The influence of gender, religion, grade, class-type, and religiosity on mathematical learning in the Israeli Junior high school

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Hanna David

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Referent: **Prof. Dr. Dr. Albert Ziegler**

Korreferent: **Prof. Dr. Dr. Kurt A. Heller**

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Forward

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Chapter 1:
Introduction

1.1. Learning mathematics in the Israeli junior high school: The gender issue and beyond it

1.1.1. Women and learning mathematics: A feminist or an economic question?

One of the main reasons for social and economic gender inequity in our society is closely connected to the unsatisfactory level of math and science that girls choose to learn while in high school. Not learning enough mathematics, physics, chemistry, and computer science limits the access of many girls to high prestige professions, whether mathematics-related, e.g. engineering, economics, or management, or not necessarily math-related, e.g. law or psychology.

Trying to activate the human available potential of women is not just a feminist issue: a modern society based on human resources and high-technology is always in need for human-power well educated in math and science (**Barro, 2001; Hanushek, & Kimko, 2000)**. Israel suffers from a lack of a substantial amount of young people who acquire such an education (e.g. **Patekin, 1999; Yerushalmi, 1997**). Germany has the same problem, which – in addition to its negative birth rate – risks its present achievements as the biggest industrialized country in Europe. My research has aimed to find, among other things, the reasons for the low participation of women in math and science. I intend to investigate some of the psychological, educational, and motivational measures contributing to mathematical learning, and discover whether they are influenced by gender, religion (Jewish versus Muslim), religiosity (secular versus religious), class-type (single- versus mixed-sex) and grade (7^{th}, 8^{th}, 9^{th}, or 10^{th}).

1.1.2. Mathematics: The gender issue

In our book: *There is another way: Girls and Women, Achievements and challenges* **(Zorman & David, 2000)**, we have drawn a picture of the situation regarding learning and participating of females in mathematics and science around the world. During the writing of the book an interesting picture as to the Israeli situation has been revealed. On the one side, it was clear that in Israel – as in almost all other examined countries – gender differences in many scientific fields have been observed.

On the other hand – gender differences in achievement have disappeared in Israel in all educational levels. In addition, in many fields and areas, considered as "masculine" all over the world, the majority of students in Israel were females. This has been the case in high school, in subjects such as chemistry (**Statistics, Israel, 1997, 1998b, 1999b, 2000)**, as well as in higher education, in subjects such as architecture (**Alterman, 2000**).

In her introduction to our book (**Zorman & David, 2000**), The ex-Chief Scientist of the Israeli Ministry of Education has argued (**Mevarech, 2000)**, that the percentage of girls participating in high level math and science was substantially lower than that of boys. For the lecture I was invited to hold in the conference organized when the book was published **(David, 2000d)** I asked Ms. Yaffa Schiff, from the Israeli Central Bureau of Statistics, the Department of Education, for the updated matriculation results. I received the results of the matriculation examinations of all scientific subjects learnt in the Israeli school in 1998/9 (**Statistics, Israel, 2001a**). This included both numbers and percentages of 12th grade pupils taking each of the following subjects: math, physics, chemistry, biology, and computer science, as well as English, at the highest possible level. These data was sorted by gender, as well as by the educational sector: general, state religious, Ultra-Orthodox, and Arab. The new picture drawn was completely different from the one presented by **Mevarech (2000**): while among males 23% of the examinees took the highest-level 5-point math exams and among girls only about 14%, 43% of those succeeding in this exam in the Jewish sector were girls. In the Arab sector the female percentage was 47. When combining the number of girls who succeeded in the 4-point level, still satisfying the entrance requirements of higher education institutions in Israel, with those successful in the 5-point level math exam, Arab girls outperformed boys. In the Jewish sector the difference was negligible; two years later Jewish girls already were the majority among those taking the 4- and 5-point math exam (**Statistics, Israel, 2002a**). In addition, in the Arab sector the percentage of girls taking the highest-level physics exam was double that that of boys (**ibid**).

<u>1.1.3. … and beyond it</u>

The gender issue in learning mathematics is not considered the most crucial one in learning mathematics in Israel. However, this work stems from a real need: the urgent necessity to improve mathematical learning in Israel. In the year 1963/4 Israel scored the first among the 12 developed countries participating in the International Study of Achievement in Mathematics **(Husen, 1967)** for both 8th and 12th graders. In 1999 it scored 28th out of 38 participants of the *TIMSS 1999 International Mathematics Study* **(Mullis, Martin, Gonzales, Gregory, Garden, O'Connor, Chrostowski, & Smith, December 2000)** among 8th graders. The deterioration of Israel to the level of a third world country regarding the math level in school has been accompanied by opening gender differences that did not exist previously (**Mullis, Martin, Fierros, Goldberg, & Stemler, July 2000; David, 2001a, 2002a, 2002b)**. Thus, the Bureau of the Chief Scientist of the Israeli Ministry of Education has recommended that in addition to all existing programs developed for the advancing of math teaching, more research should be done for finding the reasons to this unacceptable situation. With the blessing of the Ministry of Education and a promise to supply a list of my findings and recommendations I was sent on my way to answer the simple question: why?

1.1.4. A multifactor model for explaining mathematical achievement

Grobler, Grobler, & Esterhuyse (2001) have divided the factors that predict mathematical success into three main groups: cognitive predictors, such as verbal or non-verbal general scholastic aptitude; non-cognitive variables, including self-concept, general self-esteem and academic and mathematical self-concept; socio-economic predicators, including variables such as parental educational-level, class size, and teachers qualifications

Indeed, in the last decades many factors – belonging to each of the tree groups of variables, have been identified as explaining mathematics success: attitudes **(Eccles & Jacobs, 1986; Ma, 1997b; Steinback, & Gwizdala, 1995);** beliefs (**Fennema, 1990**; **Kloosterman, 1995; Schoenfeld, 1985; Schommer, 1990);** expectations (**Vollmer, 1986**); gender (**Benbow, 1988; Benbow, & Lubinski, 1993; Benbow, Lubinski, & Hyde, 1997; Benbow, Lubinski, & Shea, 2000; Benbow & Stanley, 1980, 1981**, **1988**; **Fennema, 1990, 1995; Fenema & Leder, 1990**; **Leder, 1995**); parent education (**Assenheim, 16.1.2003; Ma,** 1**997b**); homework (**Keith & Cool, 1992)** and school size **(Lee & Smith, 1997**).

In addition to these factors, many other factors influence mathematical achievement. However, a primary examination of motivational, educational, and psychological factors that influence the learning of mathematics will help to find the most proper direction for further studies, and might explain achievement differences among the sub-groups examined.

1.2. Facts about educational achievements in Israel

1. In the school year 2001/2 94% of the girls taking the high level math examination passed it in comparison to 91% of the boys; girls outperformed boys also in physics: 98% versus 96%; in computer sciences – 96% versus 92%, and in agriculture – 73% versus 67%. In the humanities the advantage of girls was much more substantial; in literature, for example, the ratio was 7%6 versus 55% success rate **(Eshet, 13.12.2002)**.

2. In the school year 2001/2 the average grade of girls was higher than that of boys' also in the 5-point matriculation exams in physics, chemistry, and biology (www.ynet.co.il**, 26.1.2003**).

3. 56% of the high school graduates of the year 1996/7 living in the northern parts of Tel Aviv have been studying for an academic degree, in cmparison to only 29% of those living in the southern and eastern suburbs do (**Zelikovich, 16.1.2003)**. This was exactly the difference between affluent neighborhoods and deprived ones in Israel **(Shachar, 26.11.2001)**.

4. In the year 1990 only 8 of the 100 graduates of the Sederot high school succeeded in the 3-point matriculation math exam, and one – in the 4-point exam, which is a requirement for university education **(Assenheim, 16.1.2003)**. In 1998 the success percentage in the matriculation exams among 12th graders in Sederot increased to 40 **(Statistics, Israel, 2002b, table 11)**. However, Sederot remained in the lowest quarter of Israeli localities of residences regarding matriculation entitlement **(ibid).**

5. In Israel, the best sole predictor of success in high school and in higher education is the parents' educational level **(Ayalon, 1994, 1995; Assenheim, 16.1.2003)**.

6. The situation regarding employment in the Arab sector is quite bad (**Wolkinson, 2000)**. For women it is much worse: only 22% of Arab females have participated in the labor force in 2001 **(Perl, 27.12.2002)**.

7. In the year 2001 the entitlement percentage for the matriculation certificate was 63.5% among Christian Arabs (http://www.cbs.gov.il.shnaton53 **table 8.20**). This percentage was substantially higher than that of Jews (52.1%).

8. In the year 2001 4,216 Arab girls and only 2,661 boys were entitled to the matriculation certificate (http://www.cbs.gov.il.shnaton53, **table 8.21**).

9. In the year 2000 girls were 54% of the secular students taking the highest-level chemistry examination; among religious students this percentage was 73 (**Statistics, Israel, 2001a)**.

And last but not least:

10. During the Passover/Easter vacation 8 Jewish and 8 Arab children's groups were invited for a chess tournament in the Chess Center in Ramat Aviv. While among Jews there were just a few girls, about half of the Arab participants were girls **(Radushinski, 2002)**.

1.2.1. What do these facts tell us?

The ten pieces of news collected randomly in the second half of the year 2002 points at some of the real problems Israel faces nowadays. On the one hand, there are statistical data showing that actually there is no gender problem regarding mathematics and science in Israel. On the other hand, as we all know such a problem does exist, but it is not connected only to education, as has been always assumed that the case was. For example, data from the Helsinki Group shows (**Traubman, 2.2.2002**), that in Israel only 10% of researchers in engineering and architecture, and only 12% in natural sciences are women. In life sciences, for example, for 15 years women have been about 50% of university graduates, while the percentage of researchers did not exceed 17%.

In addition to the gender problem, which is connected to the Israeli culture and different traditions, the list of the facts I have brought exposes a variety of other problems in the Israeli education system: deprived Jewish ethnic minorities, the need to deal with a great variance in all educational areas among Israeli Arabs, and of course – new problems stemming from the continuing conflict that has been escalated since October 2002.

However, one should see the light not only at the end of the tunnel but along it as well. For example: the very high educational level of Christian Arabs in Israel. As a small minority within the Arab larger minority they behave as Jews have traditionally behaved in Exile: education has become a superior value for them. Another flickering of light comes from the direction religious girls: though state-religious students are mostly from the less privileged ethnic group, Sephardim (e.g.

Dayan, 2001), its students – especially girls – outperform students belonging to higher SES.

But the highlight of educational achievements in the last few years is Muslim girls. They strive for education, and they increase their participation in all its stages more rapidly than any other sector. Muslim girls who play chess with Jewish boys are not just a hope for a better future in a world-of-conflict. These girls, who already consist of about half of nursing and physiotherapy students in all universities, strive their way towards the medicine and accounting departments, and judging by their willpower – they will make it soon.

1.2.2. How do these facts relate to other educational findings?

The findings I have presented are just like some drops in the see. Information regarding educational gaps of underprivileged sub-populations is published on a daily basis. Unfortunately whenever unflattering new facts are brought to the public knowledge, a new "instant" solution is offered by the authorities. For example: after the Israeli results of the 1999 TIMSS were published (**David, 2001a**), the solution offered was to "prepare" the Israeli students to the next international study, instead of trying to increase the level of their mathematical knowledge (**Baram, 15.8.2002)**. When it was discovered that the ethnic gap regarding higher education increases rather than decreases among second generation Israelis (**Shachar & Saban, 9.5.2001**), new criteria have been suggested for being accepted to higher education institutions, so that more Sephardim would be accepted rather than help raising the level of the needing students (**Assenheim, 16.1.2003**).

1.2.3. So what is suggested?

I hereby plan to study three of the main motivational orientations, as well as psychological-educational measures – some regarded as adaptive and some – as maladaptive for the learning of mathematics. This study will be done among a variety of sub-groups in order to be able to take into account variables such as gender, as has already been done in some studies in Israel, as well as a vriable not studied yet in any motivational study in Israel.

1.3. Survey of the theoretical part of this research

In order to be able to start the suggested study, a wide theoretical background is needed.

The second chapter will introduce the reader to the Israeli education system. A general description of the different populations that comprise the body called "Israelis" will be presented. The next step will be to present the reader with the educational gaps typical to system comprised of variety of religions, ethnic origins, levels of religiosity, to a society were a substantial part of its population are new comers, among them about 20% that came to Israel after 1990. Statistical data as to the educational situation of each of these subgroups will also be supplied.

The third chapter will deal with mathematics and gender in Israel and elsewhere. The reasons for gender differences in achievements and participation in all educational levels will be discussed. Suggested exolanations for the reasons to such differences will also be offered: connections between socialization and math gender differences; gender differences in type-preference of math exams; connections between math gender differences and age, both in Israel and abroad, and between gender differences and the selectivity of the population; gender differences and math anxiety, believability in own ability or self-concept, and the TIMSS findings of gender differences in mathematics among 4^{th}-, 8^{th}-, and 12^{th} graders.

Chapter four discusses the female populations taking part in my study: Muslim girls and state religious Jewish girls. For both populations I first describe their educational level in general, and in math and science in more detail. In addition, I supply the reader with a glimpse into the lives of these girls regarding their socio-economic status, their status as females in traditional societies, and special characteristics of their schools. The next step presents their participating rates in all educational levels, with a special emphasis on mathematics and science. I also add, though quite briefly, a short summary of their special problems and suggest some ways to solve them.

The single-sex class is the subject of the fifth chapter. In Israel there are almost no single-sex classes in the general education system. In the religious institutions – whether state religious or Ultra-Orthodox – all schools are either single-sex, or mixed-sex schools with single-sex classes. The suggestion to teach math and science in single-sex classes has been offered to all secular institutions; it was tried in a vew and was very successful, but was not widely adopted in Israel mainly because of prejudices. Since my study examines – for the first time in Israel – the question of mixed- versus single-sex education, I offer a summary of this issues with examples from different countries. I make a list of advantages versus disadvantages of both mixed- and single-sex classes, and I promise to let the reader join me one I come to any conclusion regarding this issue…

Chapter six examines the question of motivation, on of the cores of my study. After a brief summary of Impicit Personal Theories I offer a wide variance of definitions for motivational concepts. The next step is a review of goal theory, with the division I use in my study: to mastery-, performance-, and avoidance goals. I introduce the reader with a list of variables that have influence on motivation – culture, age, gender, ethnicity, socio-economic status, ability level, and classroom environment, and describe their potential influence on motivation according to the relevant literature. The next division I analyze is of mastery versus helpless patterns, the motivational constructs: self-efficacy and expectations, and last but not least – competence and value.

Chapter seven that comes next already introduces the aims of my study.

Chapter 2:

The Israeli education system

2.1. Gaps in the Israeli education system

> Mathematical education is the basic foundation for future studies in a wide range of professions essential for an advanced technological society. Mathematics teachers are the bridges providing appropriate mathematical education to the population of learners. Teachers have a substantial influence on both students' attitudes and achievements in mathematics (**Patekin, 1998, p. 81**).

Mathematics has a substantial influence on future educational possibilities of the young person who is about to graduate from high school (**Sells, 1973, 1981**). In Israel, as in many other countries, there is a high correlation between socio-economic status and level of school mathematics, rooted in gaps created in elementary school and even earlier. These gaps are mainly between children of well off families, learning in good schools (**Ayalon, 1994, 1995; Ayalon & Yogev, 1997; Birenbaum & Kraemer, 1995; Kashti, 1998; Suessapel, 1997)**, and children learning in peripheral schools, whose families belong to a lower SES (e.g. **Ayalon, 1994, 1995; Ayalon & Yogev, 1997**). Among those who succeed to complete the minimal requirements needed for a matriculation certificate, the percentage of pupils from disadvantaged ethnic background is relatively small (**Ayalon, 1995; Sa'ar, 16.10.2001**). Any effort to improve this situation must take place in each school separately. Though there is available data regarding the average rate of graduates entitled to the matriculation certificate in different geographical areas (**Statistics, Israel, 1999a**, **table 22.22**), such information does not reflect the situation in each school. For example, the average percentage of high school graduates who were entitled to a matriculation certificate in the year 1998 in Tel Aviv was 65.5 (ibid.). This figure included the *Alliance* high school graduates, with a success rate of 95%, and those of *Rogozin* high school, with a success rate of 62% (**Assenheim & Weingard, 24.8.2000**). Furthermore, the average pwercentage of Arabic high school graduates entitled to matriculation certificates were only 49.2 both in 1997 and 1998 (**Statistics, Israel, 1999a**, **table 22.22**). However, it reached as high as 74% in comprehensive high school no. 12, located in Jaffa, the Arabic suburb of Tel Aviv **(Assenheim & Weingard, 24.8.2000**). On the other hand, a most irritating data has been that in the year 2000 the percentage of high school graduates entitled to the matriculation certificate in the Arab sector dropped to a lower rate than in 1987.

In addition to gaps between financially and ethnically different classes, there are differences between attitudes and achievements of boys and girls. Such differences are mostly subtle (e.g. **Lundenberg, 1997**), but nevertheless they exist. While in most countries no gender differences favoring boys with average achievements in primary school have been detected, such differences – mainly in mathematics and mathematically related subjects – were found among high ability students. Participation of girls in special gifted classes has been much smaller than that of boys (**David, 1997, 1998a, 1999b, 2000d, 2001b, in press; David & Zorman, 1999**). Furthermore, girls who have participated in gifted programs have tended to choose non-scientific subjects and minimize their participation in mathematics classes whenever possible (**David, 1999b**). In addition, the aspiration level of highly talented and gifted girls has been much lower than that of gifted boys, resulting in aiming towards low-level professions (**Libes, 2000**), or being satisfied with such occupations (**David, in press**).

In the year 2001/2 about half of first grade Israeli children learnt either in Arabic or in Ultra-Orthodox educational institutions **(Ben David, 22.3.2002**). 20.3% of first graders were enrolled in the Ultra-Orthodox system (**Statistics, Israel, 2002a, table 8.15)**, while almost 30% of Israeli first-graders were in the Arab system (**ibid**, **ibid**). The level of studies in the Ultra-Orthodox population is the lowest in Israel, and birth rate – the highest. In the Arab population the level of studies is somewhat better and birthrate – lower, but still higher than among secular Jews. Thus the future achievements of Israel in math and science are not expected to improve in the near future.

2.2. Those who can make it

2.2.1. How does it work?

In Israel each pupil who wishes to acquire a matriculation certificate must be examined in mathematics in one of the three offered levels. Pupils who study mathematics at the 5- or 4-point level, with good grades in their matriculation certificate, have the best prospects to continue their academic studies at one of the Israeli universities in the most prestigious professions, including law, computers, medicine, engineering, and management. On the other hand, pupils who study enough mathematics just to be entitled to a matriculation certificate, namely, take the 3-point level mathematics examination rarely have an access to higher education in hard sciences, life sciences, or mathematics. Furthermore, potential students who wish to study popular subjects like economics or accountancy might find it very hard to be accepted to the relevant departments, being pushed to the end of the long waiting list of candidates who have a better mathematical background.

2.2.1.1. The bonuses system

The difficulty of acquiring higher education in high prestige subjects without a suitable background in math and science is not only because of lack of knowledge, which can be improved during the first and even the second year of academic learning, but mainly due to a unique acceptance policy applied in Israel. According to this policy, called "the bonuses system", 25 points are added to the grades in mathematics and English learned at the highest possible level, and 12.5 points are added to the English and math grades at the 4-point level for the calculation of the matriculation average grade. Bonuses in other subjects (for the subject list see www.ims.tau.ac.il/md/smdp009.asp) are smaller, and given only at the 5-point level exams (***Information Brochure for New Candidates*, 2002a**). Thus, candidates with high matriculation grades but with no bonuses have practically no prospects to study a profession with a high prestige at an Israeli university. For example, a perfect 800 score at the psychometrics and a perfect final grade of 100 at the matriculation certificate did not ensure acceptance to the computers department at the Tel Aviv University in the 2000/2001 academic year. A score of 750 at the psychometrics (percentile 99, **Suessapel, 1997**), and a "calculated average" of 105 in the matriculation certificate did not guarantee acceptance to the computers department either. For a candidate to the Tel Aviv University medical school, who scored 750+ in the psychometrics, an average of "calculated" 108 was needed in the matriculation certificate in order to ensure acceptance (for the calculation system see www.ims.tau.ac.il/md/smdp009.asp). Five of the seven obligatory matriculation subjects are in the humanities: Hebrew literature, Hebrew grammar and composition, history, Bible, and citizenship; in the Arab sector classic Arabic replaces the Hebrew literature compulsory exam, and Islamic religion replaces the Bible one. The sixth compulsory exam is English for both sectors. Achieving an average higher than 105 is possible only by learning at least two scientific subjects and English at the highest possible level, in addition to the obligatory subjects.

2.2.1.2. The low failing rate of math and natural sciences in the matriculation exams

Choosing to deepen high school mathematics and science over humanities has another advantage that should not be ignored. In spite of being considered difficult to master, the percentage of failing at the 4- and 5-point mathematics and scientific subjects is only 25% of the failing rates in the humanities. For example, in 1998 the percentage of failing the matriculation exam in math, physics, chemistry, or biology at the two highest levels was 4%-11% (average: 5.8%); failing in any of the 13 humanistic subjects at the 4 or 5-points level was 7%-35% (average: 20%). As a result, studying physics at the highest possible level (only 4% failed) was statistically a better choice for a psychology candidate than choosing social sciences at the 5- or 4-point level (18% failed) (**Statistics, Israel, 2001a**).

2.2.1.3. Combinations of subjects

The matriculation certificate is valuable regarding being an "entrance ticket" to the university in general and to more prestigious departments in particular depends of the combination of subjects studied at the highest possible level. There are four main categories of high-level matriculation certificates: 1. With 2 scientific subjects and 2 humanistic subjects; 2. With 2 scientific-, one humanistic-, and one technological subjects; 3. With one scientific-, 2 technological, and one humanistic subject; 4. With one scientific, one humanistic-, and 2 technological subjects – all studies at the 5-point level.

2.2.2. For whom does it work?

Unlike in many European countries and in the US, in Israel a matriculation certificate does not assure acceptance to one of the six Israeli universities. In Germany and Austria, for example, higher education is not only almost free, but almost every high school graduate is accepted to a university – even if not always to the desired subject in the preferred university. In Israel regarding both acceptance to the university and being able to pay tuition and other learning- and living-expenses, the situation is quite different.

The reservoir of potential students depends almost exclusively on graduates of the Jewish "regular" and state-religious high schools, and the percentage of such students is declining every year. The reason for it is the growth of the Ultra-Orthodox and Arab education systems.

In summa: the “system” works for well off Jewish children, living in big cities, and belonging to the preferred ethnic groups, namely Israeli born or European-American. It does not work for three main sub-groups that include the vast majority of Israelis: 1. Non-European Jews that consist about 50% of the Israeli Jewish population; 2. Arabs, who are more than 20% of the Israeli citizens; and 3. Ultra-Orthodox Jews, whose children consist already about 20% of first grade Israeli students.

2.3. Socio-economic deprived students

A most worrying data about educational gaps between the main two ethnic Jewish-Israeli groups is that this gap increases regarding the entitlement to a matriculation certificate (**Shachar & Saban, 9.5.2001**). In the year 2000 80% of Jewish high school graduates who were second generation to European and American immigrants were entitled to the matriculation certificate; among second-generation immigrants from Arabic countries this percentage reached only 56.

Among the 84,000 Israeli graduates of grade 12 in the year 2000, only 45% were entitled to a matriculation certificate that enabled them to continue their academic education in an Israeli university, namely, they took a minimum of 3-point level math and 4-point English (**The writing on the wall**, **2001**).

2.3.1. Tracking: The ethnic factor

David (2000b), **Shavit (1989, 1990**), and **Resh (1998**) have stated, that at the secondary level oriental Jews are tracked disproportionately into vocational tracks that divert them from college education. **Barak and Waks (1997**) have found, that 97% of the students in the general track but only 53% of the students in the technological/vocational track take the matriculation examinations. Pupils in the technological/vocational track study, in addition to the compulsory subjects, a broad range of disciplines including electronics, computers, and mechanics. However, 68.2% of the Jewish students in the academic track who took the matriculation examinations were entitled to a matriculation certificate in 2000, while in the technological/vocational track this percentage was only 52.9. In the Arab system the percentages were 50 and 32.4 respectively (**Statistics, Israel, 2002b, table 8.21)**. Since there is a tendency to direct students, especially boys, from lower socio-economic status to the technological/vocational track, the prospects of a boy living a deprived neighborhood, where the educational level is not high, to be entitled to a matriculation certificate are low (**Sa'ar, 10.7.2002**)

As has been found by **Ayalon (1994, 1995**) and **Ayalon and Yogev (1997)** ethnic origin is only a mediating variable for future educational level. A more profound problem is gaps in the educational level of the students' parents. Unfortunately, even among the present generation of university students, there exists a disparity of educational level depending on the origin. Only about 8% of the students' parents whose origin is Asian-African have 16+ years level of education. Among students whose parents were born in Europe-America this percentage exceeds 26 (**Statistics, Israel, 1998a**). The population of students in the most prestigious subjects consists mainly of young people with parents with an academic background.

2.3.2. Dropout

In Israel education is compulsory until the age of 15. There are high-risk sub-populations upon whom the law must sometimes force primary and junior high school obligatory education, but the severe dropout problem starts at age 15 (**Statistics, Israel, 2002a table 8.18)**. Many high schools hold a policy of not permitting a high percentage of their 9th graders continue studying in their institutions because of low achievements, mainly in mathematics and English. This is also reflected by the high rate of students leaving for another school: 15.4% between 1999-2000, and 11.7% between 2000-2001 (ibid). In many other cases children from undereducated families, where the financial situation is poor, leave school and start working in underpaid jobs. A relatively new high risk for dropout population is descendants of Ethiopian and ex-USSR immigrants, especially from the new Islamic Republics. The total percentage of pupils who do not finish high school in Israel has been about 30 in 2000; these youngsters belong mainly to low SES groups (**Assenheim, 31.8.2000)**.

2.3.3. Entitlement to the matriculation certificate

Only 37% of the Israeli 18-year olds were entitled to a matriculation certificates in 1998; less than 20% of them learned either mathematics or science at the 4- or 5-points level (**Statistics, Israel, 1998a**). Thus, only about 7% of the 18-year olds had an access to highly rewarding, respected, and intellectually academic aress. This group is ethnically homogeneous: the percentage of students whose origin is Asian-

African declines as the prestige of the profession raises. For example: in 1995 the total percentage of high school graduates whose father was born in Asia or Africa, who started studying a scientific area at the university was 27.4, while graduates whose origin was European-American were 40.8% of the total graduates (the fathers of the rest were born in Israel). Furthermore: while in the humanities – which are considered the least prestigious – the percentage of students whose origin was Asian-African was similar to that of students whose origin was European-American, the proportion changed according to the prestige of the subject learnt. In social sciences it was 29.6% vs. 37.2%; in law – 22.8% vs. 39.1%; in engineering and agriculture – 24% vs. 45.1%, and in medicine 23.4% vs. 48.3%. Thus equity of opportunities cannot be achieved until students from culturally disadvantaged background have equal prospects to be an integral part of the scientific Israeli community.

In summa: studying as many scientific subjects a possible raises the prospects of pupils to be entitled to a matriculation certificate. The percentage of failing at the 5- or 4-point level exam in a humanistic subject has been 24 for a pupil whose origin is Asia-Africa; it is only somewhat above 17 for a pupil with a European-American origin. On the other hand, in mathematics and science the difference in the failing rate has been less than one percent (7% vs. 7.8%) (**Statistics, Israel, 1999a, table 22.25).**

2.3.4. Ethnic differences

If we analyze the choices of subjects-combinations in the matriculation certificates according to their prestige from the ethnic point of view, the picture of equity will be far from perfect. In the most prestigious combinations, the percentage of pupils whose origin has been from Europe-America is more than 2.5 times than that of Asians-Africans (1.6 vs. 0.6). The situation in the second prestigious combination is similar (2.7% vs. 1%), and a little bit better in the third mentioned combination 1.9% vs. 1.1%). The gap between these two ethnic groups is still close to 2.5% (11.9% vs. 8.5%) even in the least prestigious combination among the four that enable continuation of university education in a variety of subjects (**Statistics, Israel, 2002a**).

2.3.5. Disparities in the rates of rejection to higher education

27% of the candidates to higher eduction living in deprived areas were rejected in the shool year 2000/2001, in comparison to only 11% living in affluent settlings (**Ilil Shachar, 26.11.2001)**.

It should be noted, though, that the rejection rate of candidates who apply to Israeli univerisites is not substantially higher among students whose origin is Asia-Africa (17.7%) than among those whose parents were born in Europe-America (17.1%) (**Statistics, Israel, 2002b, table 8.36**). This finding is with accordance to the one that ethnic origin as such does not influence the educational level (e.g. **Ayalon, 1994, 1995**), but rather other factors combined to it, such as socio-economic status, and educational level of parents.

2.3.6. Disparities in higher education participation

Being accepted to an Israeli medical school is an aspiration that only a minority of Israeli high school graduates can share. About 60% of the 18-year olds do not hold a matriculation certificate, mostly because of failing or not being examined in mathematics or English (**Statistics, Israel, 1999a**). In the year 2001 about 37% of young adults belonging to a high Socio-economic status studied in Israeli universities, in comparison to 2.4% of those living in deprived settlings (**Ilil Shachar, 26.11.2001**).

2.3.7. Disparities in the subjects of studying

Since 1995 the ethnic division of students learning prestigious professions was very much like that of high school graduates (**Guri-Rosenblit, 1996)**. In Israel medical students study for six years plus internship; engineering students study for four years, and law students need a year of internship after their three years of formal studies. While the division between Western- and Eastern Jews has been quite similar in the general population, in 2000 only 16% of medical students were of Asian-African origin; in mathematics and natural sciences they were only 19% of the students, and in the law departments – 23%. In the less prestigious humanities and social sciences about 30% of students learning for the B.A. degrees have been Asian-African (**Shachar, 22.5.2001**). However, in the doctoral level their percentage decreased to about 15% (**ibid**).

Taking this into consideration, the situation will not improve without outside intervention. After a constant increase in the percentage of humanities students from Asia-Africa until the 1996/7 academic year (**Statistics, Israel, 1998a**), a gap of 3.3% favoring students whose origin was European-American re-opened in the year 1997/8. As during the 90ies it has become gradually more difficult to be accepted to Israeli universities, many community colleges have been opened (**Statistics, Israel, 1999a, table 22.45**) to fulfill the need for higher education. The ethnic picture of most of these colleges is different from that of the universities: at teachers colleges, for example, over 90% of the students are females; more than two thirds are Asian-African (**Porat, 1994**; **Rotem, 2000**).

2.3.8. University degrees

In the year 1999 27% of recipients of BA/BSc university degrees were of Asian-African origin in comparison to 40.4% whose origin was Europe-America. The variance of the subjects studied by students whose origin was Asian-African was as follows: in the less prestigious humanities – 33.3%, in social sciences – 29.8%. In the four most prestigious subjects their percentage was much lower: 17.7% in medicine, 19.5% in natural sciences and mathematics, 21.4% in law, and 22.1% in engineering and architecture (**Statistics, Israel, 2002a, table 8.38)**.

The gaps between the two main Jewish ethnic groups regarding education is much wider in advanced studies: in 1999 the rate of recipients of M.A/MSc degrees whose origin was Asia-Africa was 22.5% in comparison to 51.2% whose origin was Europe-America **(ibid)**. In addition, the representation of such students in the more prestigious subjects was much lower than this rate: in medicine – 15.7%; in mathematics and natural sciences – 16.2%, in engineering and architecture – 17.2% (ibid), and in law – 18.6%.

2.3.9. Summary

This work does not deal explicitly with underprivileged sub-populations, but nevertheless, their existence is substantial, and their educational achievements influence not only national and international studies but the future scientific and technological situation of Israel as well. It has been shown by thousands of studies that socio-economic status plays an important role in learning and knowledge acquiring, thus not taking components such as ethnic origin, level of parents' education, or family income into account means leaving out of the discussion one of the most influencing causes for educational gaps and deficiencies.

I have chosen for my research three main groups: secular Jews, religious Jews, and Muslims though living in a religious town learning in state secular schools. The two groups of Jews are different from each other in both socio-economic status and ethnic origin: while most children from the secular school lived in an affluent neighborhood and studied in high prestigious elementary schools, most of those in the religious school came from less well-off parts of Tel Aviv. In addition, though the origin of the secular students school is not known, it has been shown that for pupils from high SES the ethnic origin does not predict achievements (**Ayalon, 1995**). The children learning in the religious school were mostly from Asian-African origin; among the boys this percentage was over 90. This difference between the two Jewish groups assured that the students learning in the religious school had no advantage over those learning in the secular one. Thus the results of my study would be valid per se, namely, would not be biased – as was the case in many studies of single-sex education and religious schools – because of differences in the socio-economic status of the examinees.

As for the Muslims in my study – I chose schools located in a 45,000-citizen city, where all students were Muslim. Thus many psychological and educational components, which might be influenced either by Jews, when learning in a mixed-school or living in a mixed city, or by Christians – were eliminated

2.4. Arab students

Israel is a country consisted of minorities. 19% of Israeli citizens are Arabs (1.2 millions out of 6.5 million citizens; **Greenstein, 16.4.2002**). The three main Arab sub-sectors are Muslims (about 80%), Christians (about 10%), and Druses (about 8%) (http://www.cbs.gov.il/shnaton51). Inequity – regarding the educational level – between any two of these three sub-sectors, especially between Christians and Muslims or Druses, is larger than that between Jews and Arabs: the educational level of Israeli Christian Arabs is higher than that of the educational level in the Jewish sector.

The Israeli education system is segregated by religion **(Birenbaum, 1998**). No Jews choose to learn in public Arabic schools, but there are Arabs – though not a substatntial number – who prefer Jewish education. As a result, in spite of the fact that the monthly tuition in the private schools of Jaffa is about 250EU per child (**Weingard, 2001**), and all Tel Aviv Jewish schools are free, only a small minority of the Jaffa Arabic students choose learn in one of the Tel Aviv Jewish schools.

2.4.1. Participation in the different educational levels

Some comparisons between the Jewish and Arabic Israelis will illustrate the disparities regarding participation at the different educational stages. The birthrate among Israeli Arabs is higher than among the Jews. This is reflected by the number of first grade Jews – about 86,794 (in 2001/2), in comparison to 32,955 Arabs (http://www.cbs.gov.il/shnaton53, **table 8.14**). Thus among 6-year old Arabs consisted 29% of the population while in 12^{th} grade the situation is already different: 82,661 Jews and only 15,692 – only about 15% – were Arabs.

Math achievements have been much lower among Arabs than among Jews, as has been shown by **Aviram, Kfir, & Ben-Simon (1998a, 1998b**) both among 4^{th} and 8^{th} graders.

2.4.2. Dropout

The highest dropout rate in the Arab sector occurs after grade 9 – when education is no longer compulsory. Between the 2000/1 and 2001/2 school year 19.8% of the Arab boys and 8.9% of the girls left the education system, in comparison to 7.7% of the boys and 4.2% of the girls in the Jewish sector (http://www.cbs.gov.il.shnaton53 table 8.19). The largest disparity between Arabs and Jews appears at the last stage of formal education: the end of high school. 10% of 11^{th} graders drop out of school in the Jewish sector; in the Arab sector this rate is three times higher: each third child leaves school by age 16 (**Ilil Shachar, 16.6.2002a)**. While in the Jewish sector 7% of children aged 14-18 have already left school, in the Arab sector this percentage has been 20 (ibid).

2.4.3. Matriculation success rates

The percentage of Arabs entitled to a matriculation certificate is much lower than that of Jews: in the year 2001 only 20% of Arab students in comparison to abut 40% 18-year old Jews (**Shachar, 26.11.2001**). Furthermore, while in 2001 40% of Jewish high school graduates belonging to percentile 10 Socio-Economic-Status were entitled to the matriculation certificate, only 15% of Arabs belonging to the same socio-economic percentile succeeded in the matriculation examinations (**Sa'ar, 10.7.2002**).

The percentage of high school graduates entitled to the matriculation certificate is much lower among Arabs than among Jews (http://www.cbs.gov.il.shnaton53 table 8.20). In 2000 the success rate in the matriculation examinations among Israeli Jews was 52.1% of pupils in grade 12, it was only 41.8% among Arabs. Furthermore, due to the high dropout rate in the Arab sector only 20% of all Arabs aged 18 were entitled to a matriculation certificate in comparison to 29% of Jews from underprivileged neighborhoods and 56% of those living in more affluent settlings (**Shachar, 26.11.2001**).

The low percentage of Arabs entitled to the matriculation certificate is even more worrying when data is presented for each sub-sector separately. As we have already stated, entitlement percentage is the highest among Christians – in the year 2001 it reached as high as 63.5% (http://www.cbs.gov.il.shnaton53 table 8.20). This percentage is not only substantially higher than that of Jews, which was in 2000 52.1%, but higher than any other privileged sub-sector: the religious education (61.3%); girls (57.2%), or Jews whose origin is Europe-America (58.3%) (ibid, ibid).

However, the picture of matriculation entitlement among the other Arab sectors is much darker. In 2000 the entitlement rate for Muslims it was just 39.2%, and for Druses – 38.7% (ibid). The Bedouins ranked the lowest – with 27% entitlement (**The writing on the wall, 2001).**

2.4.4. Combinations of subjects in the Arab sector

Christian Arabs scored the highest among all sectors in number of enhanced subjects: 32.3% of them succeeded in two 5-point humanistic subject and two 5-point scientific ones. The sector that scored second – religious Jews – had a much lower rate: 24%; in the general Jewish sector this rate was only 10.8% in the 2000/1 school year (**http://cbs.gov.il/shnaton53, table 8.24**). The average Arab rate of taking this combination was 20.1%, almost twice as higher as that of the Jewish one (ibid, ibid).

2.4.5. Acceptance to universities

The minimal requirement for acceptance to an Israeli university is succeeding in the 3+-point mathematics exam, and the 4+-point English matriculation exam. Let us see to what extent Israeli Arabs meet this requirement, and what happens when they do not.

2.4.5.1. Meeting the universities requirements

In the year 2000 44.1% of the Jewish school graduates met university entrance requirements in comparison to only 25.4% students in the Arab education (http://www.cbs.gov.il.shnaton53 **table 8.20**). The polarity in the Arab sector was much wider than in the Jewish one: while among Jews the more privileged group – the European-American – 51.7% met these requirements in comparison to 35.5% of Asian-African, 51.8% of Christian Arabs and only 22.1% of Muslims and 22.5% of Druses did (ibid). Thus, though the different between Jews and Arabs regarding entitlement to the matriculation certificated was in 2000 just 25%, the percentage of Muslims and Druses belonging to the lucky reservoir of potential students was about half the percentage than in the Jewish sector.

2.4.5.2. Rejection rates

Not only was the percentage of Arab students entitled to the matriculation certificate much lower than that of Jews – of those attaining it and applying to an Israeli university, the rejection rate was almost 3 times higher than among Jews: in the year 2000/1 85.2% of the candidates were Jews in comparison to 14.8% Arabs; among those rejected 31.7% were Arabs (http://www.cbs.gov.il.shnaton53, **table 8.37**).

