears to be necessary to raise parents' and especially teachers' awareness of stereotyping in mathematics because, as the studies by Tiedemann (2000, 2002) have shown, many adults have also internalised these attitudes and appear to hand them on unconsciously. Parents and teachers have to be made aware of the indirect differentiation they make between boys and girls so that they can distance themselves from these stereotypes and acquire a balanced attitude towards boys and girls concerning mathematics.

Finally, it is important for parents as well as for teachers to strengthen girls' mathematical self-concepts and make them believe in their own achievements, because they often doubt their achievements and mathematical potential which can, in turn, have a negative effect on future achievements. When parents and teachers support female students in their beliefs in their own achievements, it is possible for them to be more convinced of their achievements, not tracing their achievements back to external factors like luck or chance. Therefore, the omnipresent view of mathematics as a male domain can be overcome and turned into a view of mathematics belonging to males as well as females.

Appendix

In this questionnaire we would like to find out about your attitudes towards mathematics.
There are no correct or wrong answers.
Please tick your **personal opinion**!

Are you f ☐ m ☐

How good are you at mathematics? excellent ☐ good ☐
average ☐ below average ☐
weak ☐

Explanation:
BD = Boys definitely more than girls 
JP = Boys probably more than girls 
ND = No difference between boys and girls 
GP = Girls probably more than boys 
GD = Girls definitely more than boys 

	BD	BP	ND	GP	GD
1. Whose favourite subject is mathematics?					
2. Who thinks that it is important to understand the work in mathematics?					
3. Who is asked more questions by the mathematics teacher?					
4. Who gives up, when he/she finds a is too difficult?					
5. Who has to work hard in mathematics to do well?					
6. Who enjoys mathematics?					
7. Who cares about doing well in mathematics?					
8. Who thinks he/she did work hard enough if he/she does not do well in mathematics?					
9. Whose parents would be disappointed when he/she does not do well in mathematics?					
10. Who needs mathematics to maximise his/her future employment opportunities?					
11. Who likes challenging mathematical problems?					
12. Who is encouraged to do well by the mathematics teacher?					
13. Who do mathematics teachers expect to do well in mathematics?					

	BD	BP	ND	GP	GD
14. Who thinks that mathematics will be important for his/her adult life?					
15. Who expects to do well in mathematics?					
16. Who distracts other students from their mathematics work?					
17. Who gets the wrong answers in mathematics?					
18. Who finds mathematics easy?					
19. Whose parents think that it is important for him/her to study mathematics?					
20. Who needs more help in mathematics?					
21. Who teases boys who are good at mathematics?					
22. Who likes boys who are good at mathematics?					
23. Who is good at mathematics?					
24. Who likes using computers to solve mathematical problems?					
25. With whom do mathematics teachers spend more time?					
26. Who considers mathematics to be boring?					
27. Who considers mathematics to be difficult?					
28. Who gets on with his/her work in class?					
29. Who thinks mathematics is interesting?					
30. Who worries if he/she is not good at mathematics?					
31. Who teases girls who are good at mathematics?					
32. Who likes girls who are good at mathematics?					

33. Who do you think achieves more in mathematics? And why?

_____
_____
_____
_____
_____
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Thank you for your participation!!!

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