2.4.6. University students' rates

Only about 5% of Arabs aged 20-29 were higher education students in the year 2001 **(Ilil Shachar, 26.11.2001**). This percentage consisted of students in university and non-university institutions of higher education. While among Jews 9.3% of this age group were university students, among Arabs the percentage was only 2.5% (http://www.cbs.gov.il.shnaton53, **table 8.12**). Among Jews 4.5% of 20-29-year olds studied in non-university institutes, the percentage among Arabs was 2.4 (http://www.cbs.gov.il.shnaton53, **table 8.13**).

In 1999/2000 Jews were 90.4% of first degree students and Arabs – 9.6%, just half of their presentation in the population (http://www.cbs.gov.il.shnaton53, **table 8.35**). In the year 1998 only 7% of B.A. students were Arabs; they consisted of only 3% of M.A. students and 3.5% of Ph.D. students (ibid, table 22.34). A slight increase in the percentage of Arab student has occurred in 1999: they reached 9.3%; in the year 2000 they were already 9.8% of all students learning for the first academic degree (**Shachar & Yosifun, 21.10.2001**). However, there has been no substantial increase in the percentage of students learning in one of the 6 Israeli universities, the Technion – Israeli Institute for higher education in technology, and the Weitzman Institute of Science. The most profound increase has been in the number of students learning in colleges in general and in teachers colleges in particular (ibid).

2.4.7. Rates of university degrees recipients

In the year 1999 only 5.7% of recipients of the total 16,235 BA/BSc university degrees were Arabs (**Statistics, Israel, 2002b, table 8.38)**. In the second-degree level the gaps were much higher: only 2.6% of MA/MSc recipients were Arabs (**ibid**). This number reflects a backlash since 1985, when Arabs were 2.9% of recipients of advanced degrees (**ibid**). It should be noted that the percentage of Arabs holding graduate degrees in two of the most prestigious subjects – medicine and math and natural sciences – is much higher: 6% and 3.8% respectively (**ibid**).

In Summa: The average educational level in the Arabic sector is one of the main political, social, and financial problems that the state of Israel has to solve.

2.5. Female students – A deprived majority?

Gender inequity in education has been discussed widely in Israeli professional literature. It has been found that teachers tend to approach boys about three times as more often than girls in primary school (e.g. **Avrahami-Einat, 1989, 1998**). Gender differences have been found in capabilities, inclinations, and subject preferences (**Adler, Argaman, Zucker, & Avishai, 1995**), as well as in professional choices (ibid; **Kfir, 1988**). The main differences have been found in mathematics and mathematically related subjects (**Ayalon, 1995; David 1997, 1998a; Tamir, 1998**). This is known in the literature as being related mainly to success and failure attributions (**Amit & Movshovitz-Hadar, 1989**), and to the general sexism still existing in the Israeli school, as a reflection of the situation in the society in general (**Ben Tsvi-Mayer**, **1991; Shachar, 1994**). Intervention programs have been applied to reduce the level of sexism (e.g. **Avrahami-Einat, 1989**; **Shamai, 1995**). Alas, no program has yet been operating in Israel aimed both for the educational-psychological-sociological as well as professional aims: equity in opportunities, resulting in fair prospects for each pupil, without class, gender, or religion differences.

As known from the literature, until the age of 12 girls achieve at least as well as boys in all subjects, including mathematics. At the age of 12, because of social-cultural pressures, girls, especially the more talented ones, start to underachieve in mathematics (e.g. **Arnot, Gray, James, Rudduck, & Duveen, 1998; Bailey, 1996; Boaler, 1997; Campbell, & Sanders, 1997; Lundenberg, 1997; Wilgosh, 1998; Zorman & David, 2000**). As a result, the percentage of girls studying enough mathematics to enable their further education in a prestigious profession is smaller than that of boys (**Ayalon & Yogev, 1996; Zorman & David, 2000a**). Mathematical underachievement among girls has a high positive correlation with the level of talent or giftedness as well as with age (**Benbow, 1988**; **David, 1997, 1998, 1999b; Feldhusen & Willard-Holt, 1993**).

2.5.1. Participation and dropout in the different educational levels

2.5.1.1. Participation

Until grade 12 boys are the majority of students in all grades in the Jewish education system (http://www.cbs.gov.il/shnaton53). In the school year 2001/2 there were 176,534 boys and only 171,534 girls in grades 9-12 (**ibid, table 8.19**).

2.5.1.2. Dropout

Females have an advantage over males regarding dropout both in the general in the state-religious sector. Between 2000 and 2001 the dropout rates were 7.1% for males and 3.4% for females 9th graders, 7.2% males and 3.8% females in grade 10, 8.6% of males and 4.8% females 11th graders, and 2% males and 1.2% females for 12th graders (**Statistics, Israel, 2002b, table 8.19)**.

2.5.2. Matriculation success rates

2.5.2.1. Matriculation entitlement

In 2001 27,976 boys and 32,458 girls took the matriculation exams on the Jewish sector; 17,279 boys and 22,388 girls were entitled to the matriculation certificate **(Statistics, Israel, 2001b, table 8.20)**. The advantage of girls over boys has been obvious in three levels: 1. Only 37,012 boys in comparison to 39,137 girls attended grade 12; 2. Only 75.6% of boys in comparison to 82.9% of 12^{th} grade girls were examined in the matriculation exams; 3. The success rate of boys was only 46.7% and that of girls – 57.2% (ibid).

2.5.2.2. Success rate in specific subjects and achievements

In 2000/1 girls received better grades in all subjects in all sectors (**Travelsi-Hadad, 1.6.2002**). In addition, a higher percentage of girls than boys excelled in the matriculation exams in all subjects, including mathematics, physics, and computer sciences (Statistics, Israel, 2000). For example: in 1998 41% of the females excelled in the 3-points level math exams in comparison to only 31% of the males; in the 4-points level 52% of the females in comparison to 42% of the males excelled, and in the 5-points level 55% of the females excelled in comparison to only 52% of the boys (**Mevarech, 2000**) This data demonstrates the main female problem in high school mathematics: many girls who could have taken high level mathematic courses prefer learning in a lower level class/group, and the way towards high prestigious, highly paid, and more interesting future occupations is much harder if not altogether blocked.

Of the 28 examinations subjects – compulsory and optional – the success rate of girls was higher than that of boys in 27, including all compulsory as well as scientific subjects (http://www.cbs.gov.il.shnaton53, **table 8.22**).

2.5.2.3. Participation rates in high-level math

In 2000 43% of 12^{th} graders that were entitled to a matriculation certificate who were successful in the 5-point math exam were girls both in the secular and the religious education. In the Arab education this percentage was 47 (**Statistics, Israel, 2001a**).

2.5.3. Israeli girls – Achievements in international studies of math and science

Though females' achievements in the matriculation exams were higher than these of males' (**Mevarech, 2000**), the male mean achievement was 569 while the female mean achievement was only 546 in the TIMSS 1995 international research (**Mullis et al., February 1998, table D.2).**

In 1995 only about 25% of Israelis holding of matriculation certificates that studied physics and computer science were girls **(ibid, table D.2)**. The percentage of females among students learning physics at the final year of secondary school was 22 (**ibid**.). In spite of the fact that girls' achievement at the matriculation physics exam was higher than that of boys', the mean achievement of males was 513 points and that of females only 482 in the 1995 TIMSS study **(ibid**).

2.5.4. Girls and the psychometric exams

Until the 2001/2 academic-year there was in Israel an equal value to the matriculation grades and to the psychometric results regarding acceptance to higher education. The gender gap in the mathematical part of the psychometrics, which counts for a third of the final grade (the other two parts are verbal abilities and English knowledge), has been about a half deviation standard for more than 20 years. At the +750 level there have been four times more boys than girls (**Suessapel, 1997**). As a result many girls were denied access to scientific and technological professions. This situation resembles the one in other counties **(e.g. Arnot, Gray, James, Rudduck, & Duveen, 1998; Gallagher, De-Lisi, Holst, McGillicuddy-De-Lisi, Morely, & Callahan, 2000)**.

2.5.5. Acceptance to universities: Rejection rates

In Israel a high percentage of university candidates are rejected, and many more do not apply to certain department knowing they do not meet the minimal demands. For example: in the year 1997 only 63.5% of those applied started their academic studies in the institute they had applied to **(Statistics, Israel, 1997, table 22.31)**. In 1999 rejection rate of university candidates was somewhat higher among males than among females: 23.1% of men and only 20.3% of women applying to first year studies of first degree were rejected (**Statistics, Israel, 2002b, table 8.36**).

However, most potential candidates whose average in the matriculation certificate and in the psychometric exams is lower than the minimum required for acceptance to a certain department do not apply. As the vast majority of female candidates apply for the humanities and social sciences departments, female participation in high status scientific subjects is low. An example that will demonstrate this situation is a numerical comparison between female undergraduate candidates and those accepted to the Technion – the Israeli Institute of Technology – in the year 2000 (**Alterman, 2000, table 9**). While in the more “female” areas, like biology and architecture the percentage of women accepted was similar to that of female candidates (e.g. in biology and medical science) or even exceeded it (in architecture); in the more “masculine” areas, like mathematics, mathematics and physics, civil engineering, and agricultural engineering, the percentage of females accepted was substantially lower than that of female candidates (**ibid**).

2.5.6. Higher education

In the year 2000/1 11.1% of the 20-29 year old females and only 7.7% of males studied in an Israeli university (http://www.cbs.gov.il.shnaton53, **table 8.12**). In addition, 5.2% of this female age group and 3.6% of males belonging to it studied in non-university higher education institutions (http://www.cbs.gov.il.shnaton53, **table 8.13**).

2.5.6.1. Females in the universities

Of the 1991/2-cohort year, the percent of those who began university studies within 6 years of finishing high school, namely, until the 1997/8 academic year was 30.1 among males and 38.7 among females. In the academic year 2000/1 females consisted of 57% percent of Israeli students (http://www.cbs.gov.il.shnaton53, **table 8.33**). Among first-degree students they were 56.5%; among masters student – 58.1% and among doctoral students – 52.1% (http://www.cbs.gov.il.shnaton53, **table 8.35**).

In the humanities women were the vast majority in all degrees: 72.1% of the total student population; 71.8% of first-degree students; 74.9% of second-degree students, and 61.8% of doctoral students. In social sciences 60.9% of the total student population were women, in the BA stage – 59.0%, among masters students – 58.1%, and among Ph.D. students – 58.1%. In natural sciences and mathematics – 42.9% of BSc students, 46.5% of MSc students, and 45.9% of PhD students. In medicine: 50.2% of first-degree students, 47.7% of masters’ students, and 64.4% of third degree students. In engineering and architecture: 24.9% of BSc students, 23.2% of masters’ students, and 26.6% of doctoral students (**ibid, ibid**).

2.5.6.2. Females in non-university institutions

While in the year 1990 only 197 students received degrees from institutions of higher education which were not one of the 6 Israeli universities or the Weizmann Institute, that number grew to 11,477 in the year 2000/1 (http://www.cbs.gov.il.shnaton53, **table 8.47**), 4,697 in teaching (ibid, ibid). In the Jewish sector the opportunity to get non-university higher education has been chosen mainly either by well-off young men and women, who were not accepted to a high prestige department at an Israeli university and were willing to pay three to five times higher tuition in order to become a lawyer or an accountant, or by girls from the periphery, mostly whose origin was Asian-African (e.g. **Klein, 15.3.2002**).

2.6. Summary

The Israeli education system consists of many different groups, each as its special characteristics. The process of enlarging or narrowing the circle of those who are successful in its different stages depends on many psychological, social, educational, and familial reasons. However, the way to success in all scientific as well as in other paths goes through the mathematics filter. Therefore an accurate situation of the situation regarding mathematics is offered in the next chapters.

Chapter 3:
Mathematics and Gender

3.1. Gender gaps in math and science: Historical view

In her survey, “About girls’ ‘difficulties’ in science: A social, not a personal, matter” **Jeffe (1995)** challenges the supposedly well-known fact, that females have been “historically” inferior to males in science and mathematics. According to her, throughout the 19th century more females than males graduated from high school, regardless of their social class. **Jeffe (ibid)** shows that women comprised between 44% and 47% of algebra students in the years 1890-1910, a high percentage even in terms of the 21st century. The data about female enrolment in physics during this period are even more surprising: “In 1890, women represented 58.5 percent of the public high school students enrolled in physics, dropping to 50.5 percent by 1910” (**ibid, p. 213**). These data evidently demonstrate, that it is not the nature of mathematics or physics that has prevented females from learning them, but rather social rules, conventions, restrictions, and limitations.

Not only does **Jeffe (ibid)** show that women were highly interested in mathematics and science during the 19th century, but also points at the link between the popularity of a discipline and female participation in it. Thus, in the middle of the 19th century science became a popular subject in girls’ schools in England, because it was considered important in the classical curriculum offered to middle-class boys. Being denied the opportunity to study Greek and Latin, science was the girls’ “default”. Nevertheless they did very well in it.

In spite of school achievements, in all creative, intellectual, and innovative areas females have had inferior achievements to those of males during all the time human history has been documented. For example: a study by **Cixous (1993**), who surveyed Nobel prize winners in a period of 50 years showed that out of 510 people who won the coveted prize, only 24 were female. **Kerr (1995**), **Koblitz-Hibner, 1993; Zorman & David (2000**), and **Zuckerman, Cole, & Bruer (1992**) bring examples of superior female accomplishments in all scientific, artistic, and humanistic areas, stating that women have always had the ability to accomplish at the highest possible level. **Zorman & David (2000**) offer historical, as well as psychological, sociological, familial, and cultural explanations for female inferiority in these areas.

According to them, female achievements have to be examined in the light of restrictions, traditions, religions, obligations, and stereotypes that inhibited female achievement in most human, spiritual and mental activities.

3.2. Gender gaps in mathematics and science: Across the world

3.2.1. Gender gaps in achievement

Girls surpass boys in elementary school grades, thus they have a better chance to be accepted to good high schools. Girls' grades in junior- and in high school and at the college level have been better than boys' since the mid-eighties both in Israel and in many other countries (e.g. **Eccles [Parsons], 1984; Eccles, 1985; Ziv, 1990)**.

Gender differences in achievement favoring boys were found among South African 9th graders (**Grobler, Grobler, & Esterhuyse, 2001**). Class size correlated negatively with achievement for boys but not for girls (ibid). The boys achieved a significantly higher mean mark than the girls. The corresponding effect size was 0.48 (ibid). A greater percentage of the variance in mathematics achievement was accounted for among boys (53.07%) than among girls (38.70%) (**ibid**).

In a comparative study of 1,487 11th graders from Leipzig and Senasi (**Randel, Stevenson, & Wirtuk 2000**) that among German students – more than among Japanese ones – boys obtained higher scores in the given mathematics test, we more likely to spend more time studying mathematics, and place more importance in going to college than girls did.

Eisenberg, Martin, & Fables (1996) have stated, that gender differences in math achievements have decreased, but many studies show that gender differences in math attitudes of American and European students still exist (e.g. **Castambis, 1994**).

Out of the 21 countries participating in the TIMSS 1995 study, significant gender differences in math and science literacy among 18-year olds were found in 20 **(Mullis et al., February 1998, table 1.3**). The largest gender difference was found in Norway, the second large – in the Czech Republic, the third – in Austria and Denmark, and the fourth – in Sweden.

It should also be noted, that among the 21 countries examined in the 1995 TIMSS study, the four where 100% of both male and female 12th graders participated in math classes were Cyprus, France, Hungary, and the Russian Federation **(ibid,**

table 4.3), three of which reporting the smallest gender differences in achievements. Among those reporting the largest gender differences in achievement, Denmark reported also of 31% female students and 12% male students not taking math in 12th grade; Norway – 37% females and 27% males, Austria – 25% females and 28% males, and Switzerland 37% females and 40% males in 12th grade not participating in math classes **(ibid, ibid**).

The European countries with minimal and also insignificant gender gaps in achievements among 12th graders taking advanced math were Greece, Cyprus, and Slovenia **(ibid, table 5.4**). The two European countries with the minimal gender differences achievements in math and science in the year 1995 were Hungary and Cyprus.

<u>3.2.2. Gender gaps in participation</u>

It is quite common nowadays that more females than males that graduate from high school. In Germany **Hosenfeld, Koeller, & Baumert (1999**) found that while 32% of the boys studying in the *Hauptschule*, the least demanding track that ends after grade 9 or 10, the percentage of girls in this school type was only 21. In the *Realschule*, which ends after grade 10, the percentage of boys is similar to that of girls: 27 vs. 30. 40% of the girls and only 30% of the boys study in the most prestigious school type: the *Gymnasium* – the university preparatory school. One of the results of this situation is the disappearance of gender differences in mathematics achievements. When exposed to a higher level of education females benefit from the high level of instruction and reach a higher achievement level. Another example is Italy: the percentage of male students learning physics in 12th grade was in the year 1995 51, while females consisted of 49% of this population (**Mullis et al, July 2000).**

In the TIMSS 1995 study Germany and Switzerland had the lowest female participation rate – 44% – in 12th grade math and science. In Switzerland females consisted of 46% of 12th graders studying advanced math.

As we know, dropping out of math results in not being able to take science. Thus, three out of the four countries with a 100% math participation in grade 12 had either all 12th graders take at least one science course (Cyprus and the Russian Federation), or a high percentage of 12th graders taking at least two science courses: Cyprus (97%); the Russian Federation (99%+), and Lithuania (81%) **(ibid, table 4.4**.). The countries with the largest gender differences in math participation had also the lowest male participation rate in science: in Norway – just 1% of 12^{th} graders took 3+ science courses; in Denmark only 3%, in Switzerland – 11%, and in the Netherlands – 13% (ibid, ibid).

Cyprus had also a remarkable female participation rate in math and science – 55%. The other European countries with a female participation rate of over 55% were: Lithuania (65%), the Russian Federation (62%), and Austria (61%) (**Mullis et al., February 1998, table 1.3**). However, these three countries were among the five with maximal gender gaps among 12^{th} graders taking advanced math. The other two countries were the Czech Republic and Switzerland**.**

To demonstrate the variety of gender math gaps around the world let us look at two more examples from the TIMSS 1995 and 1999 studies:

1. Thought in the Czech Republic gender difference in 8^{th} grade were similar to those in Israel, Czech females achieved higher than Israeli males (**ibid**, **Exhibit D.1)**;
2. Gender differences favoring boys are positively related to achievements decline; thus, in Israel and the Czech Republic who both suffered from a substantial decline in achievement from 1995 to 1999 (**ibid, table 1.13)**, significant gender differences developed during these four years. On the other hand, both Japan and Holland, where achievements were much higher than in Israel, succeeded in 1999 to eliminate the gender differences still existing in 1995 among 8^{th} graders. In Korea, who had the second best achievements in the world, the average achievement was similar to that of percentage 90 in Israel, and a small but significant gender difference was found – favoring girls!

3.3. Reasons for math gender differences

The literature dealing with didactics of mathematics, as well as that analyzing gender differences from sociological, psychological, and biological-genetic aspects has been looking for may years for the reason for gender differences both in participation and achievements in this subject (e.g. **Antell & Keating, 1983; Benbow, 1986, 1988; Dreyden, & Gallagher, 1989; Geschwind & Behan, 1982; Jensen, 1982; Jensen & McMullen, 1995, Kerr, 1995; Kolata, 1983; Lent, Brown, & Larkin, 1986; Lent,**

Lopez, Brown, & Gore, 1996; Low & Over, 1993; Lubinski, Benbow, 1992; Lubinski, Benbow, & Sanders, 1993; Mills, Ablard, & Stumpf, 1993; Nevo & Zorman, 1997; O'Boyle, Alexander, & Benbow, 1991; O'Boyle, & Benbow, (1990); Thomas, 1993; Witelson, 1985; Ziv, 1990; Zohar, 1995; Zorman, & David, 2000). Let us look at some theoretical and practical issues explaining both the reasons for this phenomenon and recent changes in its state of art.

3.3.1. The Theory of Limited Differences and mathematics gender differences

The conclusion most accepted at the beginning of the 21st century is that there is no "answer" to this question, but rather a combination of causes, each contributing its share. The Theory of Limited Differences **(Cole & Singer, 1992)**, originally applied for explaining gender differences in academic promotion, reveals that the large differences between male and female promotion tracks consist of the sum of small factors, the addition of which counts to a substantial difference. If we adopt this theory we can point at a long line of small differences, the sum of which contributes to both participation and achievement gender differences in mathematics. Let us explore these "small" factors, and examine their validity. In addition, whenever there is enough data, an inter-cultural examination will be made and thus supply us with a better scope of gender math differences.

3.3.2. The closing of the gender differences in mathematics

Let us look at the TIMSS 1995 results and compare them to those of 1999 regarding change tendencies in gender differences. In the year 1995, gender differences in math achievements among 8th graders were small, non-significant or non-existent in most countries (**Beaton, Mullis, Martin, Gonzales, Kelly, & Smith, 1997**). Only two European countries – among those taking part in the TIMSS 1995 international study – still had significant gender achievement differences in mathematics: the Czech Republic and The Netherlands **(Mullis, Martin, Fierros, Goldberg, & Stemler, July 2000, table 1.14**). In 1999 such gaps occurred only Israel, which became by that time a candidate country to the EU, and the Czech Republic.

In fact, while average math and science achievements in all other European examined countries either increased or remained at about the same level since 1995, both the Czech Republic and Israel suffered from a significant decrease in achievements (**Beaton et al, 1997; David, 2001, 2002a, 2002b)**. Of the 38 countries examined in the year 1999, significant gender differences in achievements among 14-year-olds reaching each country's own upper quarter were found only in Israel, Tunisia, and the US (**Mullis et al., December 2000, exhibit 1.12)**.

The disappearance of math and science gender differences in five European countries in 4-year period might serve as a confirmation of the assumption that these differences are not biologically or physiologically based. While significant gender differences were found in 18 out of the 38 examined countries in 1995, such differences were found only in 13 countries in 1999. Alas, the countries that contributed to the overall decrease in the gender differences were Hong Kong, which is a non-European country, where achievements of both boys and girls increased significantly from 1995 to 1999; Slovenia, where girls' achievements did not improve during these years, but boys' achievements decreased; and Israel, where both girls' and boys achievement' decreased substantially. In fact – in 1995 Israeli girls achieved better than Israeli boys did in 1999! **(Martin, Mullis, Gonzales, Gregory, Smith, Chrostowski, Garden, & O'Connor, December 2000, table 1.14).**

In the 1999 TIMSS study no significant gender differences were revealed among 8th graders in mathematics in China (**Mullis et al, December 2000, Exhibit 1.11**). In addition, China scored third among the 38 examined countries in mathematics achievements among 8th graders (**ibid**, **Exhibit 1**), its students that belong to percentile 95 scored first (**ibid, Exhibit D.1**), and its students belonging to percentile 75 scored second (**ibid**).

In Israel the situation had been quite different. A substantial decrease in math achievements was accompanied by gender differences in this subject. In 1963/4 Israel was the only country among the 12 participating in the International Study of Achievement in Mathematics where 14-year-old girls scored higher than boys (**Husen, 1967, vol. II, table 5.26**). In 1999 Israel was one of the four countries among the 38 studied where significant gender differences favoring boys were found – the other three countries were Tunisia, The Islamic Republic of Iran, and the Czech Republic (**Mullis et al., December 2000, Exhibit 1.11)**. The fact that the largest gender differences in math achievement were found in two Islamic fundamentalist countries might suggest a further study about correlations between political conditions in general and the status of women in particular and gender differences in various areas, including traditionally masculine studies like mathematics. The fact that the

Czech Republic shared the third place in gender differences with Israel has to be analyzed in the light of educational and political issues.

3.4. Math gender differences and Socialization

In many cases mathematically gifted girls are interested in other domains in addition to mathematics (**David**, **1996, 2000e**; **Lubinski & Benbow, 1992)**. As a result, there are highly talented girls who prefer to choose other domains rather than mathematics or science. For example, in **Ariel's (1990)** longitudinal study of graduates of the program for the gifted at the Technion – the Israeli Institute of Technology, it was found that when the graduates were in their late 20ies, 72% of the males and only 49% of the females chose to specialize in science and technology, although the groups were similar regarding their abilities, and the girls consisted of only 24% of the student population. There are girls who do not fulfill their mathematical potential – in spite of having excellent grades in mathematics because they do not dedicate their entire time and energy to mathematics **(David**, **1996, Zorman, 1996, 1998)**. Others refuse to bear the future double burden of being a mathematician or a scientist and a mother and wife, and seek for less demanding professions.

Socialization patterns are doubled edged regarding the level of achievements. On the one hand, socialization is important for achievement, as has been shown by **Matthews & Keating (1995**) in their study of achievement patterns and their dependence on gender stereotyping among gifted 6^{th}-8^{th} grades. **Fennema (1990, 1995**) found similar results in a study of unselected population. However, **Anderson & Tollefson (1991**) have found, that not only was there no difference in the satisfaction level of the parents of gifted children participating in a gifted program of the academic and social development level of their sons and heir daughter, but they used the same criteria for both genders when deciding about participation in such activities. **Abed-el-Kader Yichya (1995**) discovered a similar finding. She found that in the Arabic Israeli family gifted girls were granted special privileges and were encouraged to fulfill their potential.

Geary (1996a, 1996b) has suggested a gender differences in math achievement model that combines biological and socio-cultural influences. According to him, gender differences in spatial abilities influence achievements in some mathematical areas. Gender differences in social styles and interests, some of which are related to sexual selection, result in gender differences in engagement in mathematics-related activities, and they further increase the advantage in certain mathematical domains.

A research by **Raymond & Benbow (1986, 1989**) found a gender difference in parents' support of children with extra-ordinary high SAT-M or SAT-V scores. Fathers were more involved in quantitative areas, while mothers – in verbal ones. A meta-analysis by **Lytton & Rommey (1991**) on studies that examined this issue revealed the same results. As a conclusion the authors summarize that such socialization patterns might cause gender differences in math and science, though they could not fully explain gender differences at a very young age.

During childhood and particularly during adolescence social status is one of the most important components of the child's well being (**Fox, 1977**). A study by **Luftig & Nichols (1991**) has investigated peers' attitudes towards regular boys and regular girls, and gifted boys and gifted girls. The most popular group was gifted boys, while the least – gifted girls. Gifted girls were perceived as sad or moody, while gifted boys – as funny and humorous. Gifted girls were described as unfriendly, melancholic, and self-absorbed, and gifted boys – as less aggressive than regular boys, more attractive physically and more creative and honest. **Ablard (1997**) found that gifted 8th grade girls had an academic self-perception similar to that of boys, but unlike regular girls they had a lesser need of social support. These studies show that the social price that the gifted girl has to pay is quite high**.**

Hansen & Hall (1997) have analyzed the perceived relationships between marriages and achievement among 167 able women aged 45-65 who graduated from the University of Michigan. Women who perceived their husbands as supportive believed in their high potential. Women, who perceived their husbands as occasionally supportive, achieved highly occasionally. These women were more successful if they could confront their husbands and negotiate with them. The group of women with unsupportive husbands had a low achievement potential, as were women who had to work just for a financial gain. Such results might influence young girls who have to choose a career and a life style. It is extremely hard to "go" for mathematics and science; if the price is giving up their talents, it can be understandable why so many young girls will give up at an early age.

3.5. Math gender achievements and the type of the exam

In many cultures girls have received better grades than boys for many years both in schools exams and in external exams. On the other hand, in multiple-choice psychometric exams boys get usually better results. For example: in Israel boys score better than girls in the Szold examinations aimed to identify 2^{nd}, 3^{rd}, and 4^{th} grade children belonging to percentile 99 and percentile 97 of the population **(Polotzki, 1989; oral communication, 2000)**. The percentage of boys is higher than that of girls in all programs aimed for the gifted (**Zorman & David, 2000**). On the other hand, in the Arabic population there are no gender differences regarding acceptance to gifted programs, in spite of the fact that the giftedness examinations are an authorized translation to Arabic of the Hebrew examinations (**oral communication, 2002**). In the psychometric exams, which are a must in order to be accepted to most departments in most Israeli universities, males outperform females in the mathematical part both among Jews and Arabs (**Zeidner, 1987)**. This result is not a special characteristic of the highest achieving students, among which the male/female ration is three to one (**Suessapel, 1997**), but of the whole population of university candidates, where the average gender difference in the mathematical part of the exam aimed to filter the best candidates for the most prestigious university department is about 50 points (the maximum is 800).

For many years there was a broadly accepted assumption, that boys had an advantage over girls in multiple-choice questions exams. The explanation of this advantage was a gender difference in risk taking, namely, that boys liked to take risks more than girls, and thus answer even questions they were not sure of, which gave them an advantage over girls in an exam that rewarded guessing. In addition, the high level of perfectionism, assumed to characterize mainly girls, was perceived as disadvantaging when racing-against-time was rewarded. While boys have been found to make an effort to answer all questions, girls have been characterized by a high percentage of correct answers but a high percentage of unanswered questions as well.

The supposedly male advantage in multiple-choice questions exams arises many questions. For example: as has been explained, in the Szold Institute exams there is an advantage to boys. However, among Arabs there is about an equal percentage of girls and boys identified as gifted. Since the Arabic exam is a reliable, validated translation of the Hebrew one, how come that the identification for giftedness Szold exams favor only Jewish boys?

Let us examine gender differences found in three types of examinations.

3.5.1. Multiple-choice versus open ended exams

In studies held during the 80ies, boys outperformed girls in multiple-choice-questions formatted exams (**Bolger, 1984; Murphy, 1980, 1982**). In Israel **Birenbaum (1998)** has found, that not only females as a group had a preference to open exams, but also males who suffer from test anxiety preferred open exam.

However, **Beller & Gafni (1996),** who analyzed the 1988 and the 1991 TIMSS studies partial results have discovered, that while in 1988 girls tended to achieve higher in the open math questions, in 1991 they achieved higher in the multiple-choice questions. The researchers explained this difference by stating, that the format of the exam per se was not the cause of the gender differences in the results, but rather, the difficulty of the items made the difference. Boys tended to guess a little more than girls, but the main effect had to do with the difficulty level: while girls tended to answer mainly the easy questions, boys tended to answer all questions. Their study of the 1995 TIMSS results (**ibid, 2000**) confirmed the conclusions f their previous (**ibid, 1996**) research.

Willingham & Cole (1997) found a similar result. In their research the finding that females preferred open tests was not consistent; the format of the test did not cause the gender differences in the results. The subject matter had a high correlation to the gender preference of open- vsersus multiple-choice exams. Girls had an advantage over boys in open tests in science and geography, while in math, language, and literature the effects size was only rarely influenced by the exam's format.

3.5.2. Exams requiring higher versus lower order cognitive skills

Zoller & Ben-Chaim (1990) discovered, that college female students scored higher than male students on higher order cognitive skills science exams. Since most multiple-choice exams do not require higher order cognitive skills, it can be concluded that females usually prefer open-ended exams.

3.5.3. Written versus oral exams

Ben-Chaim & Zoller (1997) have found, that secondary school students prefer written examinations with unlimited time, which focus on deep- rather than mechanical rote learning. Gender differences regarding the preference of the examination exact type were found: 10th grade female students preferred written examinations, when time was unlimited.

3.6. Math gender differences, risk-taking and perfectionism

Perfectionism is a double-edged characteristic. One needs to be a perfectionist in order to reach a high level of creative work. On the other hand – perfectionism is perceived as "unhealthy" when interfering with normal activities and causing psychological problems. **Baker (1996**) has found that high ability females are more perfectionist than average males and females. It was also found, that among 9th graders the percentage of perfectionist girls was higher than that of perfectionist boys (**Bellamy, 1993**). However, in a research examining gender differences in the perfectionism level among gifted middle school students (**Siegle & Schuler, 2000)**, although gifted and talented girls expressed more concern than males about organization, and their concern about making mistakes increased from grade 6 to 8, no gender differences were found in the level of unhealthy perfectionism.

Polotzki (1989) found in the Szold Institute giftedness examinations of elementary school children that boys tended to take risk more than girls. Martin (1985) had the same results in her study of adolescent Israelis. **Suessapel (1997)** suggested that gender differences in risk taking influenced the low percentage of girls scoring in percentile 95 of the Israeli psychometric examinations, taken by high school graduates who intend to start their higher education. **Silverman (1991)** found that 8-9 year-old American girls tended to minimize risk-taking thus damage their prospects to be accepted to gifted programs.

3.7. Math gender differences and age

Gender math differences achievements at all levels of educational grades and institutions are a problem common to many countries. However, there is a high variance not only of the size of these differences but also of the age when these differences first appear. The literature dealing with such differences focuses especially on age 12: At this age girls' achievements start deteriorate and fall behind boys'. This tendency continues until the age of 17-18.

3.7.1. In Israel

Gender differences in math achievements were observed in Israel as early as in grade 4 among Jewish Israelis in the TIMSS 1995 (**Mullis et al., July 2000**). In the year 1998 an Israeli research studied achievement and science gender differences among 4^{th} grade children (**Aviram, Kfir, & Ben-Simon, 1998**) in both Jewish and Arabic sectors. In all 7 scientific subjects examined, both in the Jewish general and the religious sectors, boys outperformed girls, 6 of these differences were significant. These gaps – at such an early stage of the educational path – point at mathematics gender gaps that start at an early than the average stage of studies.

In the Israel International assessment of Educational Progress in Mathematics and Science **Beller & Gafni (1996)** showed that Israel scored second out of 19 countries examined regarding gender differences in math among 4^{th} graders. This result has shown, that social, educational, political, or psychological changes might cause a backlash in girls' achievements. On the other hand, in Israel girls were in 2001 more successful than boys in 26 of the 27 subjects of the matriculation exams (**Eshet, 13.12.2002**). That included not only mathematics, but also all mathematically dependent subjects: physics, computer science, chemistry, and biology.

3.7.2. In the world

Data from the TIMSS international studies have shown, that age per se cannot predict math gender differences. In the 1995 TIMSS research math gender differences among 4^{th} graders were discovered in but 3 of the 26 countries studied **(Movshovitz-Hadar, 1998; Mullis, Martin, Beaton, Gonzales, Kelly, & Smith, June 1997; Patekin, 1999)**. One of these countries was Israel.

In most countries examined in 1995 gender math differences were found among 8 graders (**Mullis et al, June 1997)**. The results of the second international math study **(Travers & Westbury, 1989; Westbury, Ethington, & Sosniak, 1994)**, held among 19 countries (the first part – 1980-1982), and 27 countries (the second – 1984-6) already demonstrate that the hypothesis, according to which higher selectivity of the population results in larger math gender differences is quite problematic. Israel, who within 20 years deteriorated from the top of the ladder to its middle regarding math achievements both among 8th and 12th graders, also developed gender differences favoring boys among these populations. The substantial gender differences among 12th graders studying math at the highest possible level was accompanied by the smallest percentage of 12th graders – among all 16 countries participating – taking math at this level (**Travers & Westbury**, **1989**), and the highest rate of failure among the examined countries (**Holmes, 1983).**

3.8. Math gender differences and selectivity of the population

Fox (1976), Fox, Benbow, & Perkins (1983), and **Stanley, Keating, & Fox, (1974)** have found, that among the gifted gender differences favoring boys become larger when the level of giftedness becomes higher. In a research based on a national sample of 8th-12th graders, **Fan (1995)** has found, that gender differences became wider as achievements increased, and also between 8th and 12th grade. A similar finding was found in Germany regarding the female participation rates in math and physics: in the year 1995, the number of boys studying mathematics in grades 12 and 13 of the *Gymnasium* was twice as high as that of girls' (**Ziegler & Heller, 2000**). If we take into account that about 40% of the girls but only about 30% of boys aged 18-19 study in a *Gymnasium* **(Hosenfeld, Koeller, & Baumert, 1999**), the gender difference in Germany in participation is even larger. In the same year gender differences in participating both in mathematics and physics was even larger: while 37.5% of the boys studied these subjects, only 12.5% of the girls did (**Ziegler, Kuhn, & Heller, 1998)**.

In a more selective population, that of participants in Australian championships in mathematics until the year 1995, the percentage of boys increased with age **(Leder & Taylor, 1995**). **Undheim, Nordvick, Gustafsson, & Undheim (1995)** have found in a research among high ability Norwegian 16-year-olds that boys outperformed girls in math achievements. The research done for over 30 years by Benbow, Stanley, and their colleagues (**Benbow, 1986, 1988, 1992; Benbow, & Lubinski 1993, 1996; Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Benbow, Lubinski, & Hyde, 1997; Benbow & Stanely, 1980, 1981, 1983, 1988; Benbow, Stanely, Arjmand & Walberg, 1991; Benbow, & Wolins, 1996; Stanley, 1988, 1994; Stanley & Benbow, 1986; Stanley, Keating, & Fox, 1974; Stanley &**

Stumpf, 1997) as well as others **(e.g. Mills, Ablard, & Stumpf, 1993)** among high ability students showed, that gender math differences favoring boys became larger as the population becomes more selective: while there is a small gender difference in math, this gap becomes larger among high ability students. In addition, gender math differences among high ability students can be expected, as was shown by **David (1999b**), at an earlier stage of studies.

More recent works show a change of direction in these findings. A research by **Duffy, Gunther, & Walters (1997**), done among 159 12-year-old boys and girls revealed gender differences among the 10 upper percent of these children only in one subject, while in many other subjects the girls in the upper 10% outperformed boys, though not significantly. In a research by **Byrnes, Li, & Shayong (1997)**, Chinese 17-year-old students were examined in the SAT-M items in which the largest gender achievement differences were found in the US. No gender differences were found among them, in spite of the fact that their achievements were significantly higher than those of the American youngsters in all items.

3.9. Math gender differences and math anxiety

Gender differences in math anxiety are one of the explanations to gender differences in math achievements. Until recently, research findings showed that girls suffered from math anxiety more than boys, both in Israel and abroad **(Ben-Zur & Zeidner, 1988; Carr, 1996; Cramer, 1989; Hyde, 1993**; **Lupkowski & Schumaker, 1991**; **Zeidner, 1996a, 1996b). Osborne (2001)** has found, that in a nationally representative sample of high school seniors, anxiety partially explained gender differences in math achievements. **Pajares & Graham (1999**) have found no gender differences in anxiety among 6^{th} grades. A study by **Zohar (1998)** has demonstrated that success was correlated negatively to test anxiety.

Test anxiety is highly related to the level of study; namely, high-level students were less test-anxious than regular students. This was found both in Israel, where candidates to the university who scored low in anxiety test taken place before the psychometric exams scored higher in the tests (ibid), and abroad. **Lupkowski & Schumacker (1991)** showed, that talented students were less math-anxious than most unselected college students.

Cooper & Robinson (1991) have found, that math anxiety was negatively correlated to math performance among male and female students selecting mathematics-based college majors.

However, more recent studies have found no significant gender differences in math anxiety. A research by **Vlahovic-Stetic, Vidovic, & Arambasic (1999)**, held among 9-10-year-old Bulgarians revealed no gender differences in the level of math anxiety among high achieving gifted students. Even when there is such a difference exist it does not necessarily influence the achievement level. For example, **Nasser, Takahashi, & Benson (1997)**, that was held among 421 15-16 years olds studying in Arabic Israeli schools has revealed that girls expressed a higher level of anxiety before math tests, they worries more than boys, and they complained more of psychosomatic symptoms. In spite of all these findings there were no gender differences in stress at the actual time of the exam, and in the amount of irrelevant thoughts during it. **Lafferty's (1996)** study that was held in Philadelphia among 454 6^{th} graders has shown similar results: girls suffered from a somewhat higher level of math anxiety, but there were no gender differences in the achievement levels. **Pajares & Graham (1999)** have found no gender differences in math anxiety among 6^{th} grade students. On the other hand, a higher level of statistics anxiety was observed among first year psychology females than among males, but this gender difference had no influence on the overall performance (**Bradley & Wygant, 1998)**. A similar result was found in the top third of a college-bound sample (**Casey, Nuttall, & Pezaris, 1997)**: math anxiety did not influence the SAT-M score.

In addition, math anxiety is not always connected directly to the studied subject; it might as well have to do with the leaning and social conditions under which this subject is studied. **Newstead (1998)** has found, that children between the ages 9 and 11 already reported a significant level of anxiety about the social, public aspects of doing mathematics in the presence of their peers and teachers in the classroom. This finding might lead to an assumption, that when neutralizing the social aspects of doing mathematics, as done, at least partially, in single-sex settings – math anxiety will not be a "females' thing" any more.

We can conclude that math anxiety is not a main factor that might explain gender differences in math achievement. Had it been the case, girls – both in Israel and in many other countries – would not have performed better than boys in all class exams, and in Israel in almost all the matriculation exams, including math and subjects that are mathematics-dependent.

3.10. Math gender differences in believability in own abilities or self-concept

Stipek & Gralinski (1991) have found, that there are gender differences regarding believability in own math abilities among children as young as in grade 3 (**ibid, 1996**): girls rated their own abilities more negatively than boys. **Lent et al (1996)** have found latent gender differences in mathematics self-efficacy among high school students.

Lucock (1987) has found, that high-ability boys tended to keep a fairly constant level of believability in their abilities in spite of failure, while low-ability girls tended to keep a fairly low level of believability in their own abilities in spite of success. However, the question of whether this tendency is valid also for average ability boys and girls, for low ability boys and for high ability girls needs further research. Without getting into the reasons why a certain sub-population holds a lower or higher level of believability in on math ability, we shall refer here only to differences in the magnitude of this believability.

Scott (2000) has studied the question, how come that in spite of the fact that females receive higher grades in schoolwork they have inferior achievements in problem solving and reasoning tests. The researcher has hypothesized, that believability in own math abilities, which has a substantial influence on achievements, accounts for males' and females' opposite outcomes through their differential effect on performance and preparation effort. While according to **Scott** (ibid), mathematically confident students would invest more effort in problem solving and reasoning tests, and thus receive higher grades, they would invest less effort in preparations and homework, assuming their high ability might compensate for the lack of effort. With students who perceive themselves as less able the situation would be reversed: they would study harder in order to compensate for their low ability. However, **Scott (ibid**) has assumed that only less able female students will adopt this behavior, while less able males would drop mathematics if possible and if not – give up on the hope of achieving highly. In studying a sample of 318 high school students it was found that believability of own math ability proved to be the strongest predictor of problem solving; it had more influence than any other educational or psychological component examined. However, gender differences were found, as expected, namely, confidence in math abilities influenced girls' scores more than boys. In a study of remedial college mathematics course (**Stage, & Kloosterman, 1995**) a similar result was found: beliefs about mathematics ability were significantly related to final course grade only for females.

In a study of 186 8th grade students **Seegers, & Boekaerts (1996)** found gender differences in mathematical self-concept, that were correlated to mathematics test achievements. Believability in own math abilities has also proved to be positively correlated to math performance among male and female students selecting mathematics-based college majors (**Cooper & Robinson, 1991)**. Let us see how confidence in math abilities influences achievements on large samples examined in international studies.

3.10.1. Believability in own math abilities and the TIMSS results

The 1999 TIMSS study has shown, that there are gender differences both in Israel and in many other countries examined in mathematics self confidence **(Mullis et al., December, 2000)**. However, there is no correlation between the actual gender achievements differences in each country – or even between the existence of such differences – and the gender differences in mathematics self confidence.

In the 1999 TIMSS study, no significant differences in math self confidence were found in Israel among 14-year-olds with high, average, or low achievements (**ibid, table 4.9)**. Among high achieving students gender differences favoring boys were found in 10 countries; among average achievers gender differences favoring girls were found in 9 countries, and only in Morocco these differences favored boys; among low achievers – in 4 countries gender differences favored girls, and in Thailand – boys. Do these differences reflect anything but accurate self-perception? It seems that no, when we check the actual female achievements in all these groups. Israel, for example, scores no. 9 among the 43 examined countries in math self-perception, but only 28 in actual achievements (**ibid, table 4.8**). The children that scored 1-8 in math self-perception had all higher achievements than Israel. Furthermore, Singapore, who scored the first in the world in achievements, scored 28 in math self-perception. Hong Kong, no. 4 in the world regarding achievements, was no. 29 regarding math self-perception. China, no. 3 regarding achievements, was no. 30 regarding math self-perception, and Japan, no. 5 regarding achievements, was no.

39 regarding math self-perception, with only Morocco, Indonesia, the Philippines, and Thailand behind it! Thus we can see, that in Israel math self-perception of both boys and girls was substantially exaggerated. **Movshovitz-Hadar (1997**) has already suggested after the TIMSS 1995 results were published that the unrealistically high math self-esteem of Israeli students might be one of the reasons that they do not study enough mathematics, and thus helps the deterioration of the math level among boys as among girls.

Brew, Pfarn, **Leder & Bishop (1996)** have found, that even girls who were successful in mathematics had a low confidence in their abilities. **Malpass (1996)** has studied a sample of mathematically gifted high school students in southern California and found that boys had higher self-efficacy than girls. These findings should be examined in the light of the low level of participation rate in high-level mathematics on the one side, and the high achievements of the girls who did choose mathematics on the other. Interviews with world famous mathematicians (**David, 2000f, 2000g; Zorman & David, 2000)** reveal that many talented women had once been girls who did not believe in having supreme math abilities, but their realistic self-concept led them to invest maximal effort and thus achieve at the highest possible level.

3.10.2. The double-edgedness of believability in own math abilities

In the TIMSS 1999 science study the percentage of boys with high self-concept was significantly higher than that of girls in Finland, Hungary, and Latvia **(David, 2001a**). In no country was the self-concept of girls higher than that of boys'. However, as already stated, in Israel more girls than boys studied chemistry at thigh school, more girls took the matriculation exams, the success percentage of girls was higher than that of boys and girls got higher grades than boys. Taking these results into consideration, a clear distinction should be made between realistic believability in own math abilities and too optimistic such perception. In a German-Japanese study of 1,487 11th grade students from Leipzig and Sendai **(Randel, Stevenson, & Witruk, 2000),** large differences were found between students from these two countries in students' performance. One of the main reasons for the German students lesser achievement was their being less critical of themselves and their academic abilities. We can thus conclude that believability in own math abilities is a double-edged characteristic: when estimated correctly it can be used for enhancing learning in general and mathematics in particular, but it can also be misused, as has been the case in the Israeli TIMSS 1999 results for 8th graders **(David, 2001a**), or with German 11th graders as has been shown by **Randel et al (2000).**

Girls have been found, on the one hand, to be more vulnerable than boys to decrease in their believability in on math abilities, but on the other hand, there are remedies to this vulnerability. For example: **Kelly (2001**) has found, that among high school American students, girls scored lower than boys in confidence in the ability to learn mathematics when the dominating learning style was recitation. In classrooms dominated by more student-centered discussions both boys and girls had stronger confidence in their ability to learn mathematics.

3.11. Math gender differences and the TIMSS results

The data from the IES and TIMSS – the Third International Mathematics and Science study challenge the theories of increased gender differences with both selectivity of the population and age.

The substantial 1995 deterioration among 8th and 12th graders was accompanied by the opening of severe gender differences not only among 12th graders regarding participation at the highest possible math level, but among 4th graders regarding actual achievements (**Martin, Mullis, Beaton, Gonzales, Kelly, & Smith, June 1997)**. In 1995 the percentage of girls participating at the highest level math studies in grade 12 was only 42; even Germany and Switzerland, the "traditionally" masculine countries, outperformed Israel in this aspect: in these two countries 44% of 12th graders participating in the highest level math studies were girls **(Mullis et al, February 1998**).

The minimal gender differences in math achievements existing in Korea seriously challenge the theory of the high correlation between gender differences and the selectivity of the population. In 1999 Korea scored no. 2 in math achievements among the 38 participating countries. In spite of that, Korea was the only country where 8th grade girls outperformed boys in math achievements (**Mullis et al, December 2000).**

These results demonstrate, that raising the level of mathematical knowledge positively correlated to closing gaps in gender gaps in mathematics.

3.12. Summary

Gender differences in math achievements have been explained, throughout the years, by physiological-genetic, societal-familial, or psychological factors **(Zorman & David, 2000).** Research does not focus any longer on physiological-genetic directions, because in spite of the huge effort done for years there has been no breakthrough in this direction (**Benbow, 1986**; **Geschwind, 1984; Geschwind & Behan, 1982; Jensen, 1982; Kolata, 1983**; **O'Boyle, Alexander, & Benbow, 1991; O'Boyle & Benbow, 1990; Peters, 1991; Thomas, 1993; Wiley & Goldstein, 1991; Witelson 1985; Ziv, 1999; Zohar, 1995)**.

It seems that research about math gender differences should focus on the societal-familial and the psychological factors that contribute to gender differences in math achievement. Therefore the next chapter will analyze the existing research about societal-familial gender differences, with a special view on the different cultures within Israel that might contribute to gender differences both in participation and achievement in mathematics. Chapter 5 will discuss the contribution of single-sex settings to the learning of mathematics. Chapter 6 will concentrate on the psychological literature dealing with motivation, self-esteem, self-concept, the different orientations towards acquiring of knowledge, and their potential influence on math gender differences.

It is hard to change social-familial components. If, for example, it is possible to educate females towards high achievements in math and science, it is much harder to fight against a tradition of marrying girls at a young age and not allowing them to go to school after marriage. Thus, unless a wide social change is taking place any trial to decrease gender differences in participating in high level math and science classes will have but a limited success.

However, the psychology of teaching mathematics might help increasing both participation and achievements of females in mathematics and science. Some research has already been done in this area in different cultures, and this study is an additional trial to build a wider participation in the professional, social, and economical modern life.

Chapter 4:
Mathematics learning in two Israeli minorities: Muslim and religious Jewish girls

4.1. Introduction: Why Muslim and religious Jewish girls?

A study that will compare the actual mathematics achievements as well as the level of math aspirations, intentions for higher math education, math self esteem, motivation concerning math learning, and influence of peers, teachers, and parents on math learning would be a most interesting and help to reach a higher participation rate of girls in high level mathematics. In the Jewish sector females consist close to a half of the students until grade 12, when they become the majority (http://www.cbs.gov.il.shnaton53 **table 8.19**). Arabs, on the other hand, consist of 22.7% of school students in Israel (http://www.cbs.gov.il.shnaton53 **table 8.14**). However, these data does not reflect what happens in the different educational stages: in grade 1 29% of the Israeli students are Arabs (**ibid, ibid**); in grade 12 – only 16% (**ibid, ibid**). Do these numbers give an exact picture of female versus male participation in the different stages of education? We already know, that unlike in the Jewish sector, girls are the majority of students from grade 10 on (http://www.cbs.gov.il.shnaton53 **table 8.19**). Does this demographic change in the school population influence the learning in general and the learning of mathematics and science in particular?

In the school year 2001/2 state religious students consisted of about 19% of the students in the Jewish education system and about 18% of junior and high school students (http://www.cbs.gov.il.shnaton53 **table 5.15**). This large minority should also be discussed later.

4.1.1. Why Muslim girls?

Arabs consist of almost 20% of the Israeli population (e.g. **Abu-Saad, 1999; Greenstein, 16.4.2002**); Muslims are the vast majority of Arabs – about 80% (http://www.cbs.gov.il.shnaton51). The Israeli educational system is segregated by religion (**Chen, 1992; Birenbaum, 1998**), namely, no Jewish students learn in Arabic schools. Thus, the "natural" choice of learning about motivation, achievements, and psychological components influencing both achievements and choice of learning mathematics among Muslims in Israel would be doing a study of Muslims in general and Muslim girls in particular in a Muslim village where all students belong to the same religion. Such a study, that will give an updated picture about issues as the level of math anxiety among Muslims – boys and girls – in comparison both to Jews and between them by gender, will enable to understand interesting phenomena. For example: how come the percentage of Arabic girls learning physics in double as that of Jews (**Statistiscs, Israel, 2000**), or how is it possible that the percentage of Arabic women in the labor market has been only 22 in 2001 (**Makover, 27.12.2002**).

4.1.2. Why Jewish religious girls?

Religious education in Israel in divided into two main parts: state religious and Ultra-Orthodox schools. Each of these groups consists of about 20% of the Jewish population (http://www.cbs.gov.il.shnaton53), but they are very much distinct from each other. Most students in Ultra-Orthodox schools learn a very limited number of general subjects; in addition in most boys' schools only religious subjects are taught after age 13. The state religious school, on the other hand, has the same general program as the regular, secular one, namely, all subjects that are taught in the general school are offered both to males and females in religious institutes. Thus, leaning about this sector in general and about females belonging to it in particular might help understand better a large part of the human reservoir of Israel. Since all state religious schools are either single-sex or consist solely of single-sex classes, studying the achievements, motivational orientations, and aspirations of religious girls might help improve the general sector, where the percentage of girls participation in science is lower than in the religious sector. Studying the Jewish religious sector might help the Arab sector as well, since there are many common characteristics to these two sectors, such as the role of tradition in general and females' roles in particular (e.g. **Abu-Saad, 1999; Al-Haj, 1995; Mari, 1978**).

4.2. Muslim girls

The situation in the Arab education regarding female achievements in the matriculation exams is similar to the Jewish one, namely, a higher percentage of girls takes the matriculation exams, a higher percentage is entitled to the matriculation certificated, the average females' grades are higher than males' grades, and the percentage of girls excelling in the matriculation exams is higher than among boys. In 2000 girls surpassed boys in entitlement to certificates among matriculation examinees in all scientific subjects, mathematics and computers, as well as in all compulsory languages: Arabic, English, and Hebrew (**Statistics, Israel, 2002a, table 8.22).**

Let us survey the research regarding the Arabic population in Israel in general and gender math gaps in this population in particular.

4.2.1. 14-year-olds

Mittelberg & Lev-Ari (1999) summarize the results of a research done among 106 male and female Jewish 8th grade students and 105 Arabic students in four Jewish and two mixed schools. Five measures were studied: Future expectations regarding use of mathematics; 2. Self-perceptions of math achievements; 3. Math self-confidence; 4. Teachers-students relationships regarding math; 5. Factors that explain future use of mathematics. The results showed an advantage to the Arabic students in all 5 factors.

1. Only 8% of the Jewish girls, in comparison to 32% of the Jewish boys, expected to use math in the future. Among Arabs there were no gender differences – both males and females were higher than the Jewish males in this factor.
2. Perceived achievement in mathematics. While the mean score of Jewish boys was much higher than that of Jewish girls, among Arabs the situation was reversed: the mean score of girls evaluating their achievements as excellent was slightly higher than that of boys, though the difference was insignificant. The difference between Arabic and Jewish girls regarding perceived achievement in math was significant.
3. Gender differences in math self-confidence. Low rates of self-confidence characterized mainly Jewish girls. This finding resembles the one by **Meyer & Kohler (1990**) who found higher self-confidence among males than among females regarding the ability to study math. Jewish boys scored close to Arabic boys and Arabic girls in math self-confidence **(Mittelberg & Lev-Ari, 1999**). Arabic boys were not significantly different in math self-confidence from Arabic girls, as was found in the Jewish population. Another noticeable different between these four groups was the low variance among Jewish girls in comparison to a higher variance in all other groups. **Abu-Saad (1999**)

examined the level of global self-esteem of Arab adolescents in Israel and its relation to perceived academic status and aspirations, interpersonal relationships, community type, and various demographic variables among 1,560 11^{th}- and 12^{th} grade Israeli-Arab adolescents. No gender differences were found. According to **Karp & Shakeshaft (1997)**, the level of math confidence is highly related to acquiring higher education in math or math-related subjects. Thus, the homogeneous low-rate of math self-confidence among Jewish girls does not predict a change in the tendency of Jewish girls towards higher participation in scientific and technological subjects, while in the Arabic sector there is potential for it.

4. Relationships between math teachers and students. In the **Mittelberg & Lev-Ari (1999**) research, Jewish boys reported getting more attention from their teachers than Jewish girls. This finding is in accordance with the one found by **Avrahami-Einat (1989, 1998**). Jewish boys reported also receiving more help from their teachers than the girls did (**Mittelberg & Lev-Ari, 1999**). This finding was in according with the one by **Karp & Shakeshaft (1997**), who reported that teachers were giving boys more information about problem solving than they gave girls. However, in the Arab sector girls in particular perceived their teachers as more supportive. In addition, the variance regarding teacher support was smaller in the Arabic sector than in the Jewish one, meaning that male and female Arabic students shared the opinion that their male and female teacher were more supportive than Jewish teachers when it came to mathematical learning.
5. Factors explaining expectations of use of mathematics in the future. In the Jewish sector gender was the main factor explaining the variance in the expectations; girls declared of tendency towards less use of mathematics in the future when compared with boys. Among Arabs gender was not significant in explaining the variance in expectations **(Mittelberg & Lev-Ari, 1999).** Thus, it should be expected that no gender differences in valuing mathematics would be observed among Muslims in my sample.

4.2.2. 17-18-year-olds

Arabic Israeli girls are indeed a large unused human potential. In spite of the increasing tendency during the 90ies towards religion and tradition in the Arab sector, especially among Muslims, girls in this sector benefit from a comparatively high level of freedom regarding their educational advancement (**Mittelberg & Lev-Ari, 1999; David, 2000c, 2002b**). The main reasons for granting such a freedom are:

1. The high professional level of the Arabic teacher (**Abu-Saad & Hendrix, 1993, 1995);**

2. The mission feeling of the Arabic teacher as an agent of advancing Arabic youngsters in general and females in particular;

3. The high value of education in the Arabic sector in general and for talented boys and girls in particular (**Abed-el-Kader Yichya, 1995**);

4. The perception of math and science as gender-neutral professions **(Ayalon, 2000**);

5. The willingness of many young Arabic males to marry females with a higher educational level (**David, 2000d, 2001b, 2002a**);

6. As the employment level among Arabic females is very low (**Al-Haj**, **1995; Semyonov, Lewin-Epstein, & Brahm, 1998, 1999)**, in most cases highly educated girls are not perceived as a threat to Arabic males.

Let us see how these factors influence participation and success rates in high school, and eventually in the matriculation exams – the "entrance ticket" to higher education.

<u>4.2.2.1. Gender differences in participation</u>

In the Arab sector the situation regarding participation of girls in high-level math in comparison to the 50ies and 60ies can be defined as a revolution. In the year 1998 over half of the 11,500 12th graders in the Arab sector came from families where the parents completed up to 8 years of schooling (**Statistics, Israel, 2002a, table K)**, in comparison to only 12% of 12th graders in the Jewish sector with such a low level of parents education **(ibid. table J)**. In addition, while in the Jewish sector about 20% of the fathers and 15% of the mothers had 16+ years of schooling (ibid, ibid), in the Arab sector only 4% of the fathers and less than 1% of the mothers had this level of education **(ibid, table K)**. The higher the number of father's and mother's years of schooling, the higher the rates of pupils enrolled in the general track, where the probability of being examined in the matriculation exams and being entitled to certificate is higher (**ibid, ibid)**. A comparison between the rates of higher education among Arab females who were the mothers of the 12th graders of 1998 of those of 2001 will demonstrate, that Arab females have indeed been the main benefactors of the increased level of higher education among Arabs. In the 2000/1 school year 52.3% of the Arab boys in comparison to 64.4% of the girls taking the matriculation exams were entitled to a certificate (http://www.cbs.gov.il.shnaton53, **table 8.21**). 23.8% of Arab males in comparison to 25.2% of females who finished high school in 1989/1990 began university studies within 6 years (http://www.cbs.gov.il.shnaton53, **table 8.26**).

Closing gender gaps in participation of Arabic girls in math and science has been a gradual process that could be observed since the late 80ies. **Ayalon (2000)** presents in her study data relevant for the years 1983-1987 **(Statistics, Israel, 1989)** that shows, that the Arab sector had been the first in Israel to minimize gender gaps regarding the level of mathematics and science studied by students. During the 80ies the gender gap in the Arab sector was much smaller than in the Jewish sector. Both participation of girls and the level of studying in the Arabic sector were close to that of the boys.

High participation in mathematics courses among Arabic girls during the 80ies was connected to a limited variety of subjects in the humanities, social sciences or languages offered to them (**Ayalon, 2000**). Participation in high-level math has always been a condition to participation in science. Thus, high participation of Arabic girls in high-level mathematics resulted in taking more scientific courses than in the Jewish sector.

Ayalon (ibid) explains the perception of math and science as gender neutral in the Arab sector by stating, as **Mittelberg and Le-Ari** (**1999**), that since female participation in the labor market is low among female Arabs, knowledge of math and science in not perceived as threatening by Arabic males.

The gender differences picture in the Arabic Israeli sector resembles that of the Jewish one. In the year 1998 the percentage of boys succeeding in the 5-points matriculation exams among those entitled to the matriculation certificate was somewhat more than 23, while among girls it was about 14.5% – both significantly higher than in the Jewish sector, albeit only by less than one percent (**David, 2000c**).

4.2.2.2. Gender differences in entitlement to matriculation certificate

1. In the year 2001 females were the majority of matriculation certificate holders: 30% more girls than boys took the matriculation examinations; the rate of female success was 64.4% in comparison to 52.3% male success (http://www.cbs.gov.il.shnaton53, **table 8.21**). As a result, 4,216 Arabic girls but only 2,661 boys were entitled to the matriculation certificate **(ibid, ibid**);
2. In all compulsory subjects, as well as in all scientific subjects except for agriculture the percentage of girls entitled to certifications among matriculation examinees in enhance (4+-point) subjects was higher than that of boys' (http://www.cbs.gov.il.shnaton53, **table 8.22)**;
3. While among Jews only 6% of the girls that took the matriculation exams studied physics at the highest possible level in the year 1998, among female Arabs that percentage was 12% (**Statistics, Israel, 2000**);
4. 21.6% of Arabic girls and only 19.5% of boys were examined in 2000 in two scientific and two humanistic subjects at the highest possible level (http://www.cbs.gov.il.shnaton53, **table 8.24)**;
5. More girls than boys took the chemistry matriculation exam – 582 vs. 500; the success-rate among girls was higher than among boys, thus 512 girls but only 435 boys succeeded in this exam. In total 54% of matriculation certificate holders who were examined at the highest possible level in chemistry were girls – the same percentage as in the Jewish secular educational system **Statistics, Israel, 2000**);
6. The percentage of Arabic girls who succeeded in the 5-point math matriculation exam was 47, while in the Jewish sector this percentage was only 43 (**David, 2000d)**;
7. Success-rates in all 5-point level subjects were higher among females. For example: In mathematics: 85% for males, 94% for females; In physics: 89% for males, 93% for females; In chemistry: 82% for males, 86% for females; In biology: 74% for males, 83% for females; In computers: 83% for males, 94% for females; In Hebrew: 59% for males, 66% for females; In English: 72% for males, 76% for females; In Arabic: 52% for males, 61% for females (**Statistics, 2002a, table 8.22**);

8. In 1998 777 girls and only 669 boys were successful in the math matriculation exam at the 4-point math exam **(Statistics, Israel, 2000, table 22.23)**. Since in all Israeli universities there is no requirement from any department but one to be examined in the 5-points level, in the year 1998 almost 55% of the students meeting the requirement of a 4-point mathematics matriculation exam were females;
9. At the 3-point level only 867 boys in comparison to 1,673 girls were successful in the matriculation math exam in 1998 (**ibid**).

4.2.2.3. Gender differences in achievements

In the Arabic sector girls achieved higher grades in the year 1998 in all subjects and all levels of study. Between 1998 and 2000 the increase in the number of girls entitled to the matriculation certificate was more than twice as large as that of boys (http://www.cbs.gov.il.shnaton53, **table 8.20)**.

4.2.3. Gender differences in higher education

In spite of their high achievements in math and science, compared both to Arabic boys and to Jewish girls (**Mittelberg & Lev-Ari, 1999**), in 1999 girls were still the minority among university students: only 15.9% females finishing high school in 1992 in comparison to 20.9% males started their academic studies within six years after school graduation (**Statistics, Israel, 1999**, **table 22.26**).

In spite of girls' high achievements in high school, they are tracked to a less prestigious higher education path: that of non-university higher education institutes, in most cases – teachers colleges. In 2001 2.4% of the 20-29-year old Arabs studied in such institutions: 3.4% of the females but only 1.3% males of the 20-29-age group (http://www.cbs.gov.il.shnaton53, **table 8.13**).

4.2.3.1. Problems stemming from tradition

1. Some traditional attitudes that still exist among older male family member regarding the need for advanced education for females;
2. When marrying while still in school in many cases it is not accepted to continue learning;
3. In many Arab families young women are not allowed to sleep outside their home. Thus the variety of places where their can study is quite limited;

4. In order to acquire higher education the Arabic student has to do well not only in mathematics and science, but in three languages: Arabic, English, and Hebrew. Learning classical Arabic and English is equally difficult for boys and girls; learning Hebrew is – in most cases – more difficult for girls who – unlike boys – are not encouraged to socialize with Israeli Jews, who, in many cases, help male Arabs improve their understanding and speaking of Hebrew;

5. Since the financial situation of the Arab population is worse than that of the Jewish one **(Al-Haj, 1995; Semyonov & Lewin-Epstein, 1987; Perl, 27.12.2002)**, the Arab girl has to face serious financial difficulties when studying at an Israeli university. Unlike the Arab boy or the Israeli girls she would not be able to work in a job typical to a student, like part-time secretary or a waitress. Furthermore, even if she does not live at home during the week she would be expected to return to her parents every weekend so her job opportunities would be even more limited.

4.2.3.2. Possible ways to solve such problems

Problems stemming from tradition are much harder to solve than those depending on outer reasons. One possible way should be encouraging female teachers to teach in the Jewish sector, where there is a lack of science and math qualified teachers, especially in the periphery. Another one – start new factories in Arab villages and cities, so that more females would be able to join the workforce. However, this area – which needs cooperation of policy-makers – should receive more thought that will lead to action.

4.2.4. Summary

In spite of all these difficulties, the Arabic girl has proved that she is able to overcome the double discrimination, being female and Arabic, achieve highly and participate in all educational levels. The hereby incident would demonstrate the influence that the Arabic family has on the level of educations of its young generation – females as males:

Before choosing the location of conducting the Arabic part of my research, I have met many parents of young girls, school and university students. I presented them with the following question: “Suppose you have a son and a daughter. They are 17- and 18-year-olds, and you don’t have enough money to send both of them to the university. What would you do?” One said: “I would choose the best”. The other said: “I would choose the girl”. I asked: “Why?” and she answered: “A boy can find a job even if he doesn't have higher education but a girl can't". But what really surprised me was an answer given by a school teacher: "I would sell a piece of my land in order to send them both to an institute of higher education". Knowing the value of one's land for Arabs in general and for Israeli and Palestinian Arabs in particular, the sacrifice these people are willing to make in order to give an access to higher education to all their children, regardless of their gender, is admirable.

4.3. State-religious Jewish girls

4.3.1. The Religious high schools for boys and girls

Religious high schools for boys and girls, whether mixed-sex institutions that include girls and boys' classes, or separate schools, have been established in almost all Israeli cities, as well as in smaller settlements, e.g. Kibbutzim and agricultural private residences, where each school is serving the population of a few neighboring settlements (**Azrieli, 1987**).

These institutions have been meant to serve the needs of the local communities, rather than those of any elite populations (**Ayalon, 1994, 1995, Ayalon & Yogev, 1996**). The policy of accepting traditional but not necessarily religious pupils, valid in state religious elementary schools, is applied also in high school. Pupils who wish to study in a religious high school have to commit themselves not to violate the Jewish law in public, but they are not spied after in the circle of their families. This policy enabled many oriental Jews to send their children to school belonging to this stream even when not strictly religious.

4.3.1.1. Ethnic differences in the state religious high school

The policy of the Israeli ministry of education as that of the local authorities is not to publish formal statistics of the ethnic origin of students attending any specific educational stream of school. However, there are some facts providing that the percentage of students whose origin is Asia-Africa is much higher in the state religious school than in the general one.

1. Knowledge about the religiosity level of new comers that have arrived at Israel since the late 40ies and up to these days. While those arriving from Arabic countries were mostly traditional – if not strictly religious

– most new comers from Europe and America in the last 60 years, and the Russians Jews arriving in the 70ies and 90ies were non-religious. Thus, most of the children in state-religious schools were oriental, while the majority of secular students were European-American.

2. The number of religious schools and their locations: religious school are located either in less well-of suburbs of large towns, like Tel Aviv and Jerusalem, or in smaller cities, mainly developing settlements where most of the population is oriental.
3. Statistics about the percentage of students examined in oral low at the 4+ points level shows, that between 1985-1989 an average of 18.3% of European-American students took this matriculation exam, in comparison to almost 29% of oriental students (**Statistics, Israel, 1990, table 22.24**). Oral low is a compulsory subject in the religious school where almost 98% of students take this exam, while in the general education only an average of 0.4% choose it (**ibid**). Thus it can be concluded that the percentage of oriental students in the religious school is at least 50% higher than that in the general school.

As we have shown in chapter 2, ethnic disparities in the Israeli education system are quite large. My study will take the ethnic origin of the students into consideration, because such differences might influence motivational, educational, psychological, familial, and social components no less than any other components involved in the learning of mathematics.

4.3.1.2. Girls in the religious school

Girls are a vast majority among Israeli high school students in general and in the religious mixed school in particular. The main reason for this phenomenon in the general school is the relative high percentage of boys and the low percentage of girls learning in vocational schools. The main reason for the low number of boys in the mixed religious school and to a smaller extend the higher dropout rate of boys is the high percentage of boys attending a boarding schools, Yeshiva high school for boys aged 15-18 and a preparatory junior high school ("Mechina") for 12-15-year-olds, which is either a day- or a boarding school.

The girl who attends a religious high school is in many cases a very good student, who could have been accepted to any elite boarding school. She prefers to live at home, not to have to travel to school if possible, and continue her studies with a large group of her elementary school friends. Quiet often this girl has a hobby that she cherishes, and she knows that once she is away form home for the whole week or for as much as 12 hours daily she would not be able to develop it. If this girl is not willing to give up her hobby – in most cases an artistic one (**David & Zorman, 1999; Rapoport, & Garb, 1998; Rapoport, Garb, & Penso, 1994; Rapoport, Penso, & Garb, 1995; Rapoport, Penso, & Halbertal**, **1996**), she would prefer a school more flexible about her frequent absences caused by rehearsal and performances.

4.3.1.3. Girls in math and science in the religious school

Many Israeli studies have already found, that gender gaps in math and science in the state religious schools are smaller than in the general, secular education system **(Ayalon, 1994, 1995; Ayalon, & Yogev, 1996, 1997; David, 1998b, 2000a, 2000c, 2002a**). **Ayalon (1994**, **1995**) has given three explanations to this phenomenon: 1. The comparatively high prestige of religious studies, part of which are blocked from the religious girl, pushes her into studying more science and math. 2. The religious girl is educated to provide for her future household, since the ideal in this community is that the husband continues his religious education after his marriage. Thus, for acquiring a good profession she studies math and science. 3. Learning mathematics at a high level is not a requirement for learning physics, chemistry, or biology in the religious school. All these explanations are somewhat problematic. 1. Since the beginning of the 90ies a gradual increase in the percentage of religious girls learning oral low at the highest possible level has been observed (Statistics, Israel, 1990, 2000) simultaneously with the percentage of religious girls participating in the highest-level math and science (ibid). 2. State religious men participate in the labor force at an identical level to secular men; it is the Ultra-Orthodox men who prefer studying even after getting married (Makover, 27.12.2002). 3. The fact thatlearning high level mathematics is not a must for learning high level science in the religious school might explain high frequency of learning science in both boys' and girls' religious schools, and thus cannot contribute to the decrease of the participation gender gap in this sector. In addition, while it explains high level science participation in the religious school, it does not explain the lack of gender gaps in math participation in the religious school.

Ayalon (1995) and **Ayalon and Yogev (1996, 1997**) have found, that it has been easier for female students to study high level science in religious institutions, since in most cases these schools do not demand a 5-point math level for the studying of physics or chemistry at the 4+-point levels, and did not demand a 4-point level math for the studying of biology at the 4+-point level. In addition, because religious schools are either single-sexed or have only single-sex classes **(Lasloy & Bar-Lev, 1993**), girls do not have to compete with boys on vacancies in scientific tracks (**Ayalon, 1995**). This policy is certainly responsible – at least partially – for the fact that the percentage of female students entitled to the matriculation certificate who were examined at the 5 point-level chemistry was 73 in the religious education system and only 54 in both the general and Arabic education systems **(David, 2000c)**. In physics 30% of the state religious girls took the 5-point matriculation exam in comparison to 25% in the secular sector (**Statistics, Israel, 2002a**), in biology 65% of the girls in the religious sector and 63% in the secular one took the 5-point exam, and in mathematics the percentage of girls taking the 5-point exam was 43 – as in the secular sector (**ibid**).

<u>4.3.2. Religious girls in higher education</u>

There is no official statistics of participation of state religious girls in higher education. However, some data is available regarding participation in general and the choice of science in particular.

Advising religious girls learning in single-sex institutions to continue their higher education in religious teachers colleges rather than in universities is a clear policy (**Neria, 1980**). In spite of this recommendation a high percentage of female graduates of state religious schools continue their higher education at the Bar Ilan [religious] University (**El'or, 1998**), where more than half of the students define themselves as religious **(*Information brochure for new candidates*, 2002b**). There have been some major advantages to females at the Bar Ilan University:

1. In the year 1996 two thirds of ALL titles awarded by the Bar Ilan University were given to females (Statistics, Israel, 1998, table 4);

2. Females learning for the BA at the Bar Ulan University, who are mostly religious, consisted in 1996 more than 65% of the students when the overall Israeli percentage was just 55% (ibid, ibid). 63% of those awarded advanced degrees at this university were females, in comparison to 51% of the Israeli average;

4. In scientific subjects, where the Israel percentage of female participation is low, such as mathematics, statistics, and computers science (average about 38%, Statistics, Israel, 1998), physical sciences (Average about 40%, ibid), biological sciences (about 66%, ibid) the percentage of females at the Bar Ilan University was much higher: 49%, 54%, and 81% respectively (**ibid**).

4.3.3. Summary

Although learning mathematics at the highest possible level has not been a requirement for studying science in the religious system (Ayalon, 1994, 1995), 43% of all students in this educational stream have chosen to learn mathematics at the highest possible level, as in the general system (Statistics, Israel, 2001a). In spite of the fact that until the 80ies many high prestige religious girls-schools did not offer their students to study physics at this level, girls in the religious sector not only outperform girls in the secular system in participation in high-level physics, but there is a constant increase in the percentage of religious girls studying high level physics (**Statistics, Israel, 1990, 2000**), while the percentage of girls in the general system who study physics at this level has not increased substantially during the 90ies (ibid). In the year 2000 73% of the religious students taking the 5-point chemistry matriculation exam were females in comparison to only 54% in the secular system (**Statistics, Israel**, 2001a).

We can conclude that the religious sector in general and females in this sector in particular deserve more research than if has been granted until now. It should be examined whether there are differences between it and the general school caused by different values – either from home or from. Characteristics of teachers in these streams should be compared, as has been already done in primary works studying the Arab sector (Abu-Saad, 1999; Mittelbertg & Lev-Ari, 1999). But above all it should be carefully examined whether the advantages of the religious school stems from its being singles-sexed. In this case it should be asked whether separate education for boys and girls might not harm boys, as was found in many studies (e.g. Baker, & Riordan, 1998; Baker, Riordan, & Schaub, 1994; Jimenez & Lockheed, 1989; Riordan, 1990) and under what circumstances single-sex classes should be recommended for the general school as well.

Chapter 5:
Concept and frame of single-sex classes

5.1. Introduction

The debate about single- vs. mixed-sex classes has taken place regarding four different aspects: 1. Is it good – socially or academically – for girls or for boys – to study in single-sex classes? 2. Is it educationally advantageous for adolescent girls not to have social pressures, caused frequently in mixed-sex classes? 3. Does learning in single-sex setting allows girls to learn in their own way? 4. Does a "feminine" way of learning (science of math) exist?

This last question is closely connected to another one: if girls who learn in single-sex classes learn math and science in a different way than boys, is it not recommended to help them change their way of learning towards the "regular", "normal", "masculine' way? Or, as some feminist scholars have suggested, is it recommended that these scientific disciplines change in order to fit girls?

5.2. A short history of single-sex educational institutions

Solomon (1985) has reviewed the history of female educational institutions in America during the nineteenth century. According to her, 107 women's schools were in operation between 1830 and 1870, and they covered most of the subjects taught in men's colleges. According to **Green's (1979**) detailed report: "Three out of five [colleges] listed logic, nine out of ten offered chemistry and physics" (p. 221). Thus, not only were there no prejudices as to "what should a women not study", but the varied possibilities of learning science proved, that there was a high demand for such studies among female students.

This situation did not change substantially at the beginning of the 20^{th} century. Margaret Rossier has shown that "of 439 female scientists listed in the first three editions of *Men and Science* (1906, 1910, 1912) 41% graduated from a women's college" (cited by **Solomon**, **1985, p. 82**). All scientific fields were represented in the different colleges, each specializing in at least one area: astronomy and physics – at Vassar; mathematics and geology – at Bryn Mawr; chemistry and zoology – at Mount Holyoke; botany and psychology, that was considered a "natural science" during the first half of the 19th century at Welsley, and anthropology at Barnard (**ibid**). This shows, that unlike today, when natural sciences are divided into “masculine” and “feminine” fields, no such division existed until the second half of the nineteenth century.

According to **Solomon (ibid**), after the Second World War men were preferred over women in institutions of higher education, and social demands changed for a woman: she was expected to fulfill her destiny as wife and mother. Thus, female participation in scientific areas was vastly diminished, and women who wished to achieve in these fields were to compete both against society and the policy of colleges and universities. Female students who overcame all these obstacles were bright, persistent in spite of difficulties and setbacks, had good work habits, and were impervious to conventional expectations.

5.3. Single-sex versus mixed learning settings across the world

Most literature about single-sex classes in general and single-sex mathematics and science classes in particular were written either in the US or in Australia. In the US this issue is not only educational but social, political, constitutional, and feminist; in Australia most studies dealing with it focus on educational results, namely, under what conditions can girls benefit from studying in single-sex settings; is it good for all girls to study science and math in single-classes; if yes – under what circumstances, such as the differences among school types that prefer single-sex classes. The review of single-sex settings I offer here covers some European countries, Australia and New Zealand, the Far East, as well as Israel. In all reviewed article, special emphasis will be given to those dealing with math and science achievements and future aspirations.

5.3.1. Single-sex settings in the US

Monaco & Gaier (1992) review in their article the history of writing about single-sex school settings in the 60ies through the end of the 80ies. While it is important to be aware of the history of the debate about single-sex settings, it is also important to know that many assumptions that were perceived as truths in their time are no longer valid. For example, when citing **Goldberg (1968**) about the way females and males used to judge females, we have to take into account that the assumption: “architecture is a typical male profession” is no longer absolutely valid. In the year 2000, 62% of first year Israeli students of Architecture and Urban Planning at the Technion, the Israeli Institute for Higher Education in Engineering and Architecture, were women (**Alterman, 2000, table 9**). However, some of the questions that have been asked during the last four decades of the 20th century should be re-asked in the light of some new developments:

1. Is it still true, that adolescent girls display more concern about being liked and respected by their teachers? By their peers? By their parents? If so – to what extent? Is the situation in single-sex settings any different?
2. How does learning in single-sex classes influence girls' intrinsic vs. extrinsic achievement, mastery, or goal motivation?
3. Is it true that "women in single-sex settings appear to have higher self-regard and self-confidence? **(Monaco & Gaier, 1992, p. 590**)?
4. Does religion influence single-sex classes differently than it does mixed-sex classes regarding future expectations to acquire a mathematically dependent profession? Are there gender differences among the different religion groups in this aspect?
5. Is it true that parental pressure to achieve is negatively related to achievement? What are the religion and gender differences regarding this aspect? According to **Monaco and Gaier (1992**) – girls' achievements are optimal under moderate parental pressure. To what extent is it true in my sample (comparison between mixed- and single-sex classes)?
6. What are the differences between girls learning in single-sex classes and those in mixed settings regarding being liked by peers, teachers, and parents? Regarding learning motivation? Regarding future professional expectations? Regarding self-esteem? Regarding attribution to success and failure?

Most studies done in the US agree that single-sex classes, especially in mathematics, result in higher achievements for girls **(**e.g. **Astin, 1977; Cassidy, 28.11.1997; Durost, 1996; Edwards, 2002; Finn, 1980, Lee & Bryk, 1986; Price & Rosemier, 1972; Riordan, 1990; Tidball, 1973, 1980; Tschumy, 1995)** as well as higher enrollment (e.g. **Gerrity, 1994; Sadker & Sadker, 1994; Tidball, 1973)**.

A study conducted on a girls-only physics class in a public school in the US revealed that girls made substantial gains both academically and in perceptions of themselves as competent learners of science (**Streitmatter, 1997, 1998**).

In a study of African-American boys and girls learning in coeducational and single-sex classes it was found that girls in all-female classes had significantly higher scores in mathematics than those leaning in mixed-sex classes **(Singh & Vaught, 1998).**

5.3.2. In England

The GCSE examinations results in England have shown that girls learning in single-sex classes have better achievements than girls in mixed-sex schools. In addition, girls learning in single-sex schools have more A-grades – entitled to those performing best – than boys **(Gillibrand & Braun, 1994).**

Cassidy (28.11.1997) has reported about an experiment done in the UK for increasing science achievements among high school students. In 1994 girls' achievements in science were behind these of boys by 20% in the Mill Hill Country High School. On that year girls started getting science instructions in single-sex classes, and by 1997 they had an advantage of 1% over boys in their school.

Gillibrand, Robinson, Brawn, & Osborn (1999) present findings from a 3-year longitudinal case study of two single-sex GCSE physics classes in a mixed-sex school in England. The results were that girls participating in such classes gained confidence and have better achievements, and as a result consider more often the possibility of learning physics for the A-Level exams.

5.3.3. In Thailand

Jimenez & Lockheed (1989) have found that single-sex schooling of 8th graders in Thailand was significantly more effective for girls than for boys regarding performance in mathematics.

5.3.4. In New Zealand

Harker & Nash (1997) have found, in a longitudinal study of over 5000 pupils in 37 secondary schools in New Zealand, that when adequate control was exercised for the different ability level and the social and the ethnic mix of the two types of school, no significant differences in achievements were observed between students learning in single-sex or mixed classes.

5.4. Advantages of single-sex settings

Mael (1998) summarizes the advantages and disadvantages of single-sex and coed settings for girls and boys:

1. Single-sex schooling has positive benefits for the academic achievement of both sexes;
2. Single-sex schooling is positive for females in sex-typed subjects areas;
3. Single-sex schooling is beneficial for career aspiration of females;
4. Single-sex schooling is beneficial for positive sex-role and self-esteem;
5. Coed classroom foster gender inequities;
6. Coed schooling is beneficial for male discipline;
7. Coed physical fitness adversely affects both sexes.

All these points should be examined.

In her article **Reis (2001)** makes a list of the advantages for girls in single-sex settings:

5.4.1. Getting more attention from teachers

Boys have been found to get more attention from teachers in mixed classes **(Avrahami-Einat, 1989, 1998; Krupnick, 1992; Sadker, & Sadker, 1994**). There is evidence that the lowest amount of teacher attention given to girls is in science classes (**Jones & Wheatley, 1990)**. **Reis and Kettle (1995)** and **Rotem (29.9.1997)** have found that having mixed gender usually result in boys dominating the classromm. **Lee & Bryk (1986**) have used a large-scale national data to find that single sex classes have positive effects especially on girls regarding academic achievements, educational aspirations, locus of control, and self-esteem.

Not only do girls get less attention than boys from their teachers in mixed-sex classes, in many cases they are also considered less talented – especially in mathematics (**Steinback, & Gwizdala, 1995)**. Since girls perceive teachers as more meaningful to their development than boys do (**Tatar, 1998; Tschumy, 1995**), such perception might prove harmful both to their intellectual and personal sense of value. Single-sex settings might reduce this problem.

5.4.2. Hearing the female voice during math and science classes

One of the characteristics of females – especially of adolescent girls – in math and science mixed-sex settings is being silent (e.g. **AAUW, 1992**; **Heffernan, 1996; Ransom, 1993; Rotem, 1997)**. In contrary, the typical behavior of girls in single-sex math and science classes is learning through a vast amount of oral communication **(Durost, 1996; Harrison, 27.10.1997; Kerr, 1995; Sa'ar, 1.6.2001; Singh, Vaught, & Mitchell, 1998; Streitmatter, 1997; Stutler, 1997).** As was already shown, women tend to be talkative while interacting among themselves, while when in a mixed-sex company they are more silent **(e.g. Tannen, 1992)**. Girls are much more talkative and expressive than boys during childhood. In spite of that – whether through intentional education or by an unintentional process of socialization – they tend to adopt the "female" way of being quiet while in male company. One of the most noticeable results of this silence is the different reaction of males and females when in mixed-sex company: while males tend to take the ground especially when in female company, females give up the ground to males not only when they are a small minority, but also when they are the vast majority.

5.4.3. Increasing the aspirations level

Female students' achievements and aspirations are often lowered in coeducational school settings (**Cipriani-Sklar, 1997; Daly, 1995**). Girls who learned physics in a singe-sex setting in England were more likely than their peers learning in mixed-sex classes to take the A-level physics exams which are a pre-request to higher education in many scientific domains (**Gillibrand, Robinson, Brawn, & Osborn, 1999).** University of Maine Prof. Bonnie Wood has found that girls that took the algebra single-sex class at the Maine high school were twice as likely to enroll in advanced chemistry and college physics than their peers who learned in coeducational classes **(Hancock, & Kalb, 24.6.1996).**

5.4.4. Fighting the culture of romance

The culture of romance (e.g. **Zorman & David, 2000; Holland & Eisenhart, 1990; Kerr, 1995)**, which is a major educational factor of the adolescent girl, influence many young girls learning in mixed-sex classes to be quiet during classes, try to hide their abilities in order to be liked by boys, as well as be popular among other girls because of their "feminine" traits. In addition it influences girls to invest time and energy in their looks and social life. Preliminary research in Israel has shown (**Libes, 2000**) that teen-age girls in the end of the 20th century tended to aspire less towards professions like accounting or law than their mothers did, and preferred instead occupations in show-business, advertisement, or public relations. This tendency might explain – at least partially – the low motivation of girls to learn high-level math and science. It is considered more popular, perhaps more "cool", to acquire professions where looks count. The brain is not taken too seriously; thus, the adolescent girl can integrate in the romance culture and work less than her mother did in order to prepare herself for her desired profession.

<u>5.4.5. Enabling girls to benefit from their preferred learning style</u>

Girls have – in general – learning characteristics typical for them. Among those are:

- Reflect before answering the teachers' questions;
- Listen to others and not always talk – especially in a mixed-sex settings;
- Prefer a collaborative rather than a competitive setting (**Durost, 1996; Harrison, 27.10.1997**).

In mixed-sex classes, girls do not always have the opportunity to reflect before answering, because boys tend to answer the teacher's questions immediately. In such classes girls might find themselves listening most of the time and hardly speaking. In addition, girls do not enjoy in general a competitive environment, dominating in mixed-sex settings.

<u>5.4.6. Avoiding serving as teacher's helpers</u>

In mixed-sexes classes girls have quite often to serve as <u>teachers' helpers</u> (**Zorman & David, 2000**), especially by aiding boys who are noisier than girls **(Schwartz, 1991**). In single-sex classes, where usually discipline problems are less acute, talented girls are spared – at least partially – of doing this task.

<u>5.4.7. Avoiding serving as boys' assistants</u>

In many mixed-sex classes girls are expected to fulfill the function of boys' assistants (**Barton, 1999**). This situation can lead to underachievement, loss of self-value, decrease in self-esteem and self-confidence, and eventually dropout of science and computers classes.

5.4.8. Avoiding hostile climate

The **AAUW (1992**) study reported that in coeducational classes girls have been subjected to physically, sexually, and emotionally hostile classroom climates. **Hancock & Kalb (24.6.1996**) have found that eighth grade girls preferred doing physics experiments without boys around to take the equipment over.

5.4.9. Decreasing sex-stereotyped attitudes

Studies about the relation between sex-stereotyped attitudes and behaviors and American sex-segregated education from in grade K-12 find that girls' schools have less stereotypic attitudes regarding females' roles in society, women in "male" professions, and attitudes towards feminism (**Lee & Byrk, 1986; Trickett, Castro, Trickett, & Shaffner, 1982; Vockell & Lobonc, 1981)**. In addition, girls learning in single-sex classes have a lesser level of fear of success and a higher level of leadership (**Lockheed, 1976; Price & Rosemier, 1972; Winchel, Fenner, & Shaver, 1974). Lee & Lockheed (1990)** have found that single-sex schools have positive effects on 9th grade Nigerian girls achievements and attitudes toward math, but less positive results were found for male students. **Gerrity (1994)** has found that females in single-sex settings took math and science courses at double the national rate in the US. **Lee & Marks (1992**) found that in the US the most blatant examples of stereotyping occurred in chemistry mixed-sex classes. **Lee, Marks, & Byrd (1994)** have stated, that in a study of sexist incidents in the classroom 66% of all such disturbances in co-educational classrooms occurred during chemistry instruction.

5.4.10. Decreasing anxiety

> **Campbell & Evans (1997)** have compared levels of math anxiety among females in coed and single-sex classes. Their sample consisted of females randomly enrolled in mixed-sex or single-sex algebra I classes taught by the same teacher. Females in the single-sex class had a statistically significant lower mathematics anxiety rate than girls in the mixed-sex class. In addition it was found that math anxiety decreased for the males in the mixed-sex setting.

5.4.11. Increasing self-confidence

In a two-part study held in the US among high school students of all-female school, all-male school and coeducational school females learning in a girls school showed a higher degree of self-confidence than those learning in a mixed-sex school (**Steinback & Gwizdala, 1995).**

Streitmatter (1997) reports on a 2-year experiment in mathematics learning – pre-algebra and algebra – in single-sex and mixed-sex classes. The girls in the single-sex said that the single-sex setting enhanced their ability to learn mathematics and their view of themselves as mathematicians.

In Australia it was found that for girls learning in single-sex classes was associated with more confidence, which significantly increased the probability of subsequent participation in senior mainstream mathematics education (**Rowe, 1988**).

5.4.12. Increasing risk-taking behavior

Sadker and Sadker (1994) have shown, that many girls are not enthusiastic to take risks in a mixed-sex class. **Streitmatter (1997**) has found that in an all girls-math junior high school classroom girls were more likely to ask and answer questions about subject matter, which indicates their being more open to take risks either of being perceived as “brains” when answering difficult questions or as “dumb” when asking questions that might be perceived stupid by their peers.

5.4.13. Serving the needs of minority religions/traditions

Thomas (5.9.1997) has presented the problem of a large minority of Muslims living in Birmingham that would prefer single-sex classes for their daughters. One of the solutions to the problem of the low academic level, especially in math, science, and technology, was the turning one public school into singe-sex one. A similar solution was chosen in Um el-Fachm, an Israeli Muslim city, where the opening of girls’ school reduced the dropout rate of girls form 36% to 8% within 8 years **(David, 2001c)**.

5.5. The cons of single-sex classes

5.5.1. Girls benefit from single-sex classes only when most settings are mixed

Baker, Riordan, & Schaub (1994) searched the questions: “Under what circumstances do gender groupings have the largest influence on achievement? What are the causes of this influence? (p. 209). They came to the conclusion, that gender grouping will be most beneficial for females when single-class settings are relatively rare. To prove this assumption, they offer a comparative study of four countries: Belgium and New Zealand on one side, and Thailand and Japan on the other. While in the first two countries the percentage of students receiving instruction in single-sex classes is 68 and 48 correspondingly, in the last two ones it is 19 and 14. As assumed, in Thailand and Japan single-sex 12th grade was more favorable for females than in Belgium and New Zealand. However, comparing of four countries as culturally different as the chosen four, while taking into consideration just one parameter – the occurrence of single- vs. mixed-sex classes – is very limiting. Gender differences in math achievement, math and science self-confidence, future aspirations regarding math-dependent careers; the perception of certain occupations as masculine or feminine; participation in high level math and science high school courses, and motivational parameters are all culture-dependent. The main difference between Belgium and New Zealand on one side and Japan and Thailand on the other might be caused by the status of women, the importance of traditions, or expectations from a married woman and mother in these countries.

5.5.2. Single-sex classes are not good for the boys

Not only have many studies shown no advantages for boys in all-male settings (e.g. **Singh & Vaught, 1998),** in many disadvantages for boys learning in single-sex classes have been found. **Riordan (1990),** and **Baker, Riordan, & Schaub (1994**) have suggested that male achievement may be enhanced when males study with females. **Cassidy (28.11.1997**) has found, that boys seem to do well in mixed-sex classes. **Jimenez & Lockheed (1989)** found that in Thailand female 8th graders had higher gains in mathematics while males were more beneficial in mixed-sex classes. In addition to the educational advantages for boys in mixed classes it has been found **(Parker & Rennie, 1998**), that the conduct of boys worsened without the presence of girls.

It should be noted, though, that other studies show educational advantages for both boys and girls in single-sex classes. **Perry (1996)** has found, in a middle school (grades 6-8) in Virginia that the grade point average in single-sex classes was higher than in mixed sex classes both for boys and girls in math and science.

5.5.3. A financial aspect: More money is given to mixed or boys' schools

If there is a ground to suppose that girls have advantages in single-sex classes (e.g. **Harrison, 27.20.1997)**, financial discrimination against single-sex institutions should be fought as such rather than giving up the concept of a more advantageous learning setting for females

Let's look first at the Israeli data concerning this issue.

5.6. Single-sex versus mixed learning settings in Israel

Unlike in many other countries, in Israel there are single-sex classes only in the Jewish religious sector, in some Christian private institutions, and in a few high schools in the Arabic Muslim and Druses sectors. The influence of single-sex classes on the professional choices of girls in Israel has hardly been investigated.

5.6.1. In the religious sector

In Israel the objection to single-sex classes stems basically from recoiling from religious education, which is gender-separated (**Sa'ar, 20.6.2001**). About 20% of the Jewish schools in Israel belong to the state religious sector, while another 20% are Ultra-Orthodox. All these schools are single-sexed. However, these two sectors are different in almost all possible aspects. The program of general subjects is almost identical in the general school to that of the state-religious one, while most general subjects are hardly taught in the Ultra-Orthodox school. As a result while both female achievements and participation in math and science is higher in the state religious school than in the general education system (**Ayalon & Yogev, 1996, 1997**; **Rapaport & Garb, 1998; Rapoport, Garb, & Penso, 1995; Sa'ar, 20.6.2001**), the achievements and participation level in the Ultra-Orthodox sector is the lowest among all Israeli sectors. In the year 2000 only 1377 12th grade students in the Ultra-Orthodox education system – 11% – took the matriculation exams; only 529 of them were entitled to the matriculation certificate (**Statistics, Israel, 2001a, table 8.21**). In no other Israeli sector was the examinees percentage so low; In no other Jewish sector was the entitlement percentage lower than 60 (**ibid**).

Thus, the factor of single- vs. mixed sexes classes *per se* cannot predict participation or success rates in any population. It has always to be analyzed within a cultural, religious, and social context.

5.6.2. In the general sector

Until recently, no school belonging to the general, secular education system taught any subject – except for physical- and in some cases sexual education – in separate sex groups. In the school year 2000/2001 an experiment took place at the *Mevo'ot Yiron* school, belonging to four Kibbutzim: *Ein Shemer*, *Ma'anit*, *Metzer*, and *Barkai*: 9th grade girls could choose to learn physics in a separate class, and 12th grade boys studied literature in a separate class (**Sa'ar, 20.6.2001; Shachar, 27.8.2001**). These two grade-levels were chosen because they have a special importance regarding future academic choices. Girls usually dropout of the most prestigious mathematics-physics track after grade 9. As a result, the percentage of girls taking the highest possible math examination is about 14, while that of boys is more than 20 (**Mevarech, 2000; Sa'ar, 20.6.2001; Statistics, Israel, 2001**). Boys, on the other hand, must take a minimal amount of literature studies for the matriculation exam, and in most cases they take indeed only that minimum and do much worse than girls (**Sa'ar, 20.6.2001; Statistics, Israel, 2001a)**. The opportunity to learn literature without girls was aimed to let boys discover their love to this subject and enable them to expand their horizons by learning more than the minimum works required.

The result of this experiment was that half of the 60 9th grade girls, who studied physics in separate classes, chose the mathematics-physics track, usually chosen only by about 10% of 10th grade pupils. It should be noted, that in the previous year only one girl in that school chose this track. In addition, it was found that although only physics was taught in single-sex classes, there was a substantial improvement in the girls' grades in all other subjects in comparison to the previous year. The results in the literature boys' class were also good, the achievements were especially high, but the teacher, who had missed the living dialogue where mainly girls participated, decided not to continue teaching literature in a boys' class. On the other hand, the separate physics classes continued in 2002, girls who took only 4-point mathematics level were also invited to join, and computers single-sex girls' classes started to operate as well (**Sa'ar, 20.6.2000)**.

The excellent results of this experiment however have not persuaded other secular schools in the Jewish sector to offer single-class settings in mathematics or science. Neither have the overwhelming matriculation results in the state religious high schools – all operate in singles class settings. Unlike in the general education system, state religious schools are much less selective regarding the socio-economic or the average grades of applicants. In addition, the dropout rate in the religious sector is lower than in the secular one.

In the general ducation system ethnic origin influences pupils' grades more than any other measured variable though the mediator of parents' education. The percentage of state religious school children, whose parents were born in Asia/Africa, is much higher than that in the secular sector. In spite of that the rate of girls excelling in the high level mathematics and physics matriculation exams has been 10% higher among religious girls than among girls studying in the secular system (**Sa'ar, 20.6.2000**).

The debate about single-sex classes, which has been taking place in the US for the last few decades, has just started in Israel. Unfortunately, no serious scientific arguments have been part in it. About two months after the first results of the *Mevo'ot Yiron* experiment were published, the Ministry of Education offered school headmasters to read a summary of studies about single-sex science classes **(Shachar, 27.8.2001, 7.3.2002)**. A few days later a famous Israeli female writer wrote an article recommending learning math and science in single-classes **(Har'even, 2001)**, while a famous Israeli feminist published an article by the name: "No to the sexual Apartheid" (**Herzog, 2001**). The debate did not go on; in the school year 2001/2 no new single-sex classes were opened in the secular sector, in spite of the recommendation of the ministry of education to open 7^{th}-12^{th} grade girls' classes for math and science **(Shacher, 30.8.2001**). Thus the gender participation gap in physics, computers, and mathematics remained at the previous year's level.

5.7. Gifted girls in single-sex classes

Boys are more varied than girls regarding skills and achievements; there are more boys than girls in the lower and higher edges of the achievements scale. High ability girls, on the other hand, are more varied than high ability girls regarding their areas of interest; while girls tend more often to be interested in developing many areas, be more “rounded”. In addition, as has already been shown by **Stanley, Benbow, and their colleagues (Benbow, 1988, 1992; Benbow, & Lubinski, 1993; 1996; Benbow, Lubinski, & Hyde, 1997; Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Benbow, & Stanely, 1980, 1981, 1983, 1988**; **Stanely, 1988, 1994; Stanley, & Benbow, 1986; Stanley, Keating, & Fox, 1974; Stanley, & Stumpf, 1997**). Among the mathematically gifted the percentage of boys is much higher than that of girl. This has been the case both in Israel (**David, 1997**, **2001b)** and elsewhere. Thus, the mathematically talented or gifted girl belongs to a small minority in every gifted program (**David, 1997, 1999b, 20011b; Landau, 1990**).

The difference between the problem of a low rate of female participation in mathematics at a level, which enables them to acquire high prestigious jobs, and the special problem of high ability girls is fundamental. Mixing these two problems had led researchers to false conclusions as to what means should be taken to solve “the problem of females and math/science”. I hereby offer to clarify the distinction between these two problems.

The literature about gifted, talented, or high-ability females reveals substantial gender differences in mathematics starting at pre-adolescence (e.g. **Benbow, 1986, 1988, 1992**; **Benbow & Lubinski, 1993, 1996**; **Benbow, Lubinski, & Hyde, 1997; Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Benbow, & Stanely, 1980, 1981, 1983, 1988; Benbow, Stanely, Arjmand, & Walberg, 1991; Benbow, & Wolins, 1996)**, that reach their very pick when examining the number of female university staff member in the mathematics department all over the world.

There is a large group of female students, who like to study and get good grades, but nevertheless neither participate enough in high-level math, physics, and computer sciences during high school, nor aspire for a future in these areas. Cognitive, educational, psychological, and social causes will be examined, along with the class setting: single- versus mixed-sex, in order to answer the question: why?

At the young age of 7-8, when among the general population there are still no gender differences favoring boys in any subjects, gender differences favoring boys in the decision to participate in a special gifted school have been noticed **(David, 1997, 1998a**). Throughout the years 1974-1997 the percentage of girls rejecting the offer to transfer at the beginning of grade 3 to the special gifted class located at the *Graez* School in Tel Aviv was always higher than that of the boys. In all these years the mathematical scores of boys in the psychometric exam required for this school was higher than that of girls (e.g. **Cahan & Ganor, 1995; Zorman & David, 2000**). As a result these gifted classes has always had a vast majority of boys. Thus it might be possible that gifted girls have rejected the gifted mixed-sex groups, populated mainly by boys, in favor of studying among less talented peers.

While the mixed-sex school aimed forat the gifted Tel Aviv population belonging to the general system has been characterized by a low rate of participation – less than 50, the one day a week gifted program, aimed for the Tel Aviv population that belong to the state religious system has been characterized by a participation rate of over 90% during the last decade of the 20th century (**David & Zorman, 1999**). Without discussing the causes for this crucial gap between these two programs, one difference regarding choice curriculum seems to be a main reason for the low dropout rate from the program: girls have a wide choice of subjects starting in grade 5, and they usually place themselves out of mathematics (**David, 1999b**). Thus, the 5^{th}-6^{th} grade math classes for the gifted consist mainly of boys. Girls are not offered gifted girls settings, as was done in the SMPY project more than a quarter of a decade ago (**Stanley, Keating, & Fox, 1974)**. Practically, both groups of girls use the same choice pattern regarding learning high level mathematics: either they do not participate in the program, as in the gifted classes, or they participate in subjects other than mathematics, as in the Wednesday program for the gifted state religious students.

In a single-sex gifted middle-school algebra class girls were found to ask questions much more than in coeducational gifted classes or in single-sex “regular” classes (**Stutler, 1997**). While in the boys’ gifted class the boys would start working on their assignments as soon as they got them, the girls tended to ask questions covering all possible aspects of the materials. These questions developed into theoretical discussions, something that was not done before because of fear of being ridiculed or being considered unfeminine by the gifted boys in the class. Unlike in regular girls classes, in this class the girls enjoyed the competition and behaved in a “non-feminine” way – they were noisy, nonconforming, and “unladylike”. This behavior is in accordance with findings about gifted girls in general (e.g. **Landau, 1990, 2000; Zorman & David, 2000)**. One more result of the teaching of algebra in a girls’ gifted class was the tremendous increase in achievements (**Stutler, 1997)**. Gifted girls suffer more than their regular peers from the Cinderella syndrome (e.g. **Davis & Rimm, 1985; Kerr, 1995; Lavach & Lanier, 1975**; **Schwartz, 1991, 1994;**

Zorman & David, 2000). Thus, not having to be afraid that academic success will result in a failure as females results in an exceptionally large increase in academic achievements. In addition, girls in the girls' gifted math class reported a greater overall understanding of math concepts than when in the mixed class.

However, single-sex class *per se* is not THE answer to the mathematics participation problem of high ability girls. For example: while as has been shown girls mostly prefer cooperative learning, **Hernandez Garduno (1997**) has found that talented girls did not benefit from cooperative math learning. The findings of **Rizza (1999)** were similar to those of **Hernandez Garduno (1997)**, while **Gavin (1992**) obtained similar results among high ability female college students. **O'Shea** (**1998)** also found that gifted young women preferred both competition in math and fast-paced math classes.

While most researchers have stressed the importance of cooperative learning for girls (e.g. **Dillow, Flack, & Peterman, 1994; Hertz-Lazarowitz, 1994, 1995, 1999; Perrenet & Terwel, 1997; Petersen, 1991; Sell & Kline; 1995; Sharan, 1994; Slavin, 1994; Stevens & Slavin, 1995; Undrwood, Jindal, & Underwood, 1994)**, it has been found that among high ability students – whether male or female – the preferred style is competitive (**Stutler**, **1997)** and individual (**Hernandez Garduno, 1997**). Thus, the only main style difference between females and males in learning math and science was found in the female tendency towards profound learning, in the deep wish to understand everything learnt completely, and in the willingness to invest as much time and effort needed for such a high level of understanding until reaching that goal.

5.8. Summary

Junior high-school girls, especially 7th and 8th graders, are the target population for intervention programs, such as raising awareness, that will help them during a period of self-esteem loss, lack of confidence, and perception of mathematics as a male domain (**Brunner, 1996; Dick & Rallis, 1991**). Waiting for high school might prove too late to change attitudes towards mathematics, and in many cases, especially where tracking taking place during junior high school, it might be too late for moving to a higher track. Single-sex classes have been recommended by **Reis (2001**) among others:

- Group gifted females homogeneously in math/science or within cluster groups of high ability students in heterogeneous groups;

In order to:

- Maintain options for talented, creative girls in specific groups such as self-contained classes, groups of girls within heterogeneous classes and in separate classes for gifted girls, science and math clubs, or support groups (p. 20).

Chapter 6:

Motivation:
From intentions and attitudes to achievement and success

6.1. Implicit Personal Theories

6.1.1. Fixed versus incremental perception of intelligence

Dweck and her colleagues (e.g. **Dweck, 1986, 1990, 1991, 1996a, 1996b, 1998, 1999; Dweck, & Bempechat, 1983; Dweck, Chiu, & Hong, 1995a, 1995b**; **Dweck, Hong, & Chiu, 1993; Dweck, & Leggett, 1988**; **Hong, Chiu, Dweck, Lin, & Wan, 1999)** have distinguished between two kinds of implicit theories that people hold about intelligence. While there are people that believe that intelligence is a fixed trait, others believe that intelligence is changeable. Previous research works have shown that dominance of either entity or incremental theory is highly correlated with many psychological traits as well as with educational traits, such as self-efficacy or believability in own abilities, self-confidence, self-esteem, and adopting avoidance or approach orientations.

6.1.2. The main concepts of Implicit Personal Theories (IPT)

Dweck has structured her Implicit Personal Theories around the following six main concepts:

1. The importance of **Educational motivation (Dweck, 1986, 1990)**;
2. The substantial role of **Social motivation (Dweck**, **1996c)**;
3. **Goal Theory:** "a goal analysis leads us to see affect, cognition and behavior as forming coherent patterns, ones that are driven and organized by people's goals" (**Dweck, 1996a, p. 350**);
4. **Implicit theories** as organizers of goals and behaviors (**Dweck, 1996b,** the title; **Dweck, Hong, & Chiu, 1993; Hong, Chiu, Dweck, Lin, & Wan, 1999);**
5. **Self-concepts** and their relevance for motivational processes (**Dweck, 1998**);
6. **Self-theories**, that include all other components of Dweck's concepts: motivation, personality, and development (**Dweck, 1991, 1999**).

6.1.3. Judging, labeling, and forming stereotypes: The evaluating process

In a series of research works by Dweck and her colleagues (**1996b**, **1999; Dweck, Chiu, & Hong, 1995a; Chiu, Hong, & Dweck 1997; Erdley & Dweck, 1993; Gervey, Chiu, Hong, & Dweck, 1999; Hong, 1994; Hong, Chiu, Dweck, & Sacks, 1997)**, it has been shown, that there is a positive correlation between the tendency to make rapid judgments and hold an entity theory. The researchers have found, that people holding an entity theory responded differently than those holding an incremental one to statements such as: "Each person has a basic character, and you can tell what kind of person someone is by their behavior or appearance"; "A single act often tells you a lot about a person's fundamental character", or "It's fairly easy to tell what kind of person someone is by observing them on one or two occasions" (**Dweck, 1999, p. 80)**. Individuals holding an entity theory responded "yes" to these questions much more often than those holding an incremental theory.

Entity theory holders are not making quick judgments – relying on few details – due to lack of time. They rather believe that a person is unitary, and his or her characteristics are complementary to each other. As a result it is not only easier and quicker to judge any human being based on limited knowledge about them, but inaccurate as well. Entity theorists tend more than incremental theorists to form prejudices against individuals and stereotype groups. Such stereotypes and prejudices might be connected to moral, intellectual, social, or psychological individuals as well as to groups related by origin, background, religion, nationality, etc.

Church, Elliot, & Gable (2001) examined the relationship between the adoption of achievement goals in a chemistry course, and the adoption of performance or intrinsic motivation of undergraduate students. The results showed that mastery goals were positively correlated to the absence of an evaluation focus and quick, harsh evaluation; performance-approach goals were correlated to the presence of evaluation focus, and performance-avoidance goals were correlated to the presence of evaluation focus and to quick, rude evaluation as well.

6.1.4. IPT, motivational orientation, and mathematical competence

In previous studies it was assumed, that since the incremental individual and the entity one can be identified as having different personalities, extrinsic motivation, which has a high correlation with the entity individual, has a negative correlation to intrinsic motivation, perceived as connected to the incremental personality. Thus, it was expected that entity-theory children would tend to adopt an extrinsic motivation style, while incremental theorists would have a higher level of intrinsic motivation. The explanation for this preference lies in the way students perceive the aim of learning. While entity theorists study mostly for praise or achieving high grades that result in satisfying others and look smart, incremental theorists study for the sake of enlarging their knowledge or deepening it; thus they enjoy learning and do not depend as much on others' opinion about them.

A study by **Schullo & Alperson (1998)** examine the connection between believing in incremental theory of intelligence and mathematics achievements among low SES algebra 1 American students. The researchers have found that incremental female students confirmed the prediction that incremental believers would have higher final grades than those endorsing entity beliefs. Other research results (e.g. **Dweck, 1986, 1999**) have suggested that incremental theory is adaptive for both genders. In the next following chapters I will try to find out which of these research assumptions – if any – can be supported by the results of my study, to what extent, and under which circumstances.

6.1.5. Criticism of the Dweck Implicit Intelligence Theories

> According to Dweck, intrinsic motivation is linked to the belief that intelligence is a non-rigid trait, so everyone can improve her/his ability. Dweck has proved this hypothesis in a series of studies, mostly conducted in the US and under controlled conditions. However, this hypothesis might be proved invalid in other cultures. In Japan, for example, effort is perceived as a necessary trait for success, and thus intelligence is perceived much less as a stable trait than in the American culture. On the other hand, the system of reward and punishment valid in many countries influences even young children towards holding extrinsic goal motivation that helps them reach the aim of higher education.

Even in the US there has been some research contradicting the Dweck implicit personal theories of intelligence. In a study of 1,839 American students from 162 schools, it was found that the more students believed that success in mathematics was caused by natural ability, the higher they scored on the test (**Schreiber, 2002)**.

Elliot (1999) as expressed explicit criticism against one aspect of the **Dweck** Implicit Personality Theories (**1991, 1999**). Elliot has explained how competence perceptions might moderate the effect of entity or incremental beliefs on achievement goals. Thus, incremental goals will predict adoption of learning goals, while entity goals holders are predicted to adopt performance goals among high ability students, and avoidance goals of low ability ones. This contradicts Dweck's hypothesis **(1991, 1999)**, according to which competence moderates the effects of performance and mastery goals.

Environmental factors might also influence the adoption of achievement motivation (**Ames, 1992c; Elliot, 1999; Maehr, 1984; Meece, 1991; Midgley, 1993**). In such cases, if the achievement setting has a stronger influence than other factors that influence the adoption of the learning setting, its influence is overwhelming and overpowers any other such factors **(Caspi & Moffit, 1993**).

> For example: the Israeli system is in between the American and the Japanese regarding the support of intelligence as a constant trait. While tracking is not as rigid as in the Japanese system, thus implying that one can improve her or his abilities as well as achievements, most high school graduates cannot choose any subject they wish to for studying at a higher level (e.g. **Guri-Rosenblit, 1996**). As a result, many of the subjects studied in high school – among them all compulsory ones, which are English, Math, Bible for Jews, Hebrew language, writing and grammar for Jews, and Hebrew language for Arabs, Arabic for Arabs, History for Jews and Arabs and Jewish history for Jews – are taught no matter if the student wishes to study them. However, except for mathematics, all the subjects mentioned are humanistic, which makes the issue of learning them because of intrinsic motivation almost irrelevant: it is not quite clear, why studying Jewish history is going to help a student be a good physician, for example.

Elliot (1997, 1999) has offered an alternative to Dweck's (1999) explanation of adopting avoidance motivation orientation. While according to Dweck the main reason for choosing avoidance behavior is fear of failure connected to low ability, mostly perceived by a person who holds an entity belief, Elliot (1999) offers a variety of reasons that might lead to the adoption of avoidance motivation: self-based and relationally-based variables, such as self-esteem (**Kernis, 1995**; **Tice, 1991; Tice, & Baumeister, 1990**); self-validation (**Dykman, 1998**); self-worth contingency (**Covington, 1984a, 1984b, 1992; Covington, & Beery, 1976; Covington, & Robert, 1994);** self-monitoring (**Snyder, 1979**); need for approval **(Harter**, **1978**); need for affiliation (**McClelland & Boyatzis, 1982**); fear of rejection (**Mehrabian & Ksionsky, 1974**), and attachment style (**Hazan & Shaver, 1990**). In addition, there are demographic variables, such as gender (**Dweck, 1986, 1991, 1999**; **Eccles, 1985; Eccles [Parsons] 1984; Eccles, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1985**; **Eccles (Parsons), Adler, & Meece, 1984; Eccles, & Jacobs, 1986; Eccles, Wigfield, Harold, & Blumenfeld, 1993)**; ethnicity (**Urdan, 1997, 2001**; **Urdan, Midgley, 2001; Urdan, Midgley, & Anderman, 1998; Van Laar, 2000, 2001)**; and socio-economic or socio-cultural background **(Van Laar, & Sinadius, 2001; Maehr, & Yamaguchi, 2001**).

However, as Elliot (1999) has explained, when there is an achievement environment that enhances a certain motivational orientation more than another, it may have a major effect on the activating such motivation. Such is the case with avoidance motivation that causes Israeli matriculation examinees NOT to choose the unseen passage in the Hebrew Literature compulsory examination. Since getting a high grade is the only aim in the matriculation examinations, students prefer to answer questions on materials they have prepared rather than taking a risk and interpreting an unseen passage – an interesting assignment, but unfortunately one that has proven to result in about 90% of failures.

In summa: The Dweck IPT should be adopted with caution as a frame for further research rather than as absolute valid truth. Its implications have to be applied for each sub-population separately, taking into account gender, age, the educational system, and class-type, as well as social and familial components.

6.2. Motivational concepts

6.2.1 Introduction

Motivation has been defined as “the core of psychology” (**Dweck, 1991, p. 199**). Motivation starts playing a role in the classroom at the point when teaching the subject matter in the “right” way, by professional teachers, trained both in the discipline they teach and its didactics, is not reaching its aim. For example: both in Germany and in Israel (e.g. **Mullis**, **Martin, Gonzales, Gregory, Garden, O’Connor, Chrostowski, & Smith, February 1998)**, as well as in many other European countries and in the US (e.g. **Ma, 1997a, 2001**), many students dropout of mathematics. In Israel this problem might be blamed mainly on teachers whose mathematical education is not sufficient (**Barak & Waks, 1997)**. However, it cannot be explained in a country like Germany, where the requirement of a mathematics teacher who teaches in a *Gymnasium* is at least six years of higher education in mathematics. In Israel the high school system is rigid, and each pupil that wants to specialize in mathematics has not only to be good at it in grade 9, but also join a “scientific” class with high demands in other scientific subjects from class 10 up to class 12. In the US – on the other hand – each math course in taken separately. Thus, a student can change her/his choice about taking more math courses or taking low level such courses practically after each high school semester. Indeed – most students take this easy way, namely, they either dropout from math after class 11 (**Ma, 2001**), or choose not to take advanced algebra or trigonometry classes. Only a small minority of students chooses calculus; even pre-calculus, which is not a compulsory subject, is not very popular by most students (e.g**. Davenport, Davison, Kuang, Ding, Kim, & Kwak, 1998)**. **Dossey, Mullis, Lindquist, & Chambers (1988**) have found, that only 38% of grade 11 students plan to take another math course. The lack of enough high school graduates with a high-level math background is a problem in many European countries. **Guncaga (2002)** phrased the problem, referring to the situation in Slovakia, as: “and now [after understanding all mathematical aspects of the issue] what is left is dealing with the students’ motivation” (p. 203). In fact, one of the important Slovak theoreticians has defined motivation as the first in the 6 steps needed in the process of acquiring knowledge:

> 1. Motivation: Diese Einleitungsphase ist sehr wichtig, weil Sie “Motor” des Erkentnis prozesses ist. Der schüler ist fähig ein problem, das für ihn

> interessant ist, leichter zu lösen. Deshalb entsteht die Sehnsucht nach Erkentnis und Erfahrung in bestimmten Lernbereichen in der Psyche der Schüler **(Guncaga, 2002, p. 203)**.

In many non-European countries the situation is not any better. In South Africa, for example, only 32.9% of the black and only 41.7% of the colored learners, both consisting the vast majority of all students, took mathematics as a matriculation subject in 1995 **(Srauss, Plekker, Strauss, & Van der Linde, 1995)**. **Anstey (1997)** reported that between 1990 and 1995 only 23% of the black learners nationally passed mathematics in grade 12.

6.2.2. Definitions of motivation

1. "The generalization instigation and direction of behavior" (**Elliot & Covington, 2001, p. 73)**;
2. "The act or process of furnishing with an incentive or inducement to action" **(Barnhart, & Barnhart, 1978 p. 1356)**;
3. "To be motivated means to behave with the intention of achieving some outcome" (**Deci, Ryan, & Williams, 1996, p. 166)**.

6.2.2.1. Achievement motivation

1. […] The energization and direction of competence-based affect, cognition, and behavior **(Elliot, 1999)**;

2. **Elliot & Thrash (2001**) have suggested that there are two definitions for "achievement goal": the first stems from the purpose point-of view **(Dweck, 1996a; Maehr, & Anderman 1993**), i.e. depends on the aim of the person who adopts the behavior, and the second – from the orientation toward achievement (**Ames, 1992; Ames & Archer, 1987, 1988; Elliot & Thrash, 2001; Thrash & Elliot, 2002**). A third possibility for defining achievement motivation would be to combine both the reason for the behavior and its aim (**Pintrich, 2000a, 2000b, 2000c**);

3. Another definition suggested by **Elliot & Thrash (2001)** tries to combine as many variables as possible into a whole frame that includes all components relevant to achievement motivation. Thus, the dichotomy of ego/task or performance/learning goals can fit for most theoreticians discussing this subject; also they differ in the components they include into the frame of each

of the two main motivational kinds (**Dweck, 1986, 1999; Nicholls, 1984a, 1984b**). For example: cognitive engagement has been studied in the context of achievement motivation by **Pintrich, & Schrauben (1992)**; classroom contextual factors by **Pintrich, Marx, & Boyle (1993**), and **Pintrich. & Schunk (1996**); ability and effort: by **Ames, & Archer (1987, 1988**); values: by **Anderman, Eccles, Yoon, Roeser, Wigfield, & Blumenfeld, (2001)**, **Anderman, & Maehr (1994),** and **Anderman, & Midgley (1998**). Correlations between many of these components have been examined in various studies.

6.2.2.2. Learning/Intrinsic motivation

1. "Intrinsically motivated activities are those that occur for the inherent satisfactions that accompany them and which, therefore, are not dependent for occurrence on separated rewards or reinforcement" (**Ryan, Kuhl, & Deci, 1997, p. 710**);
2. **Shah & Kruglanski (2000)** have re-defined the "intrinsic motivation" concept by dividing it to two kinds: substantial and structural. While "substantial motivation" is – according to them – what has been defined by many researchers **(e.g. Braten & Olaussen, 1998; Dweck, 1989; Dweck, 1999; Dweck & Leggett, 1988; Elliot, & Harackiewicz, 1996; Elliot & Thrash, 2001; Elliott & Dweck, 1988)** as "intrinsic", "structural motivation" has been re-defined, as "based on the degree to which a given activity is associated with unique or common goals in an individual's goal's network" **(Shah & Kruglanski, 2000, p. 105)**;
3. The wish to take part in an activity for its own sake **(Deci & Ryan, 1985)**;
4. Intrinsic motivation is about doing something because it is inherently interesting or enjoyable (**Ryan & Deci, 2000c**).

Rigby, Deci, Patrick, & Ryan (1992), **Ryan, & Deci (2000b, 2000c)**, and **Ryan, Mims, & Koestner (1983)** have tried to answer the question whether intrinsic and extrinsic motivations are antagonistic. They have found that the relative autonomy of motivation has more importance in characterizing the motivational basis of learning than the intrinsic-extrinsic dichotomy. This finding is with accordance to the conclusion that intrinsic and extrinsic motivational orientations do not necessarily contradict each other. The researchers have also shown that intrinsic motivation is facilitated by autonomous social contexts, resulting in high quality learning.

Deci (1975), and **Deci & Ryan (1992)** have found that interest is a part of intrinsic motivation. Children who have an intrinsic drive are motivated by their interests and desire to acquire knowledge to be effective and self-initiating.

Renninger (2000) has stressed the importance of interest and task values in enhancing intrinsic motivation. According to her, in order to understand individual's motivation to learn and be engaged in a learning process on one's own initiative, one must focus on individual's interest. Individual interest increases as both knowledge of the subject and the value one ascribes to it increase. **Renninger (ibid)** suggests, that effort also depends on interest; thus the path from knowledge and value to intrinsic motivation goes through interest and effort. She explains how one's interest might develop with time, how should such development be supported when a child is concerned, and what are the influences of gender and age on this development.

6.2.2.3. Learning versus performance motivation

Dweck (1999) slaughters some holy cows, generally accepted as truths both in society in general and in the context of learning environments in particular. These commonly believed truths are:

1. That high ability positively correlates with learning-oriented motivation;
2. That high achievements in school enhance learning-oriented motivation;
3. That the belief in one's high intelligence has a high correlation to her/his adaptation of learning motivation;
4. That praise in general and praise of the student's intelligence I particular help to foster her/his learning achievement motivation.

By conducting a series of studies **Dweck** and her colleagues **(1975, 1990, 1991, 1996a, 1996b, 1996c, 1998, 1999; Dweck & Bempechat, 1983; Dweck, Chiu, & Hong, 1995a, 1995b; Dweck, Davidson, Nelson, & Enna, 1978; Dweck & Elliot, 1983; Dweck, Goetz, & Strauss, 1980; Dweck, Hong, & Chiu, 1993; Dweck, & Leggett, 1988; Dweck, & Repucci, 1973)** have come to the following conclusions:

1. High ability students do not necessarily adopt a learning-orientation motivation. Neither do these students tend to persist in spite of difficulties and problems. With some high ability students the opposite is correct: whether because they worry too

much about not being as good as they are expected to be, or because they have never faced real challenge and cannot take the possibility of failure into consideration, many of them give up easily and are not ready to go on after a failure (**Dweck, 1999; Legget, 1985; Licht & Dweck, 1984; Licht, Linden, Brown, & Sexton, 1984**).

2. Success in school is not necessarily a result of a learning-oriented motivation. Without taking into consideration the social and cultural components we shall discuss later, it has been shown that various personality ingredients play an important role in choosing the preferred learning orientation. For example: learned helplessness (**Diener & Dweck**, **1978, 1980**); expectations and attributions (**Dweck, 1975**); self-worth (**Kamins & Dweck**, **1998**, **Dweck, 1999**), entity versus incremental theory (**Dweck & Leggett, 1988**).

3. We might expect that believability in one's abilities will have a positive correlation with mastery-oriented motivation. Thus is seems logical that students who are praised for their achievements and intelligence would tend to adopt this orientation. However, this is not the whole story. Many students with good achievements who believe they have high intelligence perceive setback as a threat to their abilities, and are not ready to handle difficulties (**Henderson & Dweck, 1990; Hong, Chiu, & Dweck, 1995; Hong, Chiu, Dweck, & Sacks, 1997; Hong, et al, 1999**).

4. Praising in general and praising intelligence in particular usually increase the student's fear of failure, avoidance of risk-taking, and losing confidence after a single failure. The result is coping poorly with obstacles (**Kamins & Dweck, 1998; Müller & Dweck, 1998**).

Intrinsic motivation is an important construct, reflects the natural human tendency to learn and process the learned materials. On the other hand, extrinsic motivation is either a reflection of external control or a component of self-regulation. Both kinds of motivation are related to basic human needs for autonomy, competence, and relatedness.

New studies show that there is a high positive correlation between intrinsic and extrinsic motivation among students of all ages and all levels. **Harackiewicz and her colleagues** (**1989; Harackiewicz, & Manderlink, 1984; Harackiewicz & Sansone, 2000)** have discovered, that rewards – usually connected to extrinsic motivation – increase the level of intrinsic motivation.

In the US **Deci**, **Koestner, & Ryan (1999a, 199b)** and **Ryan & Deci (2000b, 2000c, 2000d)** have surveyed the literature about benefits of intrinsic as well as extrinsic motivation. They suggested that individuals have innate needs for competence and control, and that rather than focus on the effects of any particular "extrinsic" motive one must consider both intrinsic and extrinsic motivation as well as the need to satisfy both needs.

According to **Dweck (1999)**, adopting either kind of motivation helps to achieve a higher level of learning goals, and the combination of both is "[…] the best of all possible worlds" (**ibid**, p. 16). Nonetheless, **Dweck** (**1999, Elliott & Dweck, 1988)** identifies a danger of adopting avoidance strategy caused by preferring achievement goals to learning ones.

Dweck and her colleagues (e.g. **1999, Dweck & Leggett, 1988)** have suggested, that students with a dominant achievement motivation will adopt adaptive learning behaviors, such as approaching moderate assignments, and invest intellectual and time-consuming resources in order to succeed only if they perceive their ability as high (see also **Elliot, Chirkov, Kim & Sheldon, 2001; Elliot, & Church, 1997; Elliot & Covington, 2001; Elliot, Faler, McGregor, Campbell, Sedikides, & Harackiewicz, 2000; Elliot & Harackiewicz, 1994, 1996; Elliot & McGregor, 2001; Elliot, McGregor & Gable, 1999; Elliot & Sheldon, 1997; Elliot, Sheldon & Church, 1997; Elliot & Thrash, 2001; Elliott & Dweck, 1988; Maehr, 1984, 2001; Maehr & Meyer, 1997; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Nicholls, 1984a, 1984b, 1990; Thrash, & Elliot, 2002)**.

<u>In other cultures</u>. A study by **Lee (1998)**, examining the relationships among motivational beliefs, goal settings, effort, persistence, and academic performance, was conducted among students of two colleges in Taiwan. It was found that extrinsic goal orientation had a positive effect on goal level, and goal level had a direct, positive effect on academic performance. Thus, extrinsic goal orientation had a positive effect on academic performance through the mediator variable of goal level.

In summa: Since each of the above mentioned motivation styles contributes to enlarging knowledge, and since in many cases either this result is educationally satisfying or it serves as means for access to a higher level of learning, both learning and achievement motivation should be encouraged and rewarded.

6.2.3. Approach and avoidance motivation

6.2.3.1. Introduction

The difference between approach and avoidance motivation is a function of valence: while in approach motivation the behavior is influenced by a positive or desirable event or possibility, in avoidance motivation the behavior is influenced by a negative or undesirable behavior (**Elliot, 1999**). **Elliot & Covington (2001)** claim, that the dichotomy approach versus avoidance is fundamental, and should be referred to as the basic distinction upon which other motivational distinctions are built. The arguments given to this assumption are varied:

I. Historical arguments. The approach-avoidance dichotomy can be traced to the Greek philosophers Democritus (460-370 B.C.) and Aristippus (435-356 B.C.) who believed in hedonism based on gaining pleasure and avoiding pain as the main characteristic of human behavior. Their follower was the British philosopher Jeremy Bentham (1748-1832), upon his work **James (1890**) developed his discussion on pain and pleasure. **Freud (1915)**, and **Jung (1921)**, based their work on seeking pleasure and avoiding pain; **Thorndike (1911)** used the term "law of effect", according to which what leads to satisfaction is reinforced while acts that result in discomfort are weakened. **Tolman (1925), Pavlov (1927),** and **Skinner (1938)**, as well as their followers **– Lewin (1935), Miller (1944), Hull (1943), Murray (1938), Rotter (1954),** and **Maslow (1955)** all based their discoveries on Freudian insights, as well as on those of their predecessors – all relied on the approach and avoidance basic principle.

II. The second argument, according to **Elliot & Covington (2001)**, to the high importance of the approach-avoidance distinction, stems from its validity across many forms of animate life. According to **Schneirla (1959**) organisms at all levels of complexity possess an approach-type mechanism regarding getting food and shelter and mating, and avoidance-approach behavior which serves as avoidance means against dangerous situations. Such behaviors have been found among monkeys, dogs, wolves, cows, goats, rats, mice, birds, snakes, fish, and even crustaceans.

III. The third argument is based on the immediacy and automaticity of the approach- and avoidance-based motivational processes. All surviving organisms have the reflex to react immediately either towards reaching the desired aim or away from a hazardous situation (e.g. **Orians & Heerwagen, 1992; Zajonc, 1984**).

IV. The fourth argument is based on neuro-physiological data that support the existent of approach and avoidance systems in the brain. Though this evidence is still partial (e.g. **Cloninger, 1987; Davidson, 1993; Gray, 1982; Lang, Bradley, & Cuthbert 1990**), they all share the evidence that there are neuro-anatomical sub-stratums in the bottom of approach and avoidance motivation behaviors.

6.2.3.2. Constructs included in the approach and avoidance approaches

Approach behaviors include, according to **Urdan & Midgley (2001)**, the following components: effort, persistence, engagement, choice, and performance. In the avoidance behaviors list **Urdan & Midgley (ibid)** include the following components: purposefully withdrawing effort, resisting help-seeking when needed, avoiding risk-taking, and giving up when faced with a challenge.

I.

6.2.4. Social motivation

According to **Dweck (1996c**) and **Weiner (1998, 2000**), social motivation of school children is connected in most cases to educational motivation. Usually children attend school because of social and educational reasons: they do what is expected from children their age, like going to school like their peers. In addition, each child needs social experience for the development of his or her educational potential. Thus, these two kinds of motivation are clearly jointed and should be treated as two facets of the same concept.

Wentzel (1989) has presented data showing that different goals held by students are correlated to grades and standard achievements test scores. She found that non-conformist students that have not accepted the classroom normative ways of behavior received lesser grades. The explanation to this result was by assuming that these non-conformists have lesser abilities than the more conformist students. As a result she suggest intervention aimed toward changing the behavior of the less achieving students rather than focusing only on their academic disadvantages. According to **Jussim (1991)**, adopting Wentzel's recommendations might prove too costly: there is a possibility that non-conforming students achieve lower grades not because of their inferior abilities but because of teachers' bias against them, while increasing such students' conformism might have hidden price, such as limiting students' independence. **Wentzel**'s reply (**1991)** consists of two parts: 1. As both school grades and grades of objective ability tests are both inferior among non-conformists, it can hardly be convincing that teachers' bias causes low grades of these students. 2. There is no identity between conforming in class and learning social skills. Unfortunately none of these arguments is always valid; if fact, many so-called "objective" ability tests have been proven to be similar to those given as checking-knowledge tests (e.g. **Sternberg, 1996; Ziv, 1999)**, and there is no proof that social abilities are a must for educational advancement.

Wentzel (2000) also explains how social goals can interact in three different ways with academic ones. According to her, a first such interaction might occur by relations among social and academic goals: fundamental orientations toward the self and the social environment might help academic effort to be successful. Social goals can interact with task goals and together they have better prospects to influence the achieving of academic targets. A third such interaction might be reciprocal or hierarchical. For example: being liked by peers might enhance academic achievement. On the other hand, in order to be liked by the teachers or by peers in a different class climate a student might adopt a behavior of investing more effort in either social or academic tasks, and thus be able to help or seek help from others which might result in better academic results (e.g. **Ames, 1984, 1992; Ames, & Archer, 1988).**

6.2.5. Relative ability motivation

Relative ability motivation, or the wish to do better than the others, has been described in the **Pintrich, Zusho, Schiefele, & Pekrun (2001)** research as culturally dependent. Thus, while among American students relative ability goals were not significantly related to elaboration or meta-cognition, they were positively related to these two measures among German students. Although German students reported of a higher level of anxiety, as predicted by the adoption of relative ability goals orientation, they reported also more interest in their studies, a finding that contrasts some of the **Dweck** (e.g. **1999**) assumptions.

It seems that some factors might be much more significant for the shaping of students' goals than fitting to the entity Dweck Theory. For example: availability of institutions for higher education and the free choice to learn whatever interests the student. In Germany there are basically enough places in the various universities for each *Gimnasium* graduate. Because tuition is free, it is unlikely that a student will study something that bores him. In addition to the low level of relative ability goals it is expected that the level of boredom among German students will be lower than among American students, who not only have to study many compulsory subjects in order to be accepted to a graduate school where they would choose their final subject, but have to pay for their studies as well.

6.2.6. Utility motivation

Future use of the knowledge also influences the motivation to learn the subject matter. This kind of motivation has been given different names, implying different emphasizes: **Eccles (1983)** and **Eccles et al (1983)** have called it "utility value" of an assignment; **Ford (1992)** has called it "material gain"; **Maehr (1984)** – "Extrinsic rewards"; **Markus & Nurius (1986) –** "possible selves"; **Nuttin (1984, 1985) –** "time perspective", and **Raynor (1974) –** "future orientation". They all meant that the source of the student motivation lies in the material, educational, or professional results of learning.

6.2.7. Problems of definitions: Multiplicity of definitions and lack of accepted terms

> Multiplicity of definitions occurs because ours is an inexact discipline; we simply do not agree on the definitions and operations of key motivational constructs (**Schunk, 2000, p. 116)**;
>
> Problems arise because how we define constructs influences which measures we use to assess them and how we interpret our research results are directly traceable to differences in definitions and in measures used to assess the same construct (**ibid, p. 116-117**).

Indeed, even the basic motivational terms suffer from multiplicity of names. For example: while **Dweck (1986**) has differentiated between performance and learning goals, **Nicholls (1984a**) has called them ego and task engagement, and **Ames & Archer (1987**) preferred the terms performance and mastery learning goals.

Motivation research has suffered, according to **Bong (1996**), from a lack of one model including all components relevant to it. Thus, while some researchers have focused on certain aspects of motivation, and studied some of its components, others have neglected these aspects and came to conclusions without as much as taking them into consideration. In addition, motivation studies have been conducted in a variety of age groups, at different stages of education, with a tendency to choose the more available samples (e.g. psychology university or college students, middle-class school children). In addition, many studies have been conducted on just a few subjects, mainly mathematics and reading or writing. Furthermore, these studies have – in most cases – missed dealing with some of the questions connected to both edges of the achievement spectrum: students with very low achievements, and gifted students.

Bong (ibid) has summarized the main problems in motivation theory resulting from unsatisfactory system of terms, as those resulting from not taking into account some important components of motivation, resulting in lack of one comprehensive model of motivation research:

1. The different terms for theories of motivation;
2. Motivational constructs without discriminant validity;
3. The different theories of motivation overlook various components that have a substantial influence on it.

Summary and future view: We have seen that for the same motivational terms there are many synonyms, all used practically for differentiating among but tiny nuances of the same concepts. In the forthcoming discussion I will try to use no more than two terms for each motivational constructs in order to prevent as much confusion as possible.

6.3. Goals

6.3.1. Definitions of goals

1. A goal is a cognitive representation of what it is that an individual is trying to achieve in a given situation (**Wenzel, 2000**);
2. "That toward which effort is directed; aim or end" (***The American College Dictionary*****, p. 517)**;
3. "A destination, an object of effort or ambition" (***The advanced learning dictionary of current English*****, p. 535).**

6.3.2. Definitions of Achievement/learning/mastery and performance goals

1. A learning goal "refers to what knowledge and skills students are to acquire" (**Schunk & Ertmer, 2000, p. 635**); A performance goal denotes what task students are to complete" (**ibid, ibid**);
2. *An achievement goal* concerns the purposes of achievement behavior. It defines an integrated pattern of beliefs, attributions, and affects that produces the intentions of behavior (**Weiner, 1986**) and that is represented by different ways of approaching, engaging in, and responding to achievement-type activities (**Dweck & Leggett, 1988**);
3. **Elliott and Dweck (1988**) defined and achievement goal as involving a "program of cognitive processes that have cognitive, affective, and behavioral consequences" (**p. 11)**;
4. **Pintrich (2000a**) defined achievement goals as "the purposes or reasons an individual is pursuing an achievement task";
5. "Achievement goals [are] the purpose of task engagement, and the specific type of goal adopted is posited to create a framework for how individuals interpret and experience achievement settings" **(Maehr, & Ames, 1989;** cited by **Elliot, 1999)**.

6.3.3. Approach versus avoidance goals

The concept of achievement goal approach was developed in the 80ies with the work of **Nicholls (1984a), Ames (1984), Maehr (1984),** and **Dweck (1986)**. In spite of the fact that the division within approach goals into two categories has several nuances, researchers agree to the division into performance- versus mastery goals. Performance goals were believed – until contradictory results were found in more recent studies – to be linked to negative consequences, such as a low level of persistence, especially when facing failure, superficial learning, or a low level of enjoyment. Mastery goals, on the other hand, were believed to have positive outcomes, such a persistence in the face of failing, deep learning and understanding the material, and high level of enjoyment **(Ames, 1992; Dweck & Leggett, 1988; Nicholls, 1990; Nolen, 1988).**

While Dweck used her achievement goal theory to explain mastery or helpless responses to failure (e.g. **Dweck, 1984, 1986; Dweck & Bempecht, 1983; Dweck & Elliott, 1983), Nicholls** explained them with his ego-task involvement distinction his work about conceptions of ability (**Nicholls, 1978, 1984a, 1984b, 1989, 1990; Nicholls & Miller, 1984)**. However, both Dweck and Nicholls have realized, that achievement goals might belong either to the approach or to the avoidance category. **Dweck & Bempechat (1983**) have found, that performance oriented people might adopt either an approach or an avoidance behavior. Their explanation to this phenomenon was that while people with a high level of competence would probably adopt an approach behavior, those with a low level of competence would rather prefer the avoidance one. **Nicholls (1984a**) used the competence ingredient to explain his ego-task involvement dichotomy in a similar way. Schunk and Zimmerman and their colleagues (**Schunk, 1981, 1982, 1983, 1984, 1989a, 1989b, 1990, 1991, 1994, 1995, 1996, 2000; Schunk, & Ertmer, 2000; Schunk, & Zimmerman, 1994, 1996, 1998; Zimmerman, 1990; Zimmerman & Martinez-Pons, 1990**) have also researched this issue intensively.

6.3.3.1. Why is the approach versus avoidance concept needed?

Unfortunately, even when taking competence into consideration as a moderator, the performance-mastery goal distinction has not proved to predict achievement-relevant processes and outcomes. The clue to this dilemma lies in the fact that most studies by Dweck and Nicholls and their colleagues were conducted in the laboratory while those challenging them were ”field experiments”, taking place in a natural environment such as classrooms. Studies of mastery goals were consistently associated with positive outcomes in field-research; they did not prove as consistently positive in the laboratory (**Harackiewicz, Barron, & Elliot, 1998; Urdan, 1997, 2001; Wolters, Yu, & Pintrich, 1996)**.

In the case of performance goals the picture is even more mixed. Some studies have shown, that performance goals had negative outcomes when the level of competence was low (**Butler, 2000; Covington & Omlich, 1984; Elliot & Church, 1997; Elliott & Dweck, 1988; Smiley & Dweck, 1994**). In any case, in many studies that did take the competence component into consideration the results were nevertheless mixed **(Elliot, & Harackiewicz, 1996; Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997**; **Harackiewicz, & Elliot, 1998; Kaplan, & Maehr, 1999; Kaplan, & Midgley, 1997; Miller, Behrens, Greene, & Newman, 1993; Miller et al, 1996)**. Thus the conclusion must be that the Dweck/Nicholls theory about the negative influences of performance goals is not valid, unless perhaps other variables – in addition to competence – are taken into consideration, or the theory should be refined.

Elliot (1994, 1999) has found that performance goals classified as approach ones resulted in similar outcomes to those classified as mastery goals, while performance goals classified as avoidance undermined intrinsic motivation. **Elliot & Church (1997)** have discovered that performance goals classified as approach ones tended to have either no correlations or positive correlations with intrinsic motivation, while those classified as avoidance goals correlated negatively with intrinsic motivation. This discovery led to the trichotomous achievement goal framework.

6.3.3.2. The trichotomous achievement goal framework

The trichotomous achievement goal framework includes the conventional goal constructs, i.e. the approach and avoidance motivations, and three independent achievement goals: mastery goal, performance-approach goal, and performance-avoidance goal **(Elliot, 1999)**. The need for achievement is an approach motive, leading the person who adopts it to success **(McCleland, 1955a, 1961; McCleland, Atkinson, Clark, & Lowel, 1953)**. Thus, the result of materializing the need to succeed can be the adoption of either mastery or performance approach. Fear of failure has a potential to lead to performance-approach goals; when the wish to prevent a failure is accompanied to the one of attaining success the result is the adoption of a performance goal.

As we have already shown, the competence variable should have influenced the motivation approach in a straightforward way: people with high competence perception should have chosen approach goals – either mastery or achievement;

people with a low competence perception – a performance avoidance goal. In contrast to the theories of Dweck and Nicholls (ibid), where competence is the only component influencing the adoption of approach or avoidance motivation, in the trichotomous achievement goal framework perceived competence is just one out of many ingredients influencing the adoption of approach, avoidance, or mixed-goals. **Dweck** herself has suggested the incremental versus fixed beliefs about intelligence as predictors of approach or avoidance approach (e.g. **1990, 1999**). **Sorrentino** and his colleagues (e.g. **Sorrentino, Brouwers, Hanna, & Roney, 1996; Sorrentino & Hewitt, 1984; Sorrentino, Roney, & Hanna, 1992; Sorrentino, & Short, 1977; Trope, 1986**) have offered the hypothesis that the choice between approach and avoidance approaches depends partially on how much the individual seeks information about her/his performance. Various researchers have studied the influence of many more variables on choosing approach or avoidance goals; the variables considered most important and thus studied more deeply than the others are gender (e.g. **Dweck, 1986; Ghei, 1973),** ethnicity (**Rosen, 1959**; **Urdan, 1997, 2001**), and socio-economic or socio-cultural background **(Adkins, & Payne, 1972**; **Botha, 1971**; **Cooper & Tom, 1984; DeBord, 1977**; **Hall, 1972**; **Hines, 1973, 1974**; **Maehr & Nicholls, 1980**).

In addition to the components listed above, it was found that there is a neuro-physiological pre-disposition that directs the individual towards goal adoption **(Elliot, & Sheldon, 1997; Elliot, Sheldon, & Church, 1997)**. Individuals whose tendency is to react to positive stimuli would be predicted to choose performance-approach goal; those who tend to react to negative stimuli – to performance-avoidance goals. While all other variables are more easily changeable and acquired by education and socialization processes, neuro-physiological pre-dispositions are presumed to be rooted in the individual and can hardly change.

Goal orientation is also influenced by environmental variables, such as norm-based evaluation, and relationally-based variables, or fear of rejection. We can thus see, that there are, according to **Elliot (1999**), at least six different kinds of variables that influence the adoption of approach or avoidance motivation, and each theory that fails to take them into consideration might either lead to false conclusions or end with results that contradict other existing theories proved to be right under other circumstances or conditions.

6.3.3.3. The 2x2 achievement goal framework

In the second half of the 90ies a new motivational model has been proposed by **Elliot and his colleagues** (**Elliot, 1997, 1999; Elliot, & Covington, 2001**; **Elliot & Church, 1997; Elliot & Harackiewicz, 1996**). This model includes not only the "traditional opposites of "mastery/learning" vs. task/achievement motivation, but for the task/achievement motivation it includes the approach and avoidance component as well. According to this model three motivational possibilities existed: mastery/learning motivation; task/achievement approach motivation, and task/achievement avoidance motivation. This new model received scientific reinforcement; research done in various studies (e.g. **Elliot & Church, 1997; Middleton & Midgley, 1997; Skaalvik, 1997; VandeWalle, 1997)** has shown that these three goal constructs were related to different patterns and led to different results.

A new motivational construct has been suggested by **Elliot & McGregor (2001)**. This construct is the combination of mastery/learning and avoidance motivation, already suggested by **Elliot (1999)** and applied as a variable in a research by **Linnenbrick & Pintrich, (2000**), and **Pintrich (2000a, 2000b, 2000c)**. The reason for overlooking this component of the 2x2 matrices is, according to **Elliot & McGregor (2001)**, the tendency of theorists to identify mastery goals with intrinsic motivation (e.g**. Dweck, 1999**), and to perceive mastery goals as based on high competence regulation. Thus, the concept of mastery goals that co-exist with avoidance motivation seems illogical, and as a result was not taken into consideration until recently. The mastery-avoidance goal construct can be demonstrated in school as well as in every other domain of everyday life: putting much effort in order not to fail in a test; working hard in the gym for the sake of not losing one's good shape; spending a lot of time in the kitchen so that the meal will not be a failure.

Perfectionists are mostly people who have adopted a mastery-avoidance goal orientation (**Flett, Hewitt, Blankkstein, & Gray, 1998)**: they work hard in order not to fail, but since they are hardly satisfied with their achievements they tend to fear of failing or of not being good enough, which for them is the equivalent of a failure.

Perfectionism is considered a "female hazard" (**Kline & Short, 1991; Martin, 1985; Polotzki, 1989; Silverman, 1991; Reis, 1987; Schwartz, 1994; Zorman &**

David, 2000). Girls and women, especially when gifted or talented, are exposed to it more than “regular” females and more than talented and gifted males.

6.3.4. Correlations between mastery and performance goals

Barron & Harackiewicz, (2000, 2001) have found, that there are positive effects of performance goals on intrinsic motivation and performance. The model of multiple goals **(Wentzel, 1989)** they present suggests that both performance and mastery goals can optimize intrinsic motivation and performance. **Lepper and colleagues (2000; Lepper, Green, & Nisbett, 1973**; **Lepper, & Hodell, 1989**) have suggested a similar model. According to them, intrinsic and extrinsic motivational orientations can relate to one another in different ways: they can be in conflict, but they can also be positively correlated to affect behavior. **Hidi (2000)**, who reviewed changes in motivational aspects of school-activities, suggested that extrinsic factors might play an increasingly more important role in motivating students so they would progress through their education. This finding is in accordance with the Israeli school situation, where even good students with a high level of intrinsic motivation must study subjects they don’t particularly like while approaching the matriculation examinations.

Anderman, Austin, & Johnson (2001), Anderman, Eccles, Yoon, Roeser, Wigfield, & Blumenfeld (2001); Middleton & Midgley (1997), and **Nicholls (1990**) have found low correlations between mastery and performance goals. **Pajares, Britner, & Valiante (2000)** have found, in a research done among middle school American students, that task-goals and performance goals were positively correlated. **Dweck (1999)** has summarized that “but both [learning- and performance] goals can fuel achievement” **(p. 15)**.

The dichotomy between learning and achievement goals has been criticized by many researchers (e.g**. Ames & Archer, 1988; Bong, 1996, 2001; Deci, Koestner, & Ryan**, **2001; Elliot & Church, 1997; Harackiewicz et al, 1997**; **Harackiewicz et al, 1998; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Harackiewicz, & Elliot, 1998; Harackiewicz, & Sansone, 1991; Harackiewicz, & Sansone, 2000; Stone, 1998). Dweck (1999**) has summarized this concept in a few words:

> All students want to be validated for their skills and their accomplishments. They also want to develop their skills and knowledge. So it’s not that there is anything wrong with either kind of goals **(p**. **15**).

6.3.5. Goals and motivation: Connections among variables

The two main kinds of goals defined by **Dweck (1990, 1999**) are learning and performance goals. While learning goals are connected with striving towards fulfilling challenges, performance goals are connected with both the wish to please others or be perceived as smart by others, and with avoidance behavior, i.e. choosing not to strive towards challenges, caused by the fear of not being successful.

Research has shown (**Ames & Archer, 1988; Meece, Blumenfeld, & Hoyle, 1988; Miller et al, 1993; Nolen, 1988; Pintrich & Garcia, 1991)** that students with learning goals approach report using more meaningful or deep cognitive strategies than students with a performance approach.

Ames & Archer (1988) studied junior high/high school academically advanced students regarding their goal orientation, use of effective learning strategies, task choices, attitudes, and causal attributions. Students who emphasized **mastery goals** reported using more effective strategies, preferred challenging tasks, had a more positive attitude toward the learned subject, and had a stronger belief that success was a direct result of effort. Students who stressed **performance goals** perceived their ability as more important, while evaluating their ability negatively and attributing failure to lack of it.

In accordance with the **Dweck (e.g. 1999**) theory, **Wolters et al (1996)** have found that 7th and 8th graders adopting learning goals resulted in positive patterns of motivational beliefs that included high level of task values, self-efficacy, low level of test anxiety, as well as high academic performance.

Research of the relation between 9th and 10th grade high school students' motivational regulation and their use of learning strategies, effort, and classroom performance **(Wolters, 1999**) resulted in somewhat different findings. As in the previously described research (**Wolters et al, 1996)**, the students participating in this study **(Wolters, 1999**) were using the "doing better than others" motivation to enhance their effort and improve their achievements. This finding contradicts previous research (e.g. **Ames, 1992; Anderman & Maehr, 1994; Graham & Golan, 1991; Pintrich & De Groot, 1990)**, according to which intrinsic goals were found to be more adaptive than extrinsic ones, including that of outperforming others. The explanation that **Wolters (1999)** gives is that students are more familiar with this kind of motivation. Another explanation for this finding is that when high school students approach the end of adolescence, they become more aware of the importance of grades for their future academic studies, and of their relative place in the classroom and in the school, that influence their chances of being a valedictorian, or getting any of the other honors as best pupils.

6.4. Variables that influence motivation

6.4.1. Culture

Dweck and her colleagues (e.g. **1975, 1986, 1990, 1991, 1996b**, **1999, Burhans & Dweck**, **1995; Cain & Dweck, 1995)** have conducted most of their research among American students of various ages. The question whether these conclusions are valid for other cultures should be examined. For example: the Chinese culture values hard work and academic excellence (**Hong, 2001; Yang, 1986**). To work hard and be an outstanding school student is the main obligation of the Chinese child (**Tao & Hong, 2000)**. Hong Kong students that did not succeed in school were found to feel guilty for disgracing their families **(Hong & Lam, 1992).** Thus, one should expect a high percentage of students whose main learning motive is extrinsic. On the other hand, Chinese culture values self-improvement and effort-investment, and does not emphasize so much the concept of stable intelligence (e.g. **Hong, 2001**). While in American culture one might be perceived as having a low ability if (s)he puts a lot of effort in an assignment, in the Chinese culture the opposite is correct: effort-investment is perceived as an integral part of intelligence, i.e. an individual who works hard is valued as clever. Thus, among 5-year-olds correlations between effort and ability was .84 for success and .86 for failure (ibid). In the light of the differences, Dweck's theory, that points at the correlation between perception of intelligence as stable or flexible and its influence on the adoption of extrinsic or extrinsic motivation orientation through the moderator variable of incremental or entity theory might not be valid in all cultures.

Salili, Chiu, & Hong (2001a) have correctly observed, that: "[…] context of learning is influenced by the culture of a society. The prevalent norms, values and beliefs in a society are reflected in its cultural practices and expectations in different life domains" (p. 1). In their book (**ibid, 2001c**) they bring different points of view about student motivation, including attributions, values, self-esteem, effort and ability, and achievement, goal orientation, and self-regulation from various cultures. Let us see how each of these components is influenced by the culture in which it takes place.

Salili, Chiu, & Hong (2001b) have compared goal orientation, self-efficacy, test anxiety, and effort among culturally different students in three groups: <u>Chinese students in Hong Kong</u>, <u>Canadian students of European origin</u>, and <u>East-Asian Canadian students</u>. Although there is evidence that Chinese students have become more Westernized (**Yu & Yang, 1987)**, family and social groups have still played an important role on the student's achievement motivation (**Salili, 1995)**. Peers **(Chen, Stevenson, Hayward, & Burgess; 1995; Schneider & Lee, 1990)** and teachers **(Chen et al, 1995)** played a special role in supporting academic activities of Asian and Asian-American students. In addition, Chinese parents were found to be influenced by Confucian values; one of the main characteristics of Confucian teaching is the high importance of education (e.g. **Chen & Stevenson, 1989; Salili, 1995**). It is important to note, that in **Chen's (2001)** study of parents' attitudes and expectations regarding science education similar results were found: Chinese parents placed greater emphasis on self-improvement, set higher standards, and helped their children more than American parents; the attitude of the Chinese-American parents was influenced both by the Chinese heritage and the American environment.

Maehr & Yamaguchi (2001) have found cultural differences between American and Japanese college students regarding motivation. As expected, American students were more intrinsic motivated than Japanese students.

Hines (1974) compared achievement motivation data from four ethnically identical but culturally different groups: English, Australian, New Zealander, and North American individuals selected randomly from business directories and university catalogs. Among managers the English scored the highest, the Australians and the Americans scored about the same, and the New Zealanders scored the lowest. Among educators Americans scored the highest and the English scored somewhat lower; the New Zealanders – as among managers – scored the lowest. **Elizur (1979)** compared achievement motivation of Israeli and American managers. He found that the need for achievement motivation was higher among Americans. Thus we can see that motivational orientation is highly culture-dependent.

<u>6.4.2. Age: Decline in the motivation in the transition to middle school</u>

Intrinsic motivation correlates negatively with age (**Midgley, 2002**; **Stipek, 1984, 2001**). According to **Stipek (1984, 2001**), while in kindergarten children experience neither shame nor embarrassment when failing, and as a result they perceive no performance anxiety and their achievement motivation remains intact in spite of failures. The situation does not change substantially in grade 1, namely, though the learning becomes more structured most children are still intrinsically motivated and only few signs of anxiety are visible. The main difference between kindergarten and grade 1 is in the need of school children to have more contact with the teacher – many of them need extra “private” explanations and instructions. Some adopt failure-avoidance behavior and some – learned helplessness (**Covington & Beery, 1976**; **Covington & Omelich, 1981; Holt, 1964; Jakson, 1968)**. Not participating in the classroom activities and being helpless are behaviors typical to avoiding failure; another such behavior is choosing only easy assignments. The helpless child seeks help without even trying to fulfill the given task on her or his own.

Freedman-Doan, Wigfield, Eccles, Blumenfeld, Arbreton, & Harold (2000) interviewed 865 first-, second, and fourth-grade American children regarding their ability to improve their achievements in academics, sports, music, and arts. The children were optimistic about their ability to perform better by investing more effort in all areas, especially in academics and sports. In fourth grade an increasing number of children started doubting whether putting more effort would enable them to score best in their current worst activity. However, most children sill believed that their abilities could improve so much that they become best in their weakest present area. This finding is in not completely in accordance with those of **Benenson & Dweck (1986), Eccles, et al., (1993),** and **Wigfield, Eccles, Harold, Blumenfeld, Arberton, Freedman-Doan, & Yoon (1997)**, who found that during elementary school years children’s beliefs in their abilities became less positive.

A severe problem of motivation decline takes place in the transition from elementary- to middle school in the US (**Anderman & Maehr, 1994; Wigfield, Eccles, MacIver, Reuman, & Midgley, 1991)**. While in elementary school intrinsic motivation is enhanced, in middle school neither teaching methods nor class environment encourage the development of intrinsic motivation as in elementary school. **Anderman & Maehr (1994), Anderman, & Midgley (1998),** and **Eccles & Midgley (1989**) suggested that the transition from elementary to junior high school is characterized by a shift to a more performance-oriented motivation.

Dresel (2000) has indicated, that the motivation problem of school children becomes more and more acute as they grow older. Many other studies have agreed with this finding (e.g. **Helmke, 1992; Schober, 2000b)**. The Israeli educational system requires a high-level of math knowledge at the end of junior high school in order to be entitled to study high-level high school math. Thus the issue of mathematics motivation should receive a special emphasis among junior high school children, when increasing the motivation level can still make a change, namely, influence the pupil to choose a scientific track that includes high-level mathematics.

Shi, Wang, Wang, Zuo, Liu, Maehr, Mu, Linnebrink, & Hruda (2001**) have found negative influence of age on the motivational pattern across the middle school in China. Older students adopted more performance-focuses goals, and used less deep-learning strategies than younger ones.**

In summa: Most studies concentrate on the 12-16 age group, which is consisted mainly of junior high school students. However, findings from primary school children, as well as from studies among college students will also be summarized hereby, aimed to get the widest possible picture.

6.4.3. Gender and motivational styles

Many studies have found gender differences regarding the belief about how much children's abilities can change. In the **Freedman-Doan et al. (2000)** research of first, second, and fourth graders, children's ability beliefs for the various activities **–** academics, sports, arts, and music were culturally stereotyped in all domains. The same results were found both among elementary school children (**Eccles, Wigfield, Harold, & Blumenfeld, 1993; Wigfield et al., 1997**) and preadolescents to young adults (**Marsh, 1989)**.

In a research done in English high schools among hundreds 7^{th}, 9^{th}, and 11^{th} graders **Rogers, Galloway, Armstrong, & Leo (1998)** have found that in math and English the motivation level of boys was similar to that of girls.

Miller et al (1996) measured the 5 goals students might have had for doing academic goals **–** learning goals, performance goals, obtaining future consequences, pleasing the teacher, and pleasing the family. No substantial gender differences have been found.

Patrick, Ryan, & Pintrich (1999) have examined whether gender differences regarding goal orientation existed in a sample of 7^{th} and 8^{th} grade American students. It was found that females were more mastery oriented while males more extrinsically oriented. In addition, females' extrinsic orientation did not cause a decrease in self-efficacy and achievement, as was the case with males high in extrinsic motivation. On the other hand, among females mastery orientation found in the beginning of the year predicted an increased self-efficacy at the end of the year. High level of mastery orientation found among males didn't predict such effects.

Shi et al. (2001) have studied the influence of the Chinese tradition and culture on the goals of both genders. They have found that male students scored higher than female students in 17 scales of the Pattern of Adaptive Learning Survey (PAL) (**Midgley, Kaplan, Middleton, Maehr, Urdan**, **Anderman, Anderman, & Roeser, 1998**; **Midgley, Maehr, & Urdan, 1993**). Among these scales were: performance focused at school, the performance-focused in class, self-efficacy, the belief that intelligence can be changed, the feeling of belonging in class, the feeling of belonging at school, the use of deep cognitive strategies, effort-avoidance strategies and self-worth protection strategies. Some of these scales were reversed when the climate of the classroom was more democratic.

6.4.4. Ethnicity and motivational styles

Cooper & Tom (1984) have reviewed 43 studies that compared samples belonging to different SES and ethnic groups regarding their need for achievement, taking into account the different ages, genders, the year each study was taking place, and its location. In the comparison between Anglo-Americans and Afro-Americans five of the ten studies revealed that Anglo-Americans had a higher level of achievement motivation, and the results of other three studies were mixed. Of the mixed results in two studies no differences were found, and in the third – the achievement motivation of Afro-Americans was found to be higher. In the other two studies conflicting results were found for two sub-samples.

These results were in accordance with those of **Mingione (1968**) and **Adkins & Payne (1972)**. The average time of the 10 studies reviewed in the **Cooper & Tom (1984)** review was also 1972. The results were highly significant. The exceptions among the studies surveyed, namely, the one that stated a higher achievement motivation level of Afro-Americans and the two that stated no significant differences were all conducted among college students. Thus, it can be assumed that without even taking the SES into consideration, the age and the educational level play a substantial role in the level of achievement motivation of Afro-American students.

A review of nine studies comparing Anglo-Americans with non-Anglo-Americans revealed mixed results. Significant differences regarding achievement motivation were found only in one **(Hall, 1972**) out of the four comparisons between Anglo-Americans and Mexican Americans; it favored Anglo-Americans. Two studies compared achievement motivation between Anglo-Americans and Native-Americans. **Reboussin and Goldstein (1966**) found a stronger need for achievement among first year college Navaho students than among European-American students, and **Query, Query, & Singh (1975)** found a stronger though non-significant need of achievement among Anglo-Americans than among Sioux and Chipewa Native-Americans. **Mingione (1968)** compared the need of achievement in two groups of 5^{th} and 7^{th} graders: Anglo-Americans and Americans of Puerto-Rican origin. Anglo-Americans had a higher need of motivation in three out of the four gender*age groups: the exception was 7^{th} grade Puerto-Rican females who scored higher than Anglo-Americans.

A study that compared Greek-born and United-States born Greek Americans with Anglo-American (**Hines, 1973)** revealed findings similar to those of studies done among South-Eastern Asians: American-born Greek Americans had a higher need of achievement than Anglo-Americans, but lower than Greek-born Americans.

Rosen (1959) compared six different ethnic groups in six different northern states of the US. The group that scored highest in need of achievement was Greeks, the second – Jews, the third and fourth – Protestants and Italians, and the two last – French-Canadians and Afro-Americans. The largest difference was between French-Canadians and all others: the reason might lie not only in the different ethnicities but in the SES difference between these two groups and the other four as well.

6.4.5. Socioeconomic Status and motivational styles

A confirmation of the SES hypothesis as the main one influencing achievement need has been found in the **Adkins & Payne (1972)** study, conducted among 3-6-year-old children from 10 different ethnic groups. The three middle class groups – Mormons, Catholics, and Jews did not differ among themselves.

Tidrick (1971) examined the relation between SES and need of achievement among Jamaican college students. She found a significant positive correlation between these two variables. **Gokulnathan & Mehta (1970)** found consistent but non-significant relations between SES indexes – father's education, occupation, and income – and achievement need of boys and girls from 14 secondary schools in India.

Gruenfeld, Weissenberg, & Loh (1973) studied the relation between SES and the need of achievement among high school Peruvian high school students. They found no differences among seven schools serving children from various socio-economic classes. **Rosen (1972)** found among Brazilian school children that those with the fathers at the lowest educational and occupational levels outperformed their peers whose fathers were at the top of this ladder. Interestingly, this finding is similar to that found recently among Israeli Arabs: not only that the percentage of examinees in the matriculation examinations belonging to the highest SES is lower than those belonging to a lesser SES, the percentage of those entitled to the matriculation certificate has the same pattern (**Statistics, Israel, 2002a, table 13)**. In the Jewish Israeli population a positive relation between SES and achievement exists in all SE classes, as expected (ibid.).

In summa: Although there seems to be a general tendency towards a positive relation between SES and need for achievement, there are mixed findings which point mainly at the need to refine the future studies by taking into account as many variables as possible in each research.

<u>6.4.6. Ability: Motivation and goals of high ability students</u>

Inkson (1971) found a significant, positive correlation between SES and need of achievement among high ability male English teen-agers. **Gokulnathan (1970)** examined the relation between SES and need for achievement among Indian youth with high intelligence. He found – among the three indexes examined – that only father's occupation had a significant relation to need of achievement.

The question whether all students are indeed interested in both goals can be questioned in light of the fact that there are students who do not care about external reinforcement, especially highly talented and gifted students. A high level of internal motivation is in many cases a characteristic of such students, who do not always need to have outer rewards in order to invest as much as possible in learning (e.g. **Winner, 1996; Zorman & David, 2000**). On the other hand, the problem of lack of motivation among schoolboys has become a central issue in many developed countries since the beginning of the 90ies. As for lack of intrinsic motivation – there are thousands of studies dealing with this problem, most of them under the assumption that a higher level of intrinsic motivation is a main clue for improving both the process of learning and its results.

In their study **Shi, Shi et al (ibid)** have examined motivation patterns and goal orientation of gifted 10^{th} and 11^{th} grade Chinese students in comparison to their non-gifted peers. They revealed a change among the gifted students from grade 10 to grade 11: while in grade 10 the gifted students were more mastery oriented than the regular students, this orientation was declining until in grade 11 it reached the level of the mastery orientation among regular students. The opposite process took place with performance orientation: while among regular students it has increased mildly from grade 10 to 11, among gifted students the increase between these two grades was much more substantial and in grade 11 the level of performance-focused goals was higher among gifted students than among regular ones. In addition, many gifted students believed their intelligence was fixed and could not be improved, and were adopting patterns as effort-avoidance and self-protection strategies. Apparently the motivation change among these gifted students, who were already accepted to the best Chinese universities and thus had much less pressure than regular students, had a good reason. During grade 11 these gifted students were to participate in national competitions, and the tension involved caused the change in their motivation styles. Thus, it can be concluded that the school context and the special demands of each educational system might have a crucial influence on the developmental of motivational styles; sometimes more than intra-personal or interpersonal motives.

6.4.7. Classroom versus "real-life" and motivational styles

Pintrich, Marx, & Boyle (1993) have argued that motivation research has taken place mostly in a classroom context, where mastery motivation of "real-life" problems was quite limited. They assumed that four of the motivational constructs – goals, values, self-efficacy, and control beliefs – that contribute to a conceptual change, suffer, while examined in a classroom environment, from two main research problems that limit their validity: 1. They rely too much on cognitive components, and not enough on personal – psychological or sociological ones; 2. They cannot be generalized to circumstances, which belong to out-of-class reality.

In addition, **Anderman, Austin, & Johnson (2001)** have found that there are shifts in students' goal orientations. Some of these changes are predictable, because they depend on the changing learning environments and situations. Such changes can be, for example, the transition from elementary school to junior high school (**Anderman, & Maehr, 1994; Midgley, Eccles, & Feldlaufer, 1991; Midgley, Feldlaufer, & Eccles, 1989; Pajares, & Graham, 1999; Wigfield, Eccles, MacIver, Reuman, & Midgley, 1991)**.

In summa: Motivational styles are quite varied, and depend on many psychological, educational, environmental, social, and familial variables. Each such style has an influence both on classroom achievements and participation. In the rest of this chapter I will describe some more of these influencing ingredients.

6.5. Mastery and helplessness orientation patterns

6.5.1. When does helplessness occur?

Increased helpless behavior in the classroom is observed more frequently when the grade is higher **(Miller, 1982; Rholes, Blackwell**, **Jordan, & Walters, 1980)**. Thus, it can be concluded that such a behavior is learned during school years. Only by understanding the developmental changes children go through we might help decrease helplessness behaviors in the classroom.

Since students who tend to behave helplessly have also self-doubts about their abilities, and they usually decide too quickly to give up assignments rather than persist, or to choose themselves out of interesting subjects because they don't believe they are good enough in it **(Dweck, 1999**).

6.5.2. Learned helplessness and IPT

Dweck (1999) has found that while students with a helpless orientation blamed their failures on their (low) intelligence, students with mastery orientation did not blame their intelligence for their failures. No connection was found between the original ability level and the motivation orientation; however, there was a positive correlation between achievement level and motivation. Not to let a failure stop you has been proved as a recommended means to improve oneself; as well as finding new, more varied ways for learning, repeating the material to be studied, putting more effort trying to understand and apply the new learned subject. Thus, the question of "potential ability" loses some of its relevance as an indicator for future achievements when motivation orientation is taken into consideration.

6.5.3. Gender differences

There is a wide-spread belief that girls are not as persistent as boys when facing failure (**Eccles, 1983; Eccles [Parsons], Adler, & Meece, 1984**). Let us see if this belief has always proven true, and if not – what is the basis that has caused it.

Caldarone, George, Zachariou, & Picciotto (2000) have shown that gender differences in learned helplessness have a genetic basis. In their experiment, female mice showed a higher level of learned helplessness than male ones after an inescapable shock. Similar differences have been observed in rats (**Steenbergen, Heinsbroek, Van Haaren, & Van de Poll, 1989**). It should be noted, though, that no conclusions should be drawn about human behavior until solid research proves the connection between findings among animals and those among humans. Let us, thus, survey only studies about humans.

Dweck and her colleagues (**1999; Licht & Dweck, 1984**) have discovered that unlike among bright boys, bright girls in elementary school were more vulnerable to helplessness than girls with lower ability. Dweck's explanation (**1999**) for this phenomenon is, that according to the study of **Ruble, Greulich, Pomerantz, & Gochberg (1993)**, for these girls the concept of their high ability was valid only when they recalled their last success; each time they were faced with a new challenge they felt threatened and many times preferred not to take the new challenge.

In summa: Research on gender differences in learned helplessness has shown mixed results. The main variables influencing these results have been: the subject matter or the educational domain; cultural and ethnic affiliation, and the time the study was conducted: gender differences regarding learned helplessness tend to diminish with time. Thus, we shall hereby concentrate on describing studies conducted not earlier than in the last decade of the second millennium, and classify them into the following categories: 1. Studies where girls were found to score higher than boys in learned helplessness; 2. Studies where boys were found to score higher than girls in learned helplessness; 3. Studies with mixed results; 4. Studies where no gender differences regarding learned helplessness were found.

6.5.3.1. Studies where girls were found to be more helpless than boys

Dickhaeuser & Stiensmeyer-Pelster (2002) have studied gender differences in computer-related attributions among 200 university students in Germany. In the first study measuring the helplessness level the results showed substantial gender differences in learned helplessness: females were significantly more helpless than males. In the second study where attributions to failure where investigated females were found to have lower expectation for success and a higher level of shame as a result of a failure than boys.

One of the reasons that in the year 2000 girls comprised no more than 10% of computers students in Germany (***Science Policies in the European Union,*** **2000)** might be their helpless behavior, and another one – their low expectancies. For verifying this hypothesis similar studies should be conducted in other countries, e.g. in Israel, where the percentage of female computer students is over 30 (**Statistics, Israel, 2002a**). In addition, more studies should be conducted among university students to find out whether this outcome is typical to a "manly perceived profession", whether it is typical to a certain age group (average: 24.22 years), also common to younger students (e.g. American typical students), or to non-traditional students (e.g. returning students).

For the time being, the data about German students is partial, though not exactly resembling that of **Dickhaeuser & Stiensmeyer-Pelster (2002)**. **Ziegler, Schober, & Dresel, 2002, April)** examined, among other things, the level of helplessness among German grade school students in the domains of mathematics and music. In contrast to previous expectations, no gender differences were found in the helplessness level of these students. The surprising result of this study was, however, the higher percentage of helpless students both in mathematics and in music: about 20% of the students.

Another finding that should be re-examined in different cultures concerns special populations. For example: **Kline & Short, (1991)** have found, that the level of helplessness among gifted girls increased from grades 1-4 to 4-6, and decreased even more from grades 4-6 to grades 9-12.

6.5.3.2. Studies where boys scored higher than girls in learned helplessness

Valas (2001) has studied three groups of 1580 3rd and 4th, 6th and 7th and 8th and 9th Norwegian school children and found that boys showed a higher level of academic learned helplessness than girls. **Leo & Galloway (1994)** conducted a study of motivation styles among 6 primary school teachers in England and their 169 students. Although no gender differences were found regarding the adoption of helplessness behavior, teachers perceived boys as more helpless than girls both in mathematics and in English.

We can conclude, that there is not enough evidence that one gender has no advantage over the other regarding learned helplessness. From the **Leo & Galloway (ibid)** study we can also conclude, that there are differences in the perception of helplessness among teachers. Thus, since learned helplessness is – as it is referred by its name – a flexible variable, which changes, among other things, with time, more information about it should be obtained by longitudinal studies that could demonstrate its development in males as in females.

6.5.3.3. Studies with mixed results and studies where no gender differences regarding learned helplessness were found

Studies belonging to this category comprised the majority of those known in the relevant literature until the mid 80ies (**Diener & Dweck, 1978, 1980; Dweck, 1975; Dweck, & Reppucci, 1973; Eccles, 1983; Eccles [Parsons], 1984; Eccles (Parsons), Adler, & Meece, 1984; Nicholls, 1975; Rholes, Blackwell, Jordan, & Walters, 1980**), as well as those found in the **PsychInfo** database for the years 1990-2002 under: “learned and helplessness and (gender and differences)”. Let us survey them by the ages of the participating students.

Lee (1999) has studied, among other things, gender differences regarding learned helplessness among 269 4th grade students from 14 classrooms in four schools in three American districts. Although there was substantial support to the assumption that ability level plays a role in helplessness across all subjects, no gender differences were found in any subject regarding failure outcomes. High achieving male and female students of language and math tended also to hold stable beliefs of their abilities and attribute successful outcomes to their high ability.

Rozell, Gundersen, & Terpstra (1998) collected data from 84 American undergraduates and examined the influence of gender, sex-role identity, gender of the experimenter, and the quality of information on helpless behavior and behavior. No gender differences were found. It is interesting to note, though, that participants with androgynous or indifferent sex role performed best under helpless conditions, namely, those who were either characterizes by both female and male personal traits, or with hardly any gender characteristics were not influenced negatively regarding performance when helpless.

Blair (2000) studied helplessness behavior among re-entry college students, whose age was over 25. She found no gender differences in learned helplessness in this sample. **Boggiano & Barrett (1991**) studied 196 college students and 37 parents for finding gender differences in helplessness. They examined gender-based expectations by introducing vignettes that included either masculine or feminine sex-linked tasks performed by helpless and mastery-oriented children. Under conditions in which children's behavior confirmed expectations, girls acted helplessly and boys acted in a mastery-oriented way; when children's behavior violated expectancies girls acted in a mastery-oriented manner and boys in a helpless manner.

In summa: In contradiction to many previous studies, which indicated a higher level of learned helplessness among girls, especially regarding math and science, my survey does not support this assumption. However, further research is needed, taking into account variables such as age, level of education, and ethnic and cultural characteristics. Thus, it will be interesting to examine gender as well as religion, level of religiosity, grade, and class-type [single- versus mixed-sex] regarding helplessness, and its influence on both expected and actual mathematics grade.

6.5.4. The Israeli situation

Low believability in own mathematical abilities is typical to the female Israeli student. In spite of receiving higher grades than boys at all educational levels, girls tend to choose themselves out of learning this subjects at the highest possible level in high school. Low success rates in mathematics it typical to the Muslim students, and is common especially among boys. My study that will focus, among other things, on believability in own math abilities and learned helplessness will try to answer some of the main questions about the influence of these two psychological measures on both math participation and achievement not only among females versus males, Muslim versus Jewish students, students learning in mixed- versus single-sex classes, students learning in religious- versus secular classes, and students learning in grades 7, 8, 9, and 10.

6.6. Motivational constructs

6.6.1. Self-efficacy or believability in own abilities

6.6.1.1. Definition and importance

1. **Self-efficacy** means the belief one has in her/his abilities to materialize an assignment at the end of which a reward is promised (**Bandura, 1977, 1986, 1997)**.
2. “One’s convictions to successfully execute a course of action required to obtain a desired outcome” (**Bandura, 1977, 1997,** cited by **Bong, 2001**, p. 554). In a learning situation ”it refers to students’ beliefs concerning their capacity to perform given academic tasks at designated level” (**Schunk,** 1991, cited by **Bong, 2001**, p. 554).
3. “Perception of self confidence or self-efficacy refers to students’ belief in how well they could perform in a learning task and how responsible they are for their own performance” **(Bandura, 1994,** cited by **Salili, Chiu, & Hong, 2001b, p. 226)**.
4. Self-efficacy is personal judgments of one’s capabilities to organize and execute courses of action to attain designated goals **(Zimmerman, 2000b)**.

Since the beginning of the 80ies self-efficacy has been recognized as having a strong influence on students’ learning motivation. Self-efficacy has been proven to predict students’ choices, effort, persistence, and emotional reactions. Self-efficacy beliefs have been found to be sensitive to subtle changes in students’ performance context, to interact with self-regulated learning processes, and to mediate students’ academic achievements.

6.6.1.2. Self-efficacy in academic settings

Self-efficacy beliefs are expected to mediate the influence of academic components – e.g. skills or past achievements – on future actions. High self-efficacy in academic settings results in seeking challenging assignments, investing vastly in the process of learning, and persisting when facing obstacles **(Bandura & Schunk, 1981; Betz & Hackett, 1981a; Lent, Brown & Larkin, 1986; Pajares, 1996b, 1997; Pajares & Graham, 1999; Pajares & Miller, 1994, 1997; Pajares & Valiante, 2001; Pintrich & De Groot, 1990; Schunk, 1981; Zimmerman, Bandura, & Martinez-Pons, 1992).**

In the light of previous findings, **VanderStop, Pintrich, & Fagerlin (1996**) examined undergraduates from three different American colleges, studying in three different disciplines: humanities (English), social science (psychology and sociology) and natural science (biology). As a rule, the assumption that students who did well in the course were more likely to have adaptive motivational beliefs, high self-efficacy, and high task values was confirmed. These students, regardless of their discipline, reported using more efficient learning strategies.

According to **Bandura's (1986)** social cognitive theory, students' self-efficacy_beliefs – their judgment of confidence to perform academic tasks or succeed in academic activities – predict their subsequent capability to accomplish such tasks. Self-efficacy beliefs are supposed to mediate the influence of other determinants of academic outcomes – such as skill or past performance – or subsequent actions.

Harter (1992) found that increases or decreases in intrinsic motivational orientations (preference for challenge in contrary to preference for easy work, curiosity or interest versus getting high grades, or pleasing parents or teachers) were correlated to increased or decreased perceived academic competence. This is in accordance with studies that have shown positive effects of self-concept or self-perceptions of competence on intrinsic motivation (**Eccles, Wigfield, Flannagan, Miller, Reuman, & Yee, 1989**; **Harackiewicz, & Manderlink, & Sansone, 1992; Schunk, 1991a; Vallerand, Gagné, Senecal, & Pelletier, 1994).**

6.6.1.3. Mathematics self-efficacy

A series of research works by Pajares and his colleagues **(Pajares, 1996b, 1997; Pajares & Graham, 1999; Pajares & Miller, 1994, 1997)** studied correlations among self-efficacy and a variety of variables connected motivation constructs, mathematics school performance, and self-beliefs of middle school students. While in anxiety, self-concept and self-efficacy no differences were detected between the beginning and end of the year, students' task-specific self-efficacy was the only motivation variable that predicted performance – both at the beginning and end of the year **(Pajares & Graham, 1999**).

Pajares & Graham (1999) have stated that efficacy beliefs also act in accordance with other mechanisms – such as anxiety – in influencing academic results. It has been shown that self-efficacy beliefs predict mathematics achievements **(Bandura, 1986; Pajares, 1996b; Schunk, 1991)**. Actually mathematics self-efficacy predicts math achievements more than math anxiety **(Pajares & Miller, 1994, 1997)**. **Pajares & Kranzler (1995**) have found that believability in mathematical abilities predicted achievement as much as objective ability.

Mulkey (1997) showed that self-efficacy was positively related to achievement in an advanced computers course. In this study no connection was revealed between the test- format – open-ended vs. multiple choice – and achievement.

6.6.1.4. Gender differences in self-efficacy

According to **Bandura (1986)**, one of the main reasons for the still-existing gender differences in self-efficacy lies in culture. Society still expects girls to choose sex-stereotyped professions. As a result self-efficacy of girls regarding their ability to succeed in non-typical professions deteriorates. A series of studies done by **Betz, Hackett**, and colleagues (e.g. **Betz, & Hackett, 1981a, 1986, 1987; Betz, Hackett, Casas, & Rocha-Singh, 1992; Betz, & Klein, 1996; Hackett & Betz 1992, 1995)** have demonstrated that the professional self-efficacy of females is lower than that of females. **Jerby (1996)** has shown, that even in the Israeli military, where service in compulsory for women as for men, the number of professions opened for women is less than a third than for men. No wonder that under such circumstances women would have a lesser level of self-efficacy concerning their professional opportunities!

Seegers and Boekaerts (1996) studied self-efficacy and achievements gender differences in math among Dutch 8th graders, and found gender math differences favoring boys both in achievements and self-efficacy.

6.6.1.5. Gender differences in mathematics self-efficacy

The results of the surveyed studies regarding gender differences in math self-efficacy are mixed. However, a general scheme can be drawn (e.g. **Martin, Mullis, Gonzales, Smith, & Kelly, 1999; Mullis et al, 1997; Mullis et al, 1998; Mullis et al, July 2000; Mullis et al, December 2000)**, demonstrating the main variables that influence the existing or disappearing of such differences.

Time **Before 1990 –** existence of gender differences
After 1990 – gender differences start to disappear

Place **In the USA** – gender differences start to disappear
In Europe, especially in the "Germanic" countries – Germany, Austria, Denmark, and Holland – gender differences still exist
In the Far-East – no gender differences in self-esteem
In Israel – large gender differences in self-esteem.

Vermeer, Boekaerts, & Seegers (2000) have studied motivation and problem-solving behavior among 79 boys and 79 girls in grade 6 classes of 12 Dutch schools. The children were given two types of mathematical assignments: computations and applications. Girls rated themselves lower than boys on confidence, in spite of the fact that they achieved as well as boys in computational problems. This result is important because it demonstrates that gender differences are culturally dependent. While in most studies such differences are not visible at such young age, girls are at risk even at age 12 for lacking self-confidence needed to enhance further studying of mathematics.

It should be mentioned, that the issue of gender differences in self-efficacy has to be studied further. In the **Wolters & Pintrich (1998)** study such differences were not found in any studied subject; in many other studies gender differences in self-efficacy where either favoring boys or girl – depending on the subject.

6.6.1.6. Self-efficacy of gifted students

Pajares (1996a) studied the predictive and mediate role of self-efficacy beliefs in the mathematical problem solving of middle school gifted students learning in regular classes. Self-efficacy of gifted students did not make a contribution to the prediction of problem solving when math-anxiety, cognitive ability, mathematics grades, self-efficacy or self-regulated learning and gender were controlled. Gifted students had a higher math self-efficacy and a lower level of math anxiety than regular students, a finding that was also mentioned by other studies. **Pajares & Graham (1999)** have found, that middle school gifted students had a stronger mathematics self-concept beliefs, and they were more accurate about their abilities than regular students. The finding, according to which regular students tend to over-estimate their future achievements and thus be overconfident, was in accordance with previous findings (e.g. **Pajares, 1996a)**.

Pajares (ibid) has found that self-efficacy of gifted middle school students learning in regular classes made an independent contribution to math problem solving. Gifted students reported higher level of math self-efficacy and a lower level of math anxiety. Gifted girls surpassed boys in performance but not in their self-efficacy. In general, gifted students estimated their capabilities more accurately than regular ones; gifted girls were biased towards under-confidence. No gender differences were detected among 8^{th} grade American gifted students regarding either math achievements or self-efficacy (**Pajares & Graham, 1999)**.

6.6.1.7. Self efficacy and high ability girls

As mentioned by **Dweck (1999)**, and **Schwartz (1991, 1994)** girls seem to be at risk for a low level of self-efficacy, that endangers their persistence and effort. A study by **Klein & Zehms (1996**) revealed, that while self-concept of regular girls does not change substantially from grade 3 to grade 5 and from grade 5 to grade 8, a strong inclination towards decline of self-concept occurs among gifted girls: in grade 3 their self-concept is similar – somewhat even higher – that that of regular girls; in grade 5 it decreases somewhat, but in grade 8 there is a significant large decrease and they score much lower than regular girls in self-concept.

Reis, Callahan, & Goldsmith (1994) have found, that although professional expectations were high among gifted girls, they were not as high as among boys. In addition, these expectations were focused more on traditional “feminine” areas. This finding is in accordance with the one of **Ariel (1990**) that found in highly selective Israeli adolescents, participating in science enrichment program that girls tended to have lesser expectancies, such as to lesser prestigious future occupations.

Gifted and talented girls experience a risk during the process of starting junior high school, and more substantially while choosing high-level courses in mathematics, sciences, and technology. In the Israeli elementary school, as well as in most developed countries, girls outperform boys at all stages and in all areas (e.g. **Travelsi-Hadad, 1.6.2002)**. Girls are perceived as less involved in undesirable activities like weeping, bullying, rudeness, being talkative and easily frightened (e.g. **Borg & Falzon, 1990**). The feminization of school – in Israel, for example, 87% of elementary school teachers are women (**Shachar & Doron, 11.6.2002)** – makes the socialization for girls even easier. Entering junior high school – where girls still excel boys in all areas – is sometimes the beginning of the change that girls face regarding the threat on their self-efficacy. When comparing themselves to others – especially to boys – girls see that their grades are better. In addition, teachers are much more significant for girls than for boys (**Tatar, 1998**); while girls perceive teachers as facilitating learning, boys tend to perceive significant teachers as obstructing their personal development. Girls are more sensitive to the evaluation of others in general (**Golombok & Fivush, 1994**) and to that of teachers in particular (**Lackovic-Grgin & Deckovic, 1990**). Thus the singling out of boys more than girls in both negative and positive ways (**Avrahami-Einat, 1989, 1998**; **Ben-Tsvi Mayer, 1991**) might cause neglecting and even ignoring talented girls. It harms their self-efficacy, and thus damages their achievements and aspirations.

In addition, the comparisons girls make between their grades in elementary school to those in junior high school might be not less injurious. As a result girls' self-efficacy deteriorates. Thus at the end of junior high school many talented girls already choose themselves out of mathematics, science and technology. Some of the most overwhelming data that illustrates this situation is the 2001 results of the Israeli matriculation exams: although the average grade of females was higher than that of boys in mathematics, physics, electronics and computers, substantially less girls than boys took each of these subjects (**Travelsi-Hadad, 1.6.2002).**

The feminization of school, which takes place in junior high school and to a lesser extent – in high school, is a double-edged characteristic that might influences the self-efficacy of talented girls in the education system. In the Jewish junior high school 81% of the teachers are females (**Shachar & Doron, 11.6.2002)**. On the one hand, facilitating the formation of girls' attitudes towards female figures as models for identification and sources for emotional support **(Frey & Rothlisberger, 1996; Hoffman, Ushpiz & Levy-Shiff, 1988)** might be an advantage for the regular girl, who feels empowered in school. On the other hand, a role model who is herself a teacher might not be the ideal person for a talented girl who needs support in order to have such a level of self-efficacy that will enable her to self-regulate herself to become anything she wishes.

In a research of 208 10th graders from two schools, one for regular students and one for gifted in China **Dai (2001)** found that in the regular school math self-concept was higher among boys than among girls. In the gifted school, however, girls and boys had similar math self-concept, but girls had a higher self-concept than boys. This finding is not only in contrast with findings in Western cultures (e.g. **Eccles, Adler, Meece, 1984; Li & Adamson, 1995; Philips, 1987; Meece**, **& Jones, 1996**; **Meece, Parsons, Kaczala, Goff, & Futterman, 1982**), but also contradicts **Dweck's** theory **(1986, 1999)** about bright girls who have lesser beliefs in their abilities than regular girls, especially when they are faced with new challenges.

6.6.1.8. Self-efficacy and cultural/ethnic differences

In the study of **Lee (1998**) conducted among Taiwanese college students it was found that self-efficacy had a direct positive effect on goal commitment in terms of time and effort invested. Goal commitment had a direct positive influence on academic performance. We can see that self-efficacy in the Taiwanese as in Western society has an influence on achievements through the mediator variables of time and effort.

A study conducted by **Stansbury (1998)** in a chemistry course of a large American university located in the Southwest was meant to examine the road from self-efficacy to achievement among Latinos in comparison to European-Americans. "Traditional" social cognitive theories explain that low self-efficacy, which is more typical to minority students than to majority ones, has a high correlation to extrinsic goal orientation; these two ingredients of the learning process reduce cognitive engagement, and the unavoidable result is lesser achievements. The variable taken into account were: ethnicity, level of parental education, and effort investment: self-efficacy, effort regulation, intrinsic goal orientation, and extrinsic goal orientation, as well as ability orientation, financial aid information, chemistry and math initial scores and chemistry grades. Results demonstrated that the hypotheses were not fully confirmed. Motivation variables accounted just partially for the achievement variance, and not in the predicted way. In this minority population realistic self-evaluation, perceived competence, organization of the material, and rehearsal strategies were found to be the main variables for achievement prediction.

6.6.1.9. Summary

Self-efficacy or belief if own abilities predict academic achievements (**Pajares, 1996a, 1996b, Pajares & Miller, 1994; Pajares & Graham, 1999; Pajares et al, 2000; Pajares & Valiante 2001)** as well as self-regulated learning (**Ryan, Kuhl, & Deci, 1997; Deci, Ryan, & Williams, 1996; Midgett, Ryan, Adams & Corville-Smith, 2000; Nix, Ryan, Manly, & Deci, 1999; Zimerman, 1985, 1989a, 1989b, 1990a, 1990b, 2000a; Zimmerman, & Martinez-Pons, 1986, 1988, 1990)**. Thus, both academics and school staff should be aware of their students' beliefs about their capabilities because they are important components of motivation and school achievements (e.g. **Pajares, 1997**; **Schunk, 1991, 1994, 1995)**.

Among all motivational constructs studied, self-efficacy has been found to influence achievements more than any other single construct (**Pajares, 1995)**. If we study the two main ingredients that contribute to high academic achievements – effort and persistent – we can see a straight line between self-efficacy and effort and persistence: students with a strong feeling of self-efficacy invest more effort and persist more in the face of difficulties and thus achieve higher than students who lack confidence in their own abilities (**Bandura, 1997; Bandura & Schunk, 1981; Betz & Hacket, 1981; Lent, Brown, & Larkin, 1986; Pajares & Miller, 1994; Pintrich & De Groot, 1990; Schunk, 1981; Zimmerman, Bandura, & Martinez-Pons, 1992).**

6.6.2. Expectancies

6.6.2.1. Definitions

1. "[…] expectancy [is…] simply a descriptor of an action sequence in which an organism acts 'as if' it expects its behavior to produce a specific consequence" (**Tolman, 1932**, cited by **Bandura, 1986, p. 230)**.
2. "[…] expectancies [are] cognitions, usually indexed by subjective estimates of the likelihood that particular events will occur" (**Bandura, 1986, p. 230)**.
3. "Expectancies for success […] refer […] to the belief that a certain behavior will lead to particular consequence (i.e. success)" (**Wigfield & Ecless, 1992**, cited by **Bong, 2001)**.

4. “Expectancy is the belief that increased effort will lead to better performance” **(Barron & Byrne, 2000, p. 492)**.
5. Expectancies for success are “children’s beliefs about how well they will do on upcoming tasks, either in the immediate or longer term future” (**Eccles [Parsons], Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1983,** cited by **Wigfield & Eccles, 2000, p. 70)**.

Future orientation has proved to be a major motivational cause. **DeVolder and Lens (1982)** have discovered that students with high grades who invested a lot of effort in their studies valued distant future educational goals more than students with lower grades who did not put so much effort in their studying. **Schutz (1994)** and **Schutz & Lanehart (1992)** have shown, that having long-term educational goals, such as graduating, or obtaining a graduate degree, was positively related both to achievement and reported self-regulation and strategy use among high school and college students.

6.6.2.2. Expectancy-value theory of achievement motivation

Eccles (Parsons) et al, (1983) have developed a model of achievement performance and choice, based on the expectancy-value model that was studied in the domain of mathematics. According to **Wigfield & Eccles (2000)**, both expectancies and values have a direct influence on achievement choices, and they influence performance, effort, and persistence as well. Both expectancies and values are influenced by beliefs that depend on the specific domain. Thus, while on one hand values and expectancies depend on beliefs of ability or efficacy in the area studied, on the other, the formation of self-perception in any domain depends also on social-cognitive variables, namely on the past experiences and social influences (**Eccles et al., 1983; Eccles, Wigfield, & Schiefele, 1998; Wigfield & Eccles, 1992)**.

6.6.2.3. Expectancies and mathematics

Ma (2001) has indicated, that in the US there is a substantial decline between the number of students studying mathematics in grades 11 and 12. One of the results of this phenomenon is that many high school graduates are not prepared for any scientific subject when they start college. However, students with expectations for higher education have better prospects to choose learning mathematics during all four high school years. Peers and teachers have but a marginal influence on students' decision to continue their mathematics education. On the other hand, the influence of parents' expectations proved to be strong: when parents expected their children to continue their education, these children were more likely to have expectancies for higher education themselves, and thus their inclination to continue their mathematics education in grade12 was stronger.

The problem of stopping learning mathematics at an early stage of education has been recognized as a severe one not only in the US (e.g. **Davenport et al., 1998; Ma, 1997a; Maple & Stage, 1991)**, but in many other countries as well (**Mullis et al. 1998)**. However, the stage at which leaving the domain of mathematics occurs depends on the educational demands of the individual country. For example: in the year 2000, almost 50% of the Israeli 12th grade male students studied advanced mathematics courses (**Statistics, Israel, 2001**). This percentage, though similar to the participation rate of 12th graders in mathematics courses in the US (**Ma, 1997, 2001**), represents by no means a similar situation in mathematical education regarding these two countries. Some mathematics courses studies in Israel in 12th grade are learnt normally in the US during the freshman of even junior college years. In addition, while in the US a student can take mathematics in 12th grade after a break of one or even two semesters, this possibility is unacceptable in Israel. Thus, although the percentage of students learning mathematics is similar, participation in 12th grade mathematics in these two countries depends mainly on expectancies. While in the US learning three years mathematics meets – in most cases – the requirements of any college, in Israel, where students apply to higher education institutions after getting the results of the matriculation examinations, they cannot drop mathematics after grade 11. On the other hand, in Russia, where the last grade of high school is 11, there is a full participation in mathematics classes up to the end of high school (**Mullis et al., 1998**). However, the reason of this high participation is not high expectancies among Russian school children, but the demand of each high school graduate to complete the whole course of mathematics studies during the 10 years of compulsory education. Thus the expectancy of the Russian high school student to graduate high school causes her or him to learn more mathematics than the expectancy of the American student to acquire a higher education!

6.7. Competence

6.7.1. Definitions and importance

From the beginning of intrinsic motivation research, the concept of competence has been given a central place as a main concept of this construct (**Deci, 1975; Harter, 1978, White, 1959).** Over the years a clear distinction has been made between perceived competence and competence valuation as two of the components that mediate intrinsic motivation.

Perceived competence "represents the extent to which a person believes that he or she has performed or is able to perform well at an activity" (**Bandura, 1982,** cited by **Elliot, Faler, McGregor, Campbell, Sedikides, & Harackiewicz, 2000, p. 780**). Perceived competence is expected to influence performance either during the act of performing or after finishing the assignment (**Bandura, 1982**; **Harackiewicz**, **1989**). As a result of positive feedback given either during the act or after completing it intrinsic motivation is enhanced (**Bandura, & Schunk, 1981; Elliot & Harackiewicz, 1994; Harackiewicz, & Elliot, 1998; Harackiewicz & Sansone, 2000; Reeve, & Deci, 1996)**.

Competence valuation "represents the degree to which a person cares about doing well at an activity" (**Harackiewicz & Manderlink, 1984,** cited by **Elliot et al., 2000, p. 780**). Unlike perceived competence, competence valuation is active before and during action (**Harackiewicz**, **1989).**

6.7.2. From competence to intrinsic motivation

Perceived competence, which is the knowledge or rather – the estimation of one's competence, and competence valuation, which is the wish to be competent compound together the whole concept of competence. They represent two different ways through which intrinsic motivation and enjoyment can be achieved.

Elliot et al (2000) have developed the concept of competence valuation as a strategic intrinsic motivation. In two studies conducted by the researchers among college students, the level of competence valuation was raised with positive feedback given after performing an assignment. Competence valuation was the mediating variable that connected between positive feedback and intrinsic motivation. The change in intrinsic motivation was unrelated to the perceived competence, and thus the clear distinctions between these two kinds of competence and the importance of valuated competence has been shown.

Competence valuation is the commitment to perform the task well (e.g. **Epstein & Harackiewicz, 1992; Harackiewicz & Elliot, 1998)**. Intrinsic motivation is characterized by a feeling of absorption in the task. Thus, it is likely that a commitment to perform well will be accompanied by a high level of personal investment. It can thus be seen that either way from feed back through competence leads to intrinsic motivation – whether through competence valuation (**Elliot, et al., 2000)**, or through perceived competence (**Reeve & Deci, 1996; Vallerand & Reid, 1988).**

6.7.3. Parents' perception of competence

Ma (2001) has examined trends of mathematical participation among 7^{th}-12^{th} grade American students. She has found that the participation decline – reaching its maximum from grade 11 to grade 12 – was unrelated to peers' or teachers' expectations. The two main factors influencing it were parent's expectations – including parents' plans for college education, and self-expectations. Both achievements and attitudes towards mathematics were the two most important factors that influenced self-expectations for the future.

Räty, Vänskä, Kasanen, & Kärkkäinen (2002) have studies "the classic gender-related attribution pattern" (p. 121) among 468 Finnish parents. The parents of boys evaluated the mathematical competence of their sons as higher than that of their daughters. In addition, the parents of boys rated competence as more important for mathematical success than the parents of girls.

6.7.4. Competence of high ability students

Ames & Archer (1988) have found, in a study among high ability junior high/high school students learning in special classes for high ability students, that when the focus was on mastery goals the students used more effective strategies, preferred more challenging assignments, their attitude towards class was more positive, and they believed that success was a result of effort. Students whose focus was on performance goals were inclined to think that their ability was more important, were more evaluative, judged their abilities more negatively, and attributed their failure to lack of ability. Thus we can see that the objective level of the student might not play an important role in the level of tasks chosen or in the attitude towards success and failure, but the adoption of mastery or performance goals proved to be of no less importance among high ability students than among regular ones.

Many studies have focused on each of the three following domains of competence of gifted children: 1. The cognitive academic domain; 2. General self-worth; 3. The social/physical domain. Most studies found that 7-12-year-old gifted students had a higher perceived competence than their non-gifted peers (e.g. **Chan, 1988; Cornell & Grossberg, 1987; Hoge & Renzulli, 1993; Li, 1988; Schneider, 1987**). As for the general worth domain – some studies indicated that gifted children aged 8-16 surpassed their peers (e.g. **Chan, 1988; Callahan et al., 1990; Lehman & Erdwins, 1990, Loeb & Jay, 1987)** while other indicated no differences between gifted and non-gifted children on reports of perceived competence in children 10-16-year-old (e.g. **Li, 1988; Schneider, Clegg, Bryne, Ledingham, & Combie, 1989)**.

As for the social/non-academic domain: some studies found that gifted students aged 12-16 scored lower than their non-gifted peers (e.g. **Brounstein, Holahan**, **& Dreyden, 1991; Callahan, Cornel, & Loyd, 1990)**, while others found that gifted students reported a higher perceived non-academic competence than less gifted peers (e.g. **Kelly & Collangelo, 1984)**.

6.8. Values

6.8.1. Definitions

Task value presents the students' beliefs about the subject matter they study, or the skills they acquire – whether they perceive these newly learnt things as useful, important, or appealing because of being intriguing, enriching, or interesting (**Eccles & Wigfield, 1995; Eccles, Wigfield, Harold, & Blumenfeld, 1993; Wigfield, & Eccles, 1992)**.

The value construct, according to the model of Eccles and Wigfield**,** is divided into four separate components: 1. Importance – the attainment value; 2. Interest – which is an intrinsic value; 3. Usefulness – which is an utility value, and 4. Cost (e.g. **Eccles et al., 1993; Meece, Wigfield, & Eccles, 1990; Wigfield, Eccles, Yoon, Harold, Arberton, Freedman-Doan, & Blumenfeld, 1997)**.

6.8.1.1. Importance

Seegers & Boekaerts (1993) have found, that the line between motivational beliefs about mathematics and learning intention, emotional state, and task performance goes either through the result or the value of the material learned.

Eccles et al. (1993) have discovered that children as young as 6 could already differentiate between their expectancy-beliefs in each domain studied and the objective value they attributed to it.

A high correlaion was found both between course taking when thinking that the subject area studied was valuable and achievement and valuing the course (e.g. **Eccles, 1983**; **Ma, 2001; Meece, 1991; Meece, Blumenfeld, & Hoyle, 1988; Meece, & Holt, 1993; Meece & Miller, 2001; Meece et al, 1990).**

Stodolsky and colleagues **(**e.g. **Stodolsky, 1988; Stodolsky, Salk, & Glaessner, 1991)** have shown that among elementary school students, task value was perceived differently in math than in social studies. They have also found that the way high school teachers perceived the subject matter they taught varied according to the discipline. **Donald (1990, 1994**) has studies this subject at the college level and found that professors' beliefs about the nature of knowledge and learning depended on the subject they taught.

6.8.1.2. Interest

6.8.1.2.1. Definition and importance

"Interest is a feeling of wanting to know, see, do, won, share in, or take part in" **(Barnhart & Barnhart, 1978, p. 1099)**.

Interest research has an importance as a critical bridge between cognitive and affective issues in both learning and development (**Renninger, Hidi & Krapp, 1992)**. Studying interest helps to understand theories and practical applications of motivation. It enables the researcher to study the individual in context, examine affective variables against structural features of text, analyze the correlations between cognitive and social development, understand practical application of theories of motivation, and recognize the importance of developmental psychology for the study of learning.

Renninger (2000) has stressed the importance of interest and task values in enhancing motivation. According to her, in order to understand individual's motivation to learn and be engaged in a learning process on one's own initiative, one must focus on individual's interest. Individual interest increases as both knowledge of the subject and the value one ascribes to it increase. She suggests, that effort also depends on interest; thus the path from knowledge and value to intrinsic motivation goes through interest and effort. **Renninger (ibid)** explains how one's interest might develop with time, how should such development be supported when a child is concerned, and what are the influences of the gender of age on this development.

Deci & Ryan (1992) have stated that interest is a part of intrinsic motivation. Children who with an intrinsic drive are motivated by their interests and their desire to be effective and self-initiating.

6.8.1.2.2. Gender differences

In a study conducted by **Wolters & Pintrich (1998**), certain gender differences were found in the level of interest of certain subjects learnt, self-efficacy and subject-anxiety. Males were found to perceive English as <u>less interesting</u> than females. This finding, through done among 7^{th} and 8^{th} graders, is in accordance to the finding of **Wigfield & Eccles (1994**), done among young primary school children, that perceived reading as less interesting and less important than mathematics. In addition, in the **Wolters & Pintrich (1998**) study females reported higher levels of self-efficacy in English than in Mathematics and social studies. The picture was reversed regarding test anxiety: girls reported a lower level of test anxiety in English than in mathematics while among males the level in these two subjects was similar. These results also correspond previous ones (**Eccles, 1983, 1984; Wigfield & Eccles, 1994**)**.** Given the fact that the actual achievements of girls found in this study **(Wolters & Pintrich, 1998**) were higher than those of boys, as has been the case in many age-groups and man countries (e.g. in Israel **Travelsi-Hadad, 2002**), it can be concluded that the female problem in mathematics and science does not stem from a deficit in <u>valuing</u> or <u>being interest</u> in these subjects, but rather in a maladaptive self-efficacy and anxiety (e.g. **Philips & Zimmerman, 1990; Pintrich & Schunk, 1996).**

<u>6.8.1.3. Usefulness: The utility value</u>

There is a difference in students' future expectancies, self-efficacy, task value, interest, as well as test anxiety that depend on the <u>subject matter.</u> **Eccles, Wigfield, et al. (Eccles, 1983; Eccles & Wigfield, 1995; Eccles, Wigfield**, **Harold, & Blumenfeld, 1993**; **Wigfield, 1994; Wigfield & Eccles, 1992, 1994**) have found that students' expectances and efficacy beliefs, task value, and interest were less positive in English than in Mathematics, which can be explained by the value of math for the future. **Wolters & Pintrich (1998**) have conducted a study among 7th and 8th graders, aimed to find task values, self-efficacy, test anxiety, cognitive strategy use, regulatory strategy use, and performance in mathematics, English, social studies, and science. The results revealed that the motivational aspects of self-regulated learning depended on the subject matter. Students – both males and females – reported mathematics as having a higher value than English or social studies.

Although more adaptive motivational beliefs were found in all disciplines among students who did better in their curse of learning at the beginning, middle, and at the end of the course, in accordance with the findings of **Pintrich & De Groot (1990**) and **Zimmerman (1994**), these relations depended on the discipline.

6.8.1.4. Effort: The cost of success

6.8.1.4.1. Definition

"Successful completion of an initiated course of action is in large part a function of the extent to which the individual commands the relevant skills and is motivated to extend the relevant effort" **(Schwatz & Bohner, 1996, p. 136)**.

Effort is the second main ingredients that self-regulation is consisted of: the other is persistence. Effort includes, for example, an optimal dividing of the time between quality learning and covering the entire quantity of the material; time-managing during the examinations period so that each exam will get its share of preparation time and "heavy" subjects will get more time than others; the adoption of different learning techniques, whether such that are liked better or a combination of as many as possible, aimed both to ease the understanding and deepen the learning process; exercising different kinds for short- and long-time memory, so that the material learnt will be available both immediately when needed (e.g. for the next day's test) and in the far future (e.g. when working as an engineer will require solving a mathematical problem).

6.8.1.4.2. The role of effort in enhancing self-efficacy

Boekaerts (1997) has pointed at Six types of prior knowledge that are powerful components of Self-regulated learning: cognitive regulatory strategies, motivational regulatory strategies, cognitive strategies, motivation strategies, content domain, and meta-cognitive knowledge and motivational beliefs. Cognitive self-regulation can be taught. Cognitive and motivational forms of Self-regulated learning are interwoven aspects that jointly affect effort investment and task performance.

6.8.1.4.3. The amount of effort invested

The amount of effort invested for completing an assignment depends on many components **(e.g. Gollwitzer, 1993, 1996).** Two of these main ingredients are: 1. The enjoyment the individual drives from the activity; 2. The completion of this activity. It has been shown by **Martin, Ward, Achee, & Wyer (1993**) that mood has a substantial influence on both the enjoyment level and the decision when to terminate the action: individuals that enjoy what they are doing will invest more effort – for example by working a longer time, in what they are doing. Such individuals will also terminate their action after a shorter time in comparison to individuals who suffer from a bad mood. The later will not be satisfied with their achievements, and thus will continue doing it for a longer time aiming to get better results.

Wright (1996) has introduced an energization theory, according to which the amount of effort invested increases when the level of difficulty increases up to when this level reaches a "cutoff point". This point depends on the value people attribute to their actions: when the value is high the amount of investment increases. Not only is the individual willing to put more effort when valuing the assignment; (s)he becomes more persistent trying to complete it in spite of facing severe difficulties.

Effort, according to **Gollwitzer (1996)**, should be mobilized also by implementation intentions. As has been shown by **Schaal (1993)**, an intentional decision to ignore disturbances, or to concentrate in one's work when a disturbance occurs, results in putting more effort and working more persistently in spite of the disturbances.

Cantor and Blanton (1996) differentiate between two kinds of everyday action: those that are more spontaneous, and those that require a considerable amount of self-regulation and effort. Completing academic assignments might belong to both categories. There are tasks that do not require a lot of investment for one individual, while others demand both using self-regulated strategies and a maximal effort. The same assignments might be considered by another individual, or even by the same person under different circumstances (e.g. working on a home-test rather than writing the same paper during a limited time in the classroom). Thus, there are many strategies people use for defending their self while having to cope with difficulties.

When investing too much effort "proves" to the person that (s)he cannot undertake a new assignment unless ready to put a lot of effort in it, a "healthy" approach might be dropping it and keeping a feeling of self-worth or self-esteem.

6.8.1.4.4. Effort as a doubled-edged construct: The case of talented students

Philips and her colleagues (e.g. **1987; Philips & Zimmerman**, **1990**) have found that talented children do not necessarily have a high level of competence. They have studied a group of high ability students who had a feeling of incompetence. The cause of this feeling could have been a great amount of effort invested in academic areas that led to the conclusion that unless so much effort is involved, the individual is incompetent.

Due to the fact that girls invest in average more effort than boys in academic assignments, talented girls are at a double-risk from suffering from "the illusion of incompetence" (**Cantor & Blanton, 1996**). Educators and policy makers should take it into consideration when praising success achieved by investing a substantial amount of effort invested by talented girls throughout their educational path.

6.8.2. Gender differences

There are controversial findings regarding gender differences in attribution of values. For example: **Eccles et al (1993**) found that females valued literature more than males; **Eccles et al. (1989); Wigfield et al, (1991)** found that males valued mathematics more than females; **Anderman et al. (2001**) found no gender differences in attribution of values in any subject-matter.

In a study conducted by **Wolters & Pintrich (1998)**, certain gender differences were found in the level of interest of certain subjects learnt, in self-efficacy and subject-anxiety. Males were found to perceive English as less interesting than females. This finding, through done among 7^{th} and 8^{th} graders, is in accordance with the finding of **Wigfield & Eccles (1994),** done among young primary school children, that perceived reading as less interesting and less important than mathematics. In addition, in the **Wolters & Pintrich (1998)** study females reported higher levels of self-efficacy in English than in Mathematics and social studies. The picture was reversed regarding test anxiety: girls reported a lower level of test anxiety in English than in mathematics while among males the level in these two subjects was similar. These results also correspond to previous ones **(Eccles, 1983, 1984; Wigfield & Eccles, 1994)**. Given the fact that the actual achievements of girls found in this study (**Wolters & Pintrich, 1998)** were higher than those of boys, as has been the case in many age-groups and many countries (e.g. in Israel **Travelsi-Hadad, 1.6.2002**), it can be concluded that the female problem in mathematics and science does not stem from a deficit in valuing or being interest in these subjects, but rather in a maladaptive low-level self-efficacy and anxiety (e.g. **Philips & Zimmerman, 1990; Pintrich & Schunk, 1996).**

It seems that gender differences in valuing the material learnt cannot be estimated per se, but only in a much wider context Such a context must take into consideration the subject matter, the learning environment, and the age, as well as social and cultural differences.

6.8.3. Self-efficacy and task values

Self efficacy and task value depend on the subject: **Eccles (1983, 1984), Stodolski (1988)** and **Wigfield (1994; and Eccles, 1992, 1994**) have found, that students reported higher levels of self-efficacy and task value in English and social studies than in mathematics. **Wolters & Pintrich (1998)** have assumed, that task value is important for choosing an academic task that requires a certain amount of investment of time and energy, which means adopting a certain cognitive strategy and self-regulating for materializing the aim taken upon. However, when looking at the results in terms of achievements, self-efficacy is more important as it predicts better the grade achieved in the subject learnt. Similar conclusions have been derived form studies done by **Garcia & Pintrich (1994), Schunk (1994)**, and **Zimmerman (1994**).

Further investigation by **Wolters & Rosenthal (2000**) has examined connections between task value, self-efficacy, and learning and performance goal orientations among 8th graders. It has been found that task value, learning goal orientation, and performance goal orientation explained at least three of the regulatory strategies, while self-efficacy was not related significantly to any of the regulatory strategies studies. This finding helps to explain the existing gender differences in self-efficacy, especially in math and science that do no result in gender differences in any self-regulation measure.

6.8.4. Cultural factors of self-efficacy, learning orientations, and values

Most research findings are culture-bound, mainly because researchers did not systematically investigate cultural differences in the way students and teachers think, feel, and behave. Perceived competence or self-efficacy is one of the most powerful culturally dependent constructs. Thus unless this component is studied in different cultures the results of studies done in Western cultures in general and in Anglo-American in particular cannot be generalized (**Boekaerts, 1998)**.

As goal orientation theory points at the correlation between the holding of mastery goal motivation and a high level of self-regulation, the question whether there are cultural differences in this aspect have been asked by **Pintrich, Zusho, Schiefele, & Pekrun (2001)**. In their study of American and German college students they have found that a mastery goal orientation is the most adaptive goal orientation. Foocusing on learning and understanding what has been learnt gives the bests results in terms of self-efficacy, interests, self regulation in general and strategy use in particular, as well as performance. No significant differences were found between German and American students.

Hsu (1998) has studied among a Chinese distance learners in Taiwan how well the findings of self-regulated learning, developed mainly by **Corno** (**1993**), **Pintrich (1995); Pintrich & De Groot, (1990), Pintrich & Garcia, (1991**); **Schunk (1989a, 1991, 1994, 1995); Zimmerman (1989a, 1989b, 1990a),** and **Zimmerman & Martinez-Pons, 1986, 1988, 1990)** could be generalized. The conclusions of this research were as follows:

1. Value and expectancy were moderately correlated with meta-cognition;
2. Neither value nor meta-cognition were significantly positively correlated with academic achievement;
3. Meta-cognition was highly and positively correlated with resource management;
4. Expectancy was moderately and positively correlated with academic achievement;
5. Resource management had no influence on academic achievement.

Thus, we can see that in different culture and in different learning constellations the straight road between values and achievement might not only have some curves but also not exist at all. In addition, resource management, which serves as a main component of self-regulation, does not necessarily have a positive correlation with achievement.

Wolters, Yu, & Pintrich (1996) and Wolters & Pintrich (1998) have found that the adoption of relative ability goal can enhance self-regulated learning among 7^{th}-8^{th} graders, **Wolters & Rosenthal (2000**) have found the same result among 8^{th} graders, and **Wolters (1999) –** among 9^{th}-10^{th} graders.

In the light of the findings of **Pintrich, Zusho, Schiefele, & Pekrun (2001)**, that found differences between German and American students regarding their relative ability and its correlation to achievement, it would be interesting to see whether the assumptions about the relationship between the three kinds of goal motivation, values, anxiety, and boredom would be valid among Jewish and Arabic Israeli students. On one side, Israel is substantially influenced by the American culture. In addition, tuition for higher education is expensive, and thus the pressure on high school students to do well is quite significant. On the other hand – the Israeli education system has been deeply influenced by the German one, and some of the traditional values of religion and family are common to both cultures, as has been already shown in a study that examined the Effects of the male stereotype of a successful person on the performance in a thinking task among Israeli and German students (**Ziegler & David, in press; Ziegler, David, & Stöger, 2000**).

6.8.5. Social factors influencing self-efficacy and values

A research of 4^{th} graders in a low-income country in North Carolina has revealed that the percentage of students in free/reduced-price lunch programs – which is an indicator to lesser financial ability of the family – was related negatively to students' academic performance in mathematics. This finding supports the notion that economic circumstances are correlated with academic achievement (**Okpala, Okpala, & Smith, 2001).**

Masilela (1988) has studied educational achievements of South African high school students, and came to the conclusion that socio-economic status is an important factor that affects achievement.

Grobler, Grobler, & Esterhuyse (2001) have found, in a study of South African black secondary school learners, that Scholastic aptitude and certain levels of self-concept as well as socio-economic status variables play a role in the prediction of math achievement.

6.9. Summary

Motivation is a major issue in the study of psychology in general and educational psychology in particular. It includes many components, many of which have been discussed in length, some have received but a partial treatment due to the length limit of this work. However, I have tried to list the most important ones, including, of course, those that have direct relevance to my study that is to be discussed widely in chapters 8-11 of this work.

Expectancies and values are different entities, as has been shown even among first grade children. These two variables will be explained in my study – as well as others already mentioned – in the different ethnic populations: Jews and Arabs, genders, ages, and single- versus mixed-sex classes.

Chapter 7:

From abstract to concrete: The way from theory to empirical results

7.1. Short summary of the previous chapters

In the previous six chapters I have discussed all independent variables that might possibly influence the hereby-motivational study.

The first chapter is dedicated to three issues: the gender issue of learning mathematics in the Israeli junior high school, facts about educational achievements of the various sub-populations in Israel, and a survey of the theoretical part of the work.

In the second chapter I have introduced the reader to the Israeli education system regarding the achievement gaps among different sectors included in it. These gaps can be divided to four main groups:

1. Between children of well off families, learning in good schools, and children learning in peripheral schools, whose families belong to a lower SES (e.g. **Assenheim, 31.8.2000; Ayalon, 1994, 1995; Ayalon & Yogev, 1997; Birenbaum & Kraemer, 1995; Kashti, 1998; Suessapel, 1997**);
2. Between Jews and Arabs;
3. Between Jews belonging to different ethnic groups (e.g. **Ayalon, 1994, 1995; Ayalon & Yogev, 1997; Sa'ar, 10.7.2002; Shachar, Ilil, 16.6.2002a; Shachar & Saban, 9.5.2002; Statistics, Israel, 1999a**, **table 22.22**);
4. Between boys and girls;
5. Between religious and non-religious schools
6. Between single-sex and mixed-sex classes;

I also described the demands expected from a high school graduate that influence the teaching, examining, tracking (**Barak and Waks, 1997**; **Sa'ar, 10.7.2002)**, and dropout resulting from it.

The third chapter has dealt with the different aspects of mathematics and gender. Starting with the description of gender math differences in participation and achievements in a variety of countries and cultures, it proceeds to the Israeli situation. The second part of this chapter describes the connections between different independent variables, such as age, and dependent ones, such as attributions to success and failure or aspirations level, and math gender differences.

The fourth chapter deals specifically with Israeli minority girls and their achievements in mathematics and science. There is a description of the main minority groups: Arabic girls, with a special focus on Muslim, Christian, and Druses, and religious Jewish girls, including Orthodox and Ultra-Orthodox girls. A more detailed summary is given of Muslim girls, who belong to the largest minority non-Jewish Israeli group (about 90% of the Israeli Arabs are Muslim), and Orthodox girls who, unlike Ultra-Orthodox ones learn the same subjects in math and science as pupils of the general education system, and take the same matriculation examinations as well.

Chapter 5 discusses the single-sex class in general and in Israel in particular. It summarizes research findings about the advantages of single- versus mixed-sex classes in different places, subject matters, under different circumstances, and along different historical times.

Chapter 6 concentrates on the variety of motivational components that play a substantial role both in the learning process and in students' achievements. It examines the different definitions of motivation, the diversity of motivation categories, potential correlations between personality characteristics and the different kinds of motivation, and the influence of many variables – such as the level of intelligence, culture, gender, age – on the 4 main different kinds of motivation: extrinsic- versus intrinsic- and approach- versus avoidance motivation. In addition, the concepts of values, interest, effort, and competence regarding mathematical learning have been widely examined. Chapter 6 also introduces the reader with the dependent variables: the motivational components that influence educational results regarding mathematics among 12-16-year-old Israeli students. It describes the motivational orientations known from the literature, with special focus on learning-, achievement-, and avoidance motivation; theories of achievement and expectancies in general and in mathematics in particular; and attributions to success and failure regarding mathematics. The main part of this chapter is dedicated to the study of the following psychological and educational components that influence the learning of mathematics: valuing the subject of mathematics and school mathematics; belief in own mathematical abilities; helplessness regarding mathematics; belief in flexible versus rigid abilities of mathematical intelligence; stability of mathematical abilities; mathematical anxiety; and preference of extra mathematics afternoon class.

Unlike in many other countries, gender differences regarding mathematics achievement have not been a problem in the Israeli education system for over a decade. In fact – girls surpass boys in all classroom measures, and in all matriculation examinations grades (**Eshet, 13.12.2002**). While only 36.7% of 18-year-old boys were entitled to the matriculation certificate in the year 2001, the percentage of girls was much higher: 51.3% (**Freilich, 21.5.2002**). However, as explained in chapter 2, there are still gender problems regarding mathematical instructions, as well as many other problems regarding participation and achievement in this subject. The Israeli Ministry of Education has been involved in planning new, more effective teaching methods in order to improve the situation because of two main reasons:

1. The high level of inequality in the Israeli education system as was described in chapter 2,
2. Due to a constant deterioration in the level of mathematics achievements of Israeli school students that have resulted in decreasing from the first place in the world in 1963/4 in an international study (**Husen, 1967**), to the 28th out of 38 countries examined in 1999 (e.g. **Mullis et al, December 2000**).

In spite of these two major problems, all programs and studies have been done lately stemming from a different point of view: rather than try to improve the achievements in general, focus on high achievement and high participation rate of some sub-populations, and then try to isolate the components that have led to these achievements. For example: in the Jewish sector the percentage of girls examined in the highest level mathematics matriculation exam has been 50% lower than that of boys; in the Arab sector it is higher (**Statistics, Israel, 2002a**). In fact, the number of Arab girls succeeding in this exam has been equal to that of boys in 2001 **(ibid**). In addition, while in the Jewish sector only 6% of the girls take the 5-point physics exam, in the Arab sector the percentage is 12. In the Jewish sector there are also differences regarding participation in mathematics and science: while in the general sector 54% of those examined in the 5-point chemistry matriculation examination are girls, in the religious sector the percentage is 73 (**Statistics, Israel, 2000**).

The major target of my study is to examine some of the educational, social, and psychological components that contribute to higher achievements and aspirations regarding mathematics.

7.2. Aims of the current study

In order to isolate the components that influence both achievements and expectations three different kinds of studies have to be done:

1. The study of each separate motivational orientation, as well as achievement and expectations, and each of the mentioned psychological components: mathematics valuing, belief in own mathematical abilities; helplessness; belief in flexible versus rigid abilities; stability of mathematical abilities; mathematical anxiety; and mathematical preference, for each sub-population;
2. The study of connections in general and correlations in particular between each two different components mentioned in 1;
3. The study of the influence of each examined component on the expected and actual math grade for each of the sub-groups.

7.2.1. Studying motivational, educational, and psychological components influencing mathematical learning

7.2.1.1. Motivational orientations: Learning-goal orientation, Approach orientation, and Avoidance orientation,

The first aim of my study is to investigate motivation for learning mathematics among 12-16-year-old junior high school children – boys and girls, Jews and Arabs, leaning in secular or religious institutions, in single-sex or mixed classes.

7.2.1.2. Studying achievement

7.2.1.2.1. Achievement gender differences

Since in Israel all gender differences in class work, in report cards, and in the matriculations examinations favor girls, I aim to find achievement gender differences – both actual and expected – favoring girls. Such a finding, though in accordance with new data (e.g. **Hyde, & Kling, 2001**), is in contrast with older data both from abroad (e.g. **Fennema, 1990; Fennema, & Leder, 1990; Hyde, Fennema, & Lamon, 1990; Hyde, 1990, 1993, 1996**) and from Israel (e.g. **Amit, 1994**; **David, 2001a, 2002a;**

Movshovizt-Hadar, 1997, 1998). In spite of that I aim to show that though in international studies math gender differences favoring boys still exist among Israeli students achievements, such differences have disappeared in class work as well as in the matriculation examinations (**Statistics, Israel, 2002a**).

7.2.1.2.2. Achievement and age

Age has been proven to be crucial in children motivation in general and in the mathematics domain in particular (e.g. **Anderman & Maehr, 1994**; **Eccles, & Wigfield, 2002; Eccles et al, 1989, 1993, 1998, Marsh, 1989; Wigfield, & Eccles, 1994; Wigfield et al, 1991, 1997).** An important aim of my research is to find if in Israel – as in other countries – motivation declines when entering junior high school, and if it does – is it common for all three motivational orientations studies – approach, mastery, and avoidance motivation.

Thus, the four age groups chosen for my research to delimit the three years of the Israeli junior high school: from 12-13 year-olds, who have just started junior high school a few weeks before my study, to 15-16 year-olds who have left the last grade of junior high school a few weeks before my study. Trying to track the exact time when changes in math achievements and aspirations take place has an essential importance; any future intervention program for enhancing mathematics learning must take into accounts when is the optimal time to start and who is the target of the intervention.

7.2.1.2.3. Achievement gender differences and age

While in grade 4 no gender differences regarding math achievements were detected in the TIMSS-1995 (**David, 2001a, 2002a**; **Movshovitz-Hadar, 1998; Mullis et al, June 1997; Patekin, 1999**), such differences were found among 8th graders in most examined countries (**Beaton et al, 1997)**. Thus, it should be examined whether such differences exist in my sample, if they do – when is the decline of either aspirations or achievement maximal and when minimal, and whether such a decline is significantly correlated to other examined motivational ingredients.

7.2.1.3. Studying value of mathematics: Gender differences

Studies about gender gaps regarding valuing mathematics have had mixed results (e.g. **Eccles et al., 1983, 1989, 1993; Jacobs, & Eccles, 2000; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Wigfield, & Eccles, 2001; Wigfield et al, 1990**). Thus, one of my first aims regarding valuing mathematics is to find out if in my sample of Israel junior high school children there are gender difference, and among which sub-populations and age-groups such differences are larger or smaller.

I.

7.2.1.4. Studying believability in math abilities or math self-concept

Believability in ones' own mathematical abilities has been found in the literature as one of the main ingredients influencing math achievement: competence-related beliefs are strong predictors of performance and task choice (e.g. **Bandura, 1997; Eccles et al., 1983; Meeceet al, 1990; Wigfieldet al, 2002; Wigfield & Eccles, 2001**). Thus, an important aim of my study is to search the differences in math self-believability among all groups of my sample and the correlations between it and all other motivational and educational components.

7.2.1.5. Studying mathematical helplessness

Another aim of this study is to examine the question whether some Israeli sub-populations are more vulnerable than others to mathematical helplessness. In particular – it will be interesting and important to find whether females in general feel more helpless than males towards mathematics.

7.2.1.6. Mathematical anxiety: Gender differences

A vast body of research shows that girls suffer more than boys from math anxiety (**Ben-Zur & Zeidner, 1988; Carr, 1996; Cramer, 1989; Hyde, 1993; Lupkowski & Schumaker, 1991; Zeidner, 1996a, 1996b**). **Osborne (2001**) has found, in a nationally representative sample of high school seniors, that anxiety explains some of the variance in math grades. A study done in Israel by **Zohar (1988**) revealed that success was negatively correlated to math test anxiety. On the other hand, **Pajares (1996a**) has found no gender differences in math anxiety among 6th graders.

In this study I am to find out whether it is true whether girls – or any sub-population – suffers from math anxiety more than in general, and to what extent. In addition, I intend to discover whether anxiety has any correlation – for each sub-population of my sample – on math achievements.

7.2.1.7. Preference: will the Israeli student choose an extra afternoon math classes?

The issue of taking extra-curricular math classes as a preferred subject has been in the Israeli agenda in comparison to other cultures. On the one hand high school mathematics is considered one of the most difficult subjects, and on the other – as explained in length in chapter 2 it is a compulsory one both as a school subjects and a subject of the matriculation examinations. On the other hand – many Israeli students – whose percentage increases with age and socio-economic status take afternoon private classes in order to get good grades at school and be allowed to learn high level mathematics. Thus, the question of afternoon enrichment mathematics classes is practically hypothetical, unless the child is classified as "gifted" or "highly talented". In these cases there are special mathematical classes aimed for the high ability students either in the afternoon or in the morning (**David, 1996, 1997, 1998a, 1998b, 1999a, 1999b, 2001b, in press; David & Zorman, 1999; Zorman & David, 2000)**.

7.2.2. Connections and correlations among the variables

7.2.2.1. Studying the connections between learning- or achievement goals and values

Goal orientation theories (e.g. **Dweck, 1990, 1999; Nichols, 1989**) report positive correlations between learning for the sake of improving knowledge or increasing skills, namely learning orientation, and valuing the material learnt, while performance or ego goals, namely, learning for outperforming others or for a reward is negatively correlated with valuing it (see also **Meece, Blumenfeld, & Hoyle, 1988; Miller, Behrens, Greene, & Newman, 1993; Nolen, 1988**; **Nolen, & Haladyna, 1990a, 1990b; Pintrich, & Schrauben, 1992)**. In this study I intend to examine if the expected correlation proofs valid along all subpopulations of my sample.

7.2.2.2. Studying the connections between learning goals and achievement

Several studies have shown, that learning goals are positively related to achievement (e.g. **Green & Miller, 1996; Meece & Holt, 1993; Pintrich & DeGroot, 1990; Pintrich & Garcia, 1991).**

Junior high school is the time when most Israeli pupils show a severe decline in math achievement. Almost half of them choose to learn mathematics either in lowest minimal level enabling them to acquire matriculation certificate (**Sa'ar, 10.7.2002**), and many more – in the average level offered. Thus it should e important to discover whether and to what extent such a decision is connected to the decline in learning goals.

7.2.2.3. Studying the connections between learning- and achievement goals and IPT

In a series of research works by Dweck, her colleagues, and others it has been shown that students holding an entity, fixed theory of intelligence tend to choose achievement goals – either approach or voidance, while those holding incremental, flexible theory of intelligence tend more towards learning goals (**Dweck, 1999; Dweck & Leggett, 1988; Rhodewalt, 1994; Roedel & Schraw, 1995; Stone, 1998).** The same correlation was observed among Korean students as well **(Grant, & Dweck, 2001)**. I aim to find whether similar results can be apploed on my population in general and to what extend for each sub-population in particular.

7.2.2.4. Studying correlations between avoidance motivation and believability in own abilities

Stipek & Gralinski (1991) have studied third graders and junior high school pupils. They found that only among the older students avoidance motivation was positively correlated with low self-concept in mathematics.

7.2.2.5. Studying the connections between actual math achievements and aspirations

In this study I aim to find out if there is a high positive correlation between actual and expected grades. **Nicholls (1979**) has already shown, that starting at age 12, there is a correlation >.70 between performance rating in reading and the actual reading grades. I expect that the correlation between all possible pairs of grades: actual and expected grade in the last assignment and actual and expected grade in the last term-card will be high.

7.2.2.6. Studying the connections between actual math achievements and valuing mathematics

Value of math has proven to influence both math motivation and achievement. In this study I am to find to what extend valuing of mathematics influences the three kinds of motivational orientations, actual achievements and expected achievements across the different ages, genders, religions, levels of religiosity and class-type. **Wigfield et al (1997)** have found, that around age 10-12 competence perceptions in a domain starts forming a strong connection to the valuing of this domain.

7.2.2.7. Studying connections between math achievement and math anxiety

It is generally accepted that test anxiety correlates negatively to achievement (e.g**. Zeidner 1998)**. **McEwan & Goldenberg, (1999)** have found among psychology students negative correlations of -.35 and -.34 between achievement and test anxiety, larger than found by **Hembree (1988)** in two meta-analyses

In spite of the tendency to relate math anxiety to low achievements there is a large body of literature – both about anxiety and achievement in general and about mathematical anxiety and achievement in particular that either indicates that there is no significant correlation between theses two components or there is a positive correlations between them. For example: In a research done among Canadian first year master of nursing students **(McEwan & Goldenberg, 1999**) it was found that trait anxiety was the only valid predictor of academic success, and that academic ability and inherent anxiety had a greater potential for predicting students' success: learning orientation had no such prediction ability at all.

A research done among Israeli Arabic students (**Nasser et al, 1997**) has shown, that in spite of the fact that girls expressed a higher level of math test anxiety, it had no influence on their achievements. Thus, it should be interesting to discover, whether all girls in my sample behave in similar way, and if not – which girls do, if any. In addition, math-anxiety will be examined regarding its correlations to all motivational factors mentioned in all sub-populations of my sample.

7.2.2.8. Studying connections between believability in math abilities and achievement

Findings from the TIMSS-1999 show that there is no positive correlation between belief in own abilities and actual abilities (**Mullis et al., December 2000**). It would be interesting, tough, whether this result would prove valid in my study' and to what extent.

7.2.2.8.1. Connections between believability in math abilities and achievement: Gender differences

Brew et al (1996) have found that even girls who were mathematically successful had a low level of confidence in their abilities. There is only some evidence demonstrating that the correlations between belief in own abilities and actual achievements are as strong among boys as among girls (e.g. **Meece et al., 1990).** Thus, an additional aim of my study is to study these links among the different groups of Israeli junior high school students of my sample.

One aim regarding believability in own math abilities will be to study whether in this aspect there are significant gender differences, and if there are – among which sub-populations and age groups. There is research evidence that believability in own ability in mathematics is higher among junior high school boys than among girls (e.g. **Eccles et al, 1989; Marsh, 1989; Marsh et al, 1985; Wigfield et al, 1991, 1997**).

7.2.2.8.2. Connections between believability in math abilities and achievement:
Religion differences

Another aim will be to find out if Arab girls have indeed higher belief in their own math abilities than Jewish girls, and there are no gender differences regarding belief in own abilities among Arabs. According to **Mittelberg & Lev-Ari (ibid)** Arab boys were not significantly different in math self-confidence than Arab girls, as was found in the Jewish population. As a result, the 3 groups: Jewish boys, Arab boys, and Arab girls were close to each other in math self-confidence; Jewish girls scored significantly lower.

7.2.2.9. Studying connections between believability in math abilities and math intrinsic motivation

As found in the literature (e.g. **Harter, 1978, 1992; Ryan & Deci, 2000c**) a positive correlation exists between believability in math abilities and math intrinsic motivation. However, since no research about the correlation between these two motivational components has been done for any Israeli sample, I aim to find out if the magnitude and direction of this correlation is similar to what has been found elsewhere; if not – among which sub-populations it is substantially different, and the possible reason for such disparities.

7.2.2.10. Studying connections between mathematical helplessness and achievements/aspirations

I also aim to discover if mathematics helplessness correlates indeed negatively with mathematics achievements and/or aspirations.

7.2.2.11. Studying connections among mathematical helplessness, learning vs. achievement goals, and believability in math abilities

According to **Dweck & Legget (1988), Maehr (1984), Maehr & Meyer (1997), Maehr & Yamaguchi (2001)**, and **Nicholls (1989)**, students with performance goals orientation will act helplessly when the level of believability in their own abilities is low. In addition, **Dweck & Bush (**1976) have found gender differences in learned helplessness. Thus, I aim to find if this is valid to Israeli students as well, and to what extent.

7.2.2.12. Studying holding incremental or entity beliefs and motivational orientations

Dweck and her colleagues (e.g. **Dweck & Legget, 1988; Stone, 1998)** have shown that in the last grades of elementary school and in junior high school there is a positive correlation between holding fixed theories of intelligence and preferring performance- rather than learning goals.

In previous studies it was assumed, that since the incremental individual and the entity one can be identified as having different personalities, extrinsic motivation, which has a high correlation with the entity individual, has a negative correlation to intrinsic motivation, perceived as connected to the incremental personality. Thus, it was assumed that children who are entity theorists would tend to adopt an extrinsic motivation style, while incremental theorists have a higher level of intrinsic motivation. The explanation for this preference lies in the way students perceive the aim of learning. While entity theorists study mostly for achieving praise or high grades that result in satisfying others and look smart, incremental theorists study for the sake of enlarging their knowledge or deepening it, thus they enjoy learning and do not depend as much on others' opinion about them.

7.2.2.13. Studying holding incremental or entity beliefs and stability of math abilities

Investigating the correlation between stability of math abilities and holding an entity or incremental intelligence personal theory in each sub-population of my sample will be another aim of my research. Research done by **Dweck and her colleagues (e.g. 1996b, 1999, Dweck, & Bempechat, 1983, Dweck, Chiu, & Hong, 1995a, 1995b)** suggests that the more a person would tend towards a fixed perception of intelligence, the more her or his math abilities will be perceived as stable. On the other hand, results from the Israeli matriculation examinations point at the fact that different sectors behave in different ways regarding the choice of matriculation subjects, which might suggest that in these sectors the ability to learn some subjects is not perceived as fixed. For example: in the year 2000 the Christian sector scored in the first place among students learning 2 enhanced humanistic and 2 enhanced scientific subjects – 32.3% of the examinees (**Statistics, Israel, 2002b, table 8.24)**. The sector that scored second was the state religious one – 24%, in the Muslim education it was 18.8%, while in the Hebrew general education it reached only 7.8% and **(ibid**). While in the Jewish general sector students who take two scientific subjects at the highest possible level as well as higher level English satisfy the minimal entrance requirement of most universities, Arabs and Jewish students learning in religious schools must take at least one more subject in order to satisfy either the school- or the university requirement. Let us assume that the distribution of entity and incremental theorists is equal among all populations. In that case we must conclude that believing in one of these theories will not be tightly connected to the choosing of learning enhanced mathematics or any other subject. In the case of Arabs it will probably not matter so much how stable the student perceives his or her abilities, but rather what are the subjects he or she must take in order to be accepted to an Israeli university and acquire a good future profession. In the case of a religious student – who must study Oral Law and Bible at the highest possible level in order to remain in school stability of abilities would no matter so much either.

Chapter 8:
Method

8.1. The population

Four Israeli schools were chosen for the sample:

8.1.1. The Tel Aviv Municipal "Bet-Gimmel" school – *Zeitlin*

In the *Zeitlin* religious junior- and high school in Tel Aviv, 236 questionnaires, from 9 classes – 4 boys' and 5 girls'; 3 7th, 4 8th, and 2 9th grade classes were filled. The school has over 1100 students, all learning in single-sex classes;

The Tel Aviv Municipal "Bet-Gimmel" [=ב-ג] school, named after the late Rabbi Aaron *Zeitlin*, is comprised of a boys' school ("Bet") and a girls' one ("Gimmel"). The school policy has an admissions priority for Tel Aviv residents. The two criteria for acceptance of pupils who are not residents of Tel Aviv are a high academic level and a "very good" grade in "behavior". Every year three new scientific 7th grade classes are opened: two for girls and one for boys. Every 6th grader who wants to ensure acceptance to one of these classes has to take psychometric tests given at the end of the first term, and score at percentile 85. The school admits new students to the 8th, 9th, and 10th scientific classes if there are vacancies due to dropout of students from the existing classes. The school does not admit students to the non-scientific classes, where the dropout rate is much higher. Thus, while the average number of 7th grade classes open every year is 8, there are always just 5-6 12th grade classes.

About two thirds of the school population are girls. In the 2001/2 school year the average class size was 34. However, the class size varied by the type of the class: scientific 7th grade classes were the largest; non-scientific 8th grade classes – the smallest.

The school's socio-economic profile is mixed: most of its students come from southern suburbs, which are considered lower class to low middle-class neighborhoods, and only about a quarter come from the northern parts of Tel Aviv, which are middle to upper middle-class neighborhoods. The male population at *Zeitlin* is at least 90% of Asian-African origin. In spite of this fact the percentage of 12th graders entitled to the matriculation certificate in one of the highest among all Tel Aviv schools.

8.1.2. The Tel Aviv *Alliance* school

The *Alliance* junior- and high school in Tel Aviv is a mixed school with 24 junior high school and 20 high school classes. 260 questionnaires were filed in 8 classes – 2 7th, 8th, 9th, and 10th grade classes;

The *Alliance* school located in Ramat Aviv, a northern suburb of Tel Aviv, is one of the best schools not only in Tel Aviv but also in the whole country regarding the success rate in the matriculation examinations. In the year 2001 it scored with 95% success rate of its graduates **(Ilil Shachar, 27.3.2002**).

French is an obligatory subject at the *Alliance* school, thus students who are admitted to one of its 7th grade classes must belong to one of the three categories:

i. Be a native speaker of French;
ii. Be a new comer from a French speaking country;
iii. Belong to a wealthy family that can pay for private French lessons.

As pupils from the first two groups are a small minority of the Israeli population, most of *Alliance* students belong to the third one. In addition, as the school is not municipal acceptance has always been limited to students with high academic achievements in other subjects as well.

In the 2001/2 academic year the *Alliance* school had 43 classes with 1605 students. The average class size was over 37 pupils – higher than the average in the Jewish sector and similar to the Arab one. The number of boys was almost equal to that of girls in all school grades and all classes: the total was 798 boys and 807 girls.

8.1.3. The Um El-Fachm *El-Razi* junior high school

The *El-Razi* junior high school is located in Um El-Fachm, a large religious Muslim village a few kilometers from the border of the Palestinian Authority.

El-Razi is a mixed-sex school with over 800 students. 237 questionnaires were collected in 7 classes: 2 7th and 8th classes, and 3 9th grade classes. In 2001/2 15%-40% of the 12-15 year old girls In the *El-Razi* school already cover their heads, and according the headmaster this tendency increases every year, especially among younger girls. Almost all female teachers were wearing traditional dresses and covered their heads as well, while the headmaster and all male teachers and students were wearing western cloths.

The school is considered a good one in comparison to other schools in the Arab sector in general and to the other junior high schools in Um El-Fachm in particular. The school is non-selective and the dropout rate is low. The average class size is 34-35 children in all grades.

The socio-economic background of the students is about the average of that in the Arab sector.

8.1.4. The Um El-Fachm *Hadige* high school for girls

The *Hadige* high school for girls in Um El-Fachm was founded in 1992 as an initiative of parents who wanted their daughters to study in a single-sex school. The school is non-selective: there are no entrance examinations or other conditions for girls who wish to be accepted the school.

The *Hadige* high school consists of 21 classes: 7 10th grade classes, 6 11th-, and 8 12th grade classes. Both 10th grade classes participating in my study had 37 students in each; as no student was missing or refused to fill a questionnaire 74 questionnaires were filled in these two classes.

Like in *Zeitlin* each school grade in *Hadige* has two scientific classes, to which students are selected according to their 9th grade report and entrance examinations. Unlike in *Zeitlin* there is no dropout policy. All girls who wish to take the matriculation exams are encouraged to do so; many other tracks are open for the girls who find the scientific track too demanding. In the non-scientific classes the number of students is lower thus the average school number is 31 students per class.

The 621 girls who studied in *Hadige* in the 2001/2 school year belonged to all social and financial classes in Um El-Fachm and in the villages around it. Um El-Fachm is considered very religious – its previous mayor resigned in the year 2000 in order to become leader of the Israeli Islamic Movement. In the Hadige high school about 75% of the girls cover their heads, and all students as well as female teachers wear traditional long dark costumes.

8.1.5. Distribution of the questionnaires in each cell

822 questionnaires were collected; 808 of them have been analyzed. The questionnaires can be divided to 5 groups, according to the 5 following independent variable:

1. Gender:

1. Boys – *Zeitlin*: 93, *El-Razi*: 111, *Alliance*: 131. TOTAL: 335
2. Girls – *Zeitlin*: 143, *El-Razi*: 126, *Alliance*: 130, *Hadige*: 74. TOTAL: 473

2. Class type:

1. Mixed classes: 15; Total: 469 (*Alliance* and *El-Razi* students).
2. Single-sex classes: 11; 4 boys' classes, and 7 girls' classes; 236 *Zeitlin* students; 73 *Hadige* students. Total: 339 students.

3. Grade and age:

In the study 7 7th grade, 8 8th grade, 7 9th grade, and 4 10th grade classes participated. The mean age of all students was 13.95 years. The minimal age was, at the time of the study, 11.75 year; the maximal – 16.75.

Table 8.1. Age-means for each sub-population

		Mean	Std	T	df	p
	General	13.95	1.09	---	---	---
Gender	Male	13.83	1.10	2.53	746	.02
	Female	14.04	1.09			
Class type	Single	14.49	1.09	11.32	746	<.001
	Mixed	13.62	0.87			
Religion	Jews	14.02	1.01	2.09	746	.04
	Muslims	13.85	1.04			
Religiosity	Religious	14.23	0.83	4.32	746	<.001
	Non Religious	13.85	1.17			

4. Religion:

498 student studied in the two Jewish schools; 310 in the two Arab schools.

5. Religiosity:

236 children studied in the *Zeitlin* religious school; 572 studied in the three state- non-religious schools.

Table 8.2. The 5 dimensional frequencies table

		GENDER															
		1								2							
		CLASS-TYPE								CLASS-TYPE							
		1				2				1				2			
		GRADE				GRADE				GRADE				GRADE			
		7	8	9	10	7	8	9	10	7	8	9	10	7	8	9	10
		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
RELIGION	RELIGIOSITY																
1	0	37	25	28	33	.	.	.	.	36	34	30	32	.	.	.	.
	1	.	.	.	.	.	30	54	27	.	.	.	.	25	31	59	25
3	0	33	33	39	.	.	.		.	36	38	49	.	.	.	.	73
	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

8.2. The tools

My main research tool was a questionnaire that measures the following motivational and educational components:

1. Value of math
2. Belief in own math abilities
3. Helplessness
4. Belief in incremental or rigid theory of intelligence
5. Stability of math abilities
6. Learning goals
7. Approach goals
8. Avoidance goals
9. Math anxiety
10. Preference of afternoon math classes
11. Aspirations level
12. Actual achievements

Items that were phrased negatively were re-coded before processing them.

The following scales were all validated, they have been used frequently in many research works done both in the US and in Germany. They were all highly reliable (alpha was between .96 and .69).

<u>1. Value of math (6)</u> (Dweck, 1986; Stöger, 2001; Ziegler, Dresel, & Schober, 1998, 2000)
Alpha=.749

- Math classes are very useful.
- Iike math classes.
- Math class is important.
- Being able to do math is important.
- I like to be able to do math.
- Math is something very useful.

<u>2. Belief in own abilities (4)</u> (Dresel, Schober, & Ziegler, April 2002; Dweck, 1999, Stöger, 2001)

<u>Alpha=.691</u>

- I normally consider myself to be talented in math.
- I am <u>not sure</u> that I am good enough to be successful in math.
- I <u>do</u> <u>not</u> have much <u>confidence</u> in my abilities for math.
- When I am presented with new material in math, I am usually able to understand it.

<u>3. Helplessness (4)</u> (Breitkopf, 1985; Dweck, 1986; Stöger, 2001)
<u>Alpha=.769</u>

- I cannot think clearly in math.
- Even if I study a lot, I won‘t be good in math.
- I don‘t think that I will ever be able to do math.
- In math, I feel over-challenged.

<u>4. Belief in incremental or rigid theory of intelligence</u> (IPT Modality) (5) (Dweck, 1986, 1999; Stöger, 2001)
<u>Alpha = .756</u>

- My intelligence in math is something about me that I can’t change very much.
- I can improve my abilities in math.
- Do you control the improvement of your abilities in math?
- What I know in math is not fixed; I can add knowledge and broaden my abilities.
- I can learn new things, but I can’t really change my basic intelligence in math.

<u>5. Stability of math abilities (8)</u> (Dweck, 1986; Stöger, 2001)
<u>Alpha =.750</u>

- Whatever I know in math, I know, and that‘s the way it stays.
- Once I can do something in math, the ability stays with me forever.
- I cannot change the fact that there are things in math that I can‘t do.
- Once I know something in math, I never forget it.

- It happens that I can no longer do things in math that I was able to do before.
- Once I master something in math, I do it right in the future.
- I can forget (or „un-learn„) things that I know in math.
- I can add new things to what I already know in math.

Table 8.3. Measuring motivational orientations

(Dweck, 1986; Schober, 2000, Stoeger, 2001)

Motivational Orientation	Items *Above all, in math I would like...*
6. Learning goals (Alpha=.957)	...to improve my abilities. ...to learn many new things. ...to learn as much as possible. ...to do tricky assignments from which I can learn. ...to be able to do more and more. …to understand the learnt material.
7. Approach-performance-orientation (Alpha=.960)	... it that my parents notice how good I am. ... it that my teacher praises me because I am good. ... it that my parents are proud of me because I am good. ... it that my teacher notices how good I am. … it that my classmates notice how good I am. .... it that my parents praise me because I am good. ... to be able to be happy about a good grade. ... it that my teacher likes me because I am good. ... it that my classmates admire me because I am good. ... to get a good grade. ... it if my classmates like me because I am good. ... to be satisfied with myself, because I got a good grade.
8. Avoidance-performance-orientation (Alpha=.832)	... it if my classmates don‘t notice that I can‘t do something. ... to not be sad about a bad grade. ... to avoid my classmates not liking me anymore because I am bad. …to not get any bad grades. …to avoid being dissatisfied with myself because I got a bad grade. ... it if my teacher wouldn‘t notice that I can‘t do something. … if my classmates do not laugh at me because I am bad. …to avoid my parents being disappointed in me because I am bad. ... it if m. it if my parents didn‘t notice that there is something that I can‘t do. ... to avoid my teacher not liking me because I am bad. ... it if my teacher does not reproach (yell at) me because I am bad. ... it if my parents do not reproach me because I am bad.

9. Math anxiety (6) (Dweck, 1986; Dresel, 2001; Stöger, 2001)
Alpha=.776

- When I think about math, I am afraid that my teacher notices that I can't do something.
- When I think about math, I am afraid that my teacher doesn't like me because I am bad.
- When I think about math, I am afraid that my classmates laugh at me because I am bad.
- When I think about math, I am afraid that my parents are disappointed in me because I am bad.
- When I think about math, I am afraid to get a bad grade.
- When I think about math, I am afraid that my parents will reproach me because I am bad.

10. Preference of math afternoon classes (Dweck, 1986; Stöger, 2001)
Imagine that you had to decide on one extra work group in one subject in addition to the normal lessons. All main subjects could be chosen. How much would you like to choose math?

11. Expectations /Aspiration level (Dweck, 1986; Ziegler & Schober, 1999)

i. In the next math assignment, what is the lowest grade that you could get and still consider to be satisfactory? _____
ii. What is the lowest final grade in math that you would still consider to be satisfactory? ____

12. Actual achievements (Dweck, 1986; Ziegler & Schober, 1999)
What grades did you have in math?
i. In your last report card / half term card: ____
ii. In your last test / assignment ____

Separate versions were prepared for the different genders both in Hebrew and Arabic. In addition, on the left top of the first page of each questionnaire a capital "F" or "M" was printed to minimize confusion.

Only scales nos. 11 and 12, namely those dealing with the expected and actual grades, have been answered by numerical number, ranging from 0-100. Since in most Jewish schools the minimal grade is 40 ("unsatisfactory"), grades ranging from 0-39 in the Arabic version were corrected to 40.

All other questions were given a 6-stages Lickert-scale with the poles: "1: I disagree completely" or "absolutely no" and "6: I agree completely" or "absolutely yes".

8.3. The process

8.3.1. Preparing the questionnaires: Overcoming the translation problem

As summarized in the "tools" part of this chapter, the questionnaire was prepared out of validated full scales of existing, widely used English and German questionnaires. I have translated the questionnaire into Hebrew; an Arabic psychologist prepared the Arabic version. The final Hebrew and Arabic versions – both in the masculine and the feminine forms – were checked and re-checked until found qualified for the written approval of The Department of Research, The Office of the Chief Scientist, The Israeli Ministry of Education.

8.3.2. Access: Overcoming the Achilles heel of a large-scale research

After translating of the questionnaires and acquiring not only the written agreement of the Ministry of education to do the research but also its recommendation, I had to overcome the access problem. In my case there were three major problems that could endanger the success of my work:

1. The need to do the research within a few weeks in all schools in order to have a similar age of children in each grade;
2. The need to do the research in large schools so that the minimal number of each cut (gender/grade/religion/religiosity/class-type) would be no less than 25;
3. The El-Akza Intifada that broke in September 2000 made access to many Arab villages – especially to the more religious Muslim ones – quite hard.

I. In order to overcome the time limit I scheduled my research between the third week of September and the fourth week of October 2001. I made myself available within a few hours from the time I got a telephone call from each headmaster and arrived at their schools when there were enough classes that could participate in my research. The Jewish high holidays that took place during 3 weeks of this period of time enabled me to share my time between the Jewish and the Arab schools; choosing the first weeks of the new school year minimized the objection of the headmasters to what they defined as: "wasting the learning time of the pupils".

II. The need to choose <u>large schools</u>. I had to choose the *Zeitlin* religious school: it is the only mixed-sex school with single-sex classes in Tel Aviv, and since I live in Tel Aviv that was the only school of its kind where I could arrive in a short notice. Being an old friend of the school ex-headmistress and maintaining professional connections with the physics teacher who was in charge of the school schedule facilitated my access to the *Zeitlin* school.

Access to the *Alliance* school was much more difficult. It took long weeks before the headmistress was willing to meet me, and she did agree to do so only after reading my book (**Zorman & David, 2000**). After getting her primary acceptance I still had to arrange the time with the two teachers in charge of the schedule: the one of the junior-high school and the other – of the high school. Since it was the beginning of the year and the school did not have a permanent substitute teacher for each subject taught I agreed to serve as a substitute teacher within half an hour after getting a telephone call from the school. During these classes I conducted my study

Both headmasters of the *El-Razi* and the *Hadige* schools are outstanding graduates of the Israeli higher education system, and they both taking great pain because of the escalation of relationships between Arabs and Jews. Thus, the research I conducted in their schools served their aim of education to co-existence and they were glad that the Israeli Ministry of Education would have results from the Arab sector regarding mathematical education. As a result they were treating me as if I was doing them a favor rather than the other way round. Each visit to their schools became a social event during which long conversations with many of the teachers were taking part.

<u>**III.** Access to Um el-Fachm</u>, where both the Arab schools are located, was the least of my difficulties. I have many personal friends in this village, and it seemed that the whole Um El-Fachm population recognizes the car that drives me there. Muslims would never let anybody harm their visitors, so I felt safer there than in Tel Aviv… In fact – during one of my visit at the *Hadige* school I left my bag at the school gate and came back to pick it after an hour. The bag was waiting for me at the headmasters' office, with nothing missing from my purse that was inside…

<u>8.3.3. Filling the questionnaires</u>

The students have filled the questionnaires during a special class aimed for a discussion about future aspirations regarding mathematics. I was present in all classes during all the time of filling the questionnaires. In the Arab classes a teacher was always present as well. In *Zeitlin* a teacher was present in most classes; in *Alliance* I functioned as a substitute for a missing teacher. When the teacher was present we entered the classroom together; the teacher told the students that as they had agreed to participate that was the time for it. I introduced myself, and spoke about five minutes about the mathematics problem in the Israeli school and about girls and mathematics. I also spoke about authorized studies, and the other schools that participated in the study. I answered some questions and promised to answer all other ones after the questionnaires were returned.

When the teacher was present she or he helped me answering the students' questions during the time the students filled the questionnaires. The variety in the filling duration was very large: while some pupils completed this assignment in 10 minutes, there were a few that did not finish in 50. I let the pupils who returned the questionnaires do homework, study for exams, or read. I also asked each pupil that returned the questionnaire if she or he would like to solve a mathematical riddle. Most students did; many were quite enthusiastic about it.

After all students handed me the filled questionnaires I answered more of their questions about the questionnaires, e.g. who wrote it, did boys and girls had the same questionnaires, etc., and about their potential academic future. Many of the students – both males and females – were quite ignorant as to the necessity of learning high-level mathematics as a condition for studying certain professions. In three out of the four schools the staff was cooperative and thanked me for consulting the pupils.

8.3.4. "Just making sure": From the filled questionnaires to the filed data

I checked each returned questionnaire if the gender of the pupil returning it was in accordance with the "F" or "M" written on it. In every mixed-sex class I made two piles on the table: one for the M's and one for the F's. In addition I checked all returned questionnaires to make sure the students filled all pages. Mostly this procedure assured the re-filling of the missing answers, but in a few cases the student refused to complete the unfilled questionnaire. Thus I managed to "lose" only 16 out of the initial 824 questionnaires.

The filled questionnaires of each class were collected in a large manila enveloped, sealed, and the class-number along with the school name were written on it. I put the sealed envelopes in a locked closet at the headmaster's office of each school until the end of the learning day, and took them immediately afterwards to my home.

I opened an SPSS file for each class as soon as I got back home. This was aimed to minimize mistakes, such as a missing page in the questionnaire or questionnaires that were not filled properly or completely. Such mistakes could not be corrected later, when I did not come to the school any more. The combining of all files was done after I finished collecting all questionnaires and coding the separate file.

Chapter 9:
Results

9.1. Introduction to the results

The coming chapter will contain the following parts:

1. Presentation of means and significant differences among all sub-groups (boys and girls, Jews and Muslims, secular and religious students, students learning in single- versus mixed-sex classes, and students in grades 7, 8, 9, and 10), and significant 2-way and 3-way interactions, tat were a result of the following ANalysis Of Variance of three groups of three independent variables:

i. Gender*Religion*Grade;

ii. Gender*Class-type [single-or mixed-sex]*Grade;

iii. Gender*religiosity [secular versus religious]*grade.

Because of the huge amount of data only significant results will be presented.

All the above analyses were conducted for the following measures:

i. The three "classic" motivational orientations, namely, learning, approach, and avoidance motivation;

ii. Expected and actual grades in mathematics;

iii. Value of mathematics, believability in own math ability, mathematical helplessness, Intelligence Personality Theories regarding mathematics, stability of math abilities, mathematical anxiety, and preference of mathematics afternoon class.

2. Significant correlations findings higher than |.3| among all the above components;

3. Regression for both grade expectancy and actual grades by learning-, approach-, and avoidance motivation; value of mathematics, believability in own math ability, mathematical helplessness, Intelligence Personality Theories regarding mathematics, stability of math abilities, mathematical anxiety, and preference of mathematics afternoon class; from then on: "The grand 10". These regressions have been conducted in the general view as well as for each sub-group.

9.2. Motivational, educational, and psychological components influencing achievements and aspirations

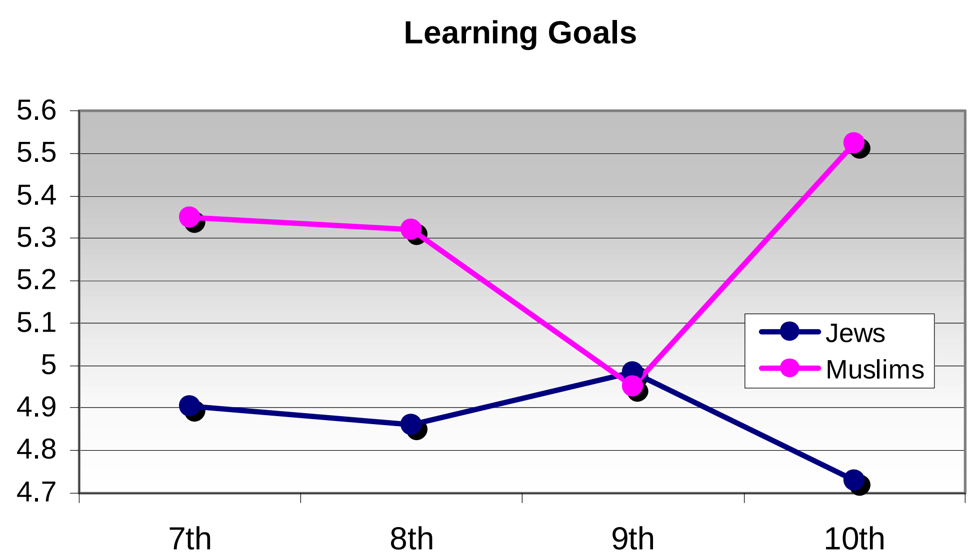
I. Gender*Religion*Grade

9.2.1. Studying motivsational orientations: Learning-goal orientation, approach orientation, and avoidance orientation

9.2.1.1. Learning goals

9.2.1.1.1. Learning goals: Religion
A significant difference was found [F(1,771)=36.13, p<.001]
Jews scored lower than Muslims in learning goals [means (sd): 4.87 (.04), 5.25 (.05) respectively].

9.2.1.1.2. Learning goals: Religion*Grade
Significant interactions were found [F(3,771)=7.82, p<.001]



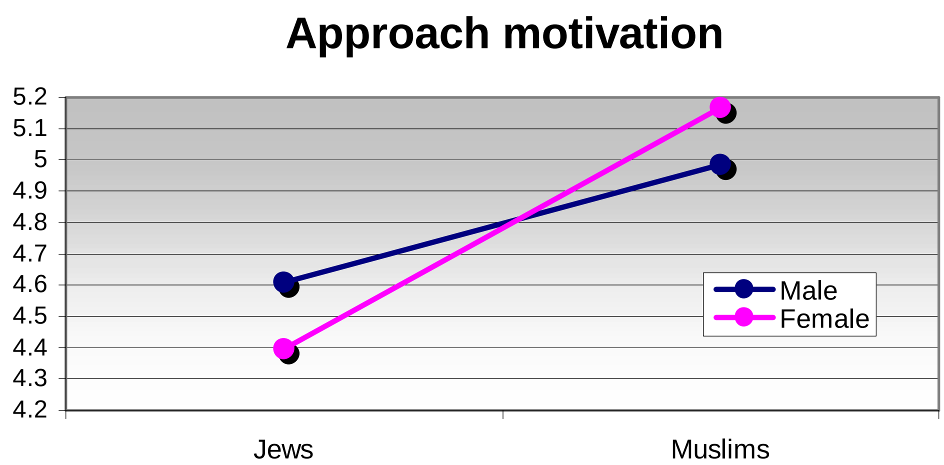
Among Jews increases from grade 7 to 8 and 9 to 10 and an increase from grade 8 to 9 have been observed [means (sd): 4.90 (.09), 4.86 (.08), 4.99 (.07), and 4.73 (.08) in grades 7-10 respectively];
Among Muslims a decrease has been observed from grade 8 to 9 and a sharper one – from grade 8 to 9; an increase – from grade 9 to 10 [means (sd): 5.35 (.10), 5.32 (.10), 4.95 (.09), and 5.52 (.10) in grades 7-10 respectively].

9.2.1.2. Approach goals

9.2.1.2.1. Approach goals: Religion
Significant differences have been found [F(1,768)=57.78, p<.001)
Jews had a lower approach goal motivation than Muslims [means (sd): 4.50 (.05), 5.09 (.06) respectively].

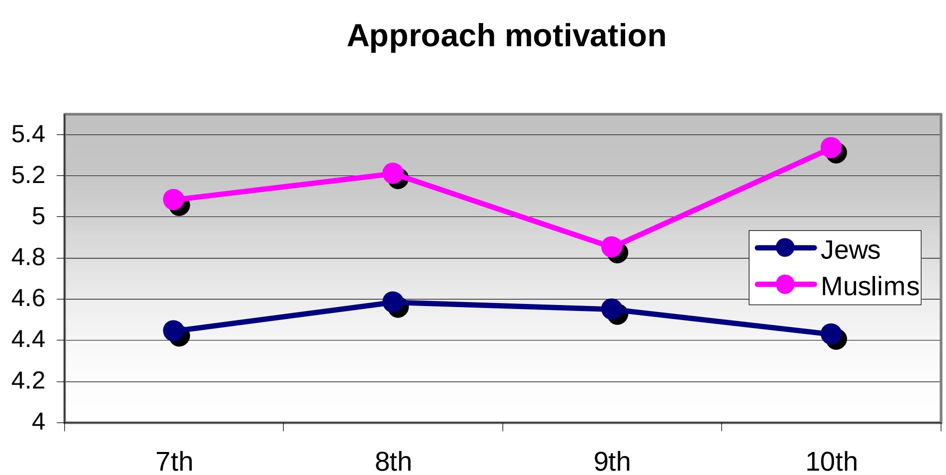
9.2.1.2.2. Approach goals: Gender*Religion

Significant interactions have been found [F(1,768)=3.90, p<.05)



Among Jews boys had higher approach goals than girls [means (sd): 4.61 (.07), 4.40 (.06) respectively];
Among Muslims boys had lower approach goals than girls [means (sd): 4.99 (.01), 5.17 (.07) respectively].

9.2.1.2.3. Approach goals: Religion*Grade
Almost significant interactions have been found [F(3,768)=2.28, p=.078)



Among Jews approach motivation increased from grade 7 to 8 and decreased from grade 8 to 9 and 9 to 10 [means (sd): 4.44 (.10), 4.59 (.09), 4.55 (.08), and 4.43 (.09) in grades 7-10 respectively];

Among Muslims approach motivation increased from grade 7 to 8, decreased from grade 8 to 9 and increased from grade 9 to 10 [means (sd): 5.08 (.12), 5.21 (.12), 4.85 (.11), and 5.34 (.11) in grades 7-10 respectively].

9.2.1.3. Avoidance goals

9.2.1.3.1. Avoidance goals: Gender

Significant differences have been found [F(1,763)=8.27, p<.01)

Boys scored higher than girls [means (sd): 3.83 (.07), 3.61 (.06) respectively].

9.2.1.3.2. Avoidance goals: Religion

Significant differences have been found [F(1,763)=19.85, p<.001)

Jews scored lower than Muslims [means (sd): 3.53 (.05), 3.92 (.07) respectively].

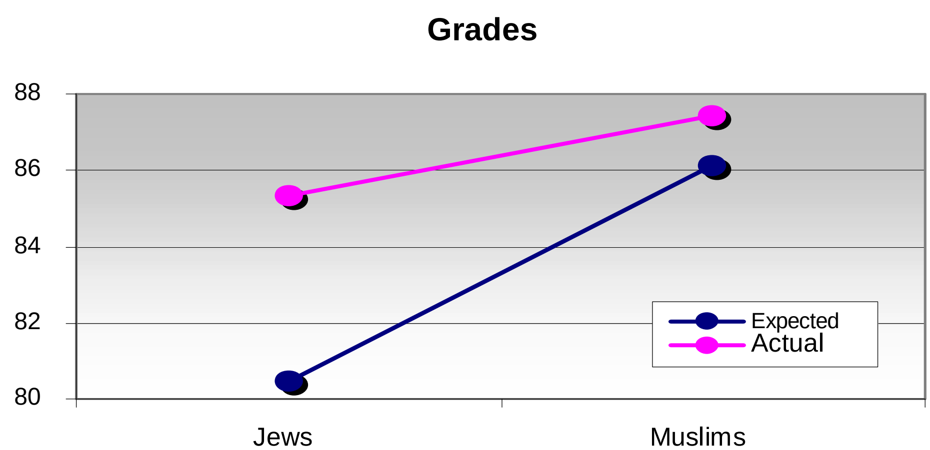
9.2.2. Studying achievements and aspirations

9.2.2.1. Achievements: Gender

No significant gender differences regarding either expected or actual math grade was observed.

9.2.2.2. Achievement and aspirations: Religion

A significant difference was found between Jews and Muslims both in expected and actual grades [F(1,647)=23.88, p<.001]



Jews were found to have significantly lower scores than Muslims in
Expected grade: [means (sd): 80.48 (.39) and 86.10 (.58)] respectively; and in
Actual grade: [means (sd): 85.33 (.59) and 87.43 (.43)] respectively.

Though the main effect was highly significant, the gap between the expected and the actual grade was much larger among Jews than among Muslims. It seems that the main effect was created mainly because of the gap in the expected grade between Jews and Muslims

A significant difference occurred [F(3,634))=4.52, p<.01)];

A grade decline happened in grade 9 [means (sd): 84.45 (.84), 84.43 (.74), 81.27 (.61), and 84.04 (.76) for grades 7-10 respectively].

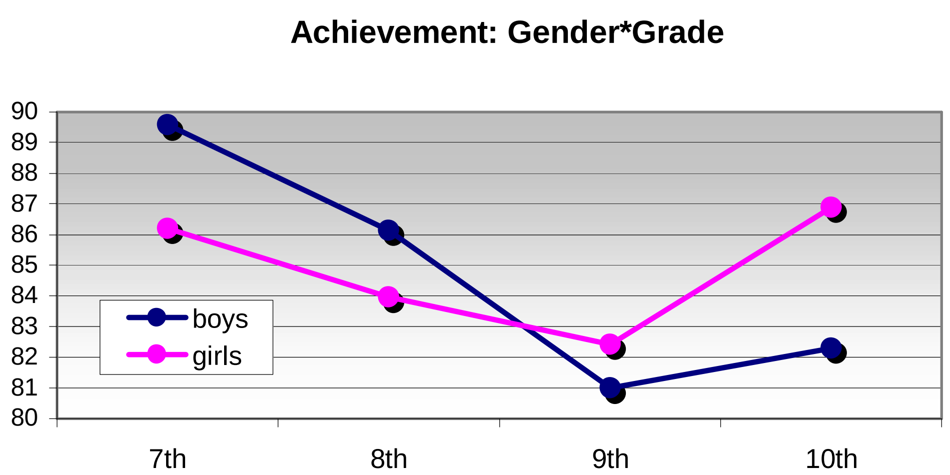
9.2.2.3. Achievements and aspirations: Grade

Significant differences were found among the 4 examined grades in expected and actual grades [F(1,637)=4.62, p<.003]

Grades were found to decrease from grade 7 to 8 and from 8 to 9, and then – to increase from grade 9 to 10 [means (sd): 87.89 (.94), 85.04 (.81), 81.70 (.69), and 85.36 (.71) respectively].

9.2.2.4. Achievements and aspirations: Gender*Grade

An almost significant interaction was found among the 4 examined grades for the two genders: [F(3,634)=2.37, p=.069]



While boys outperformed girls in grade 7 and 8, girls scored higher than boys in grades 9 and 10

In grade 7: **means (sd): 89.57 (1.52) and 86.2 (1.10);**

In grade 8: means (sd): 86.13 (1.25) and 83.96 (1.03);

In grade 9: means (sd): 80.99 (1.02) and 82.42 (.93);

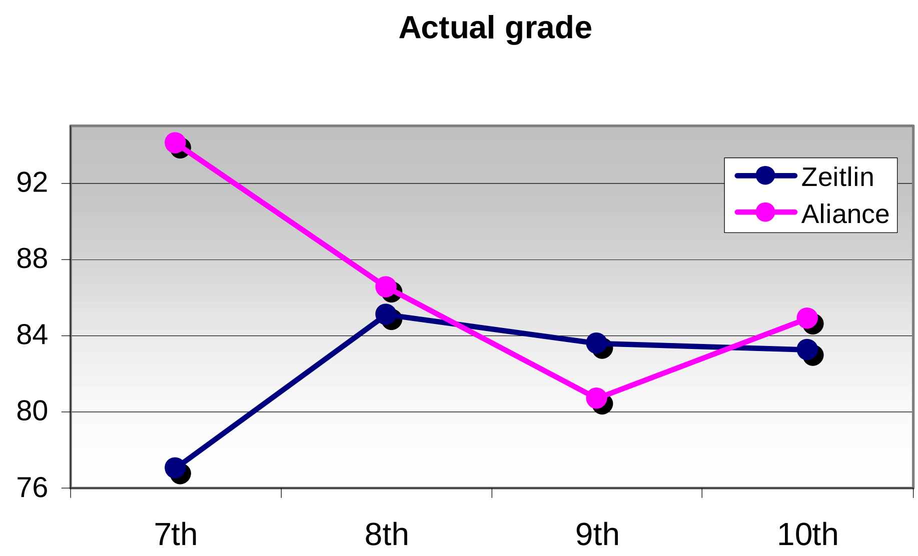
And in grade 10: means (sd): 82.30 (1.21) and 86.88 (.87) respectively.

9.2.2.5. Achievement and aspirations: *Zeitlin* versus *Alliance*

A particularly interesting comparison between the grades of *Zeitlin* and Alliance schools: both are located in Tel Aviv, both are selective, both are considered as belonging to the first league of high schools.

Let us see the comparison regarding the actual grades of these two schools. It should be noted that while differences regarding the schools and schools with the level-grade are significant at the p<.000 level, the achievements differences at the grade-level level are only hardly significant (p=.057).

An almost significant interaction was found among the 4 examined grades for the two genders: [F(3,469)=2.52, p=.057]



While in grade 7 the *Alliance* students outperformed those of *Zeitlin* substantially, in grade 9 the *Zeitlin* students outperformed those of *Alliance* and in grades 8 and 9 the achievements of students of these two schools were very similar:
In grade 7: means (sd): 94.10 (1.41) and 77.04 (2.38);
In grade 8: means (sd): 86.55 (1.67) and 85.13 (1.53);
In grade 9: means (sd): 80.71 (1.55) and 83.59 (1.15);
In grade 10: means (sd): 84.89 (1.94) and 83.26 (1.65)] for *Alliance* and *Zeitlin* respectively.

9.2.3. Studying value of mathematics

9.2.3.1. Value of math: Religion

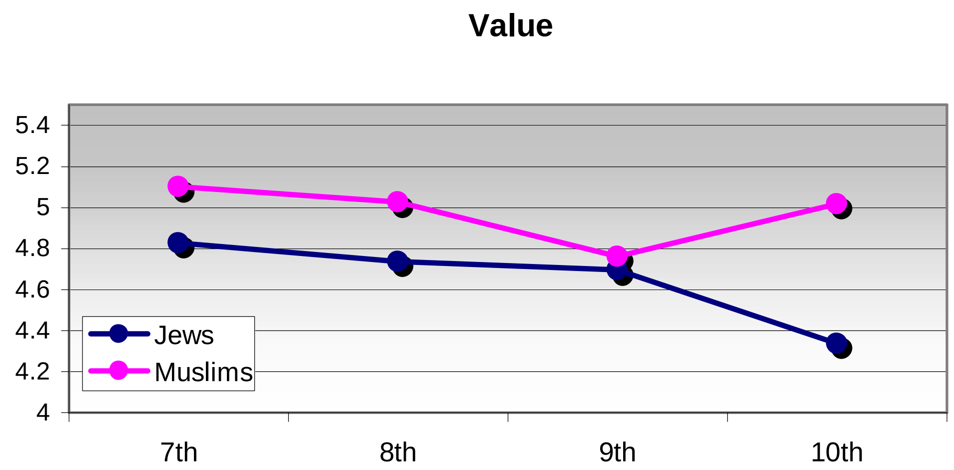
A significant difference was found between Jews and Muslims: [F(1,788)=17.08, p<.001)]
Jews valued mathematics less than Muslims [means (sd): 4.65 (.04) and 4.97 (.06) respectively].

9.2.3.2. Value of math: Grade

Significant differences were found among the four examined grades [F(3,788)=4.55, p<.01)]
A decrease in valuing mathematics was observed from grade 7 to 8, 8 to 9, and 9 to 10 [means (sd): 4.96 (.07), 4.88 (.07), 4.73 (.07), and 4.56 (.07) for grades 7-10 respectively].

9.2.3.3. Value of math: Religion*Grade

Significant interactions were found among the four examined grades between Jews and Muslims [F(3,788)=2.72, p<.05)]



Among Jews a significant decline occurred between grade 9 and 10, though there was a tendency towards decreasing the value of math during each pair of subsequent years.
Among Muslims a significant decrease occurred between grade 8 and 9, a significant increase – between grade 9 and 10.
In grades 7, 8, and 10 Muslims score higher than Jews regarding valuing mathematics.
In grade 7: means (sd): 4.83 (.10) and 5.10 (.11);
In grade 8: means (sd): 4.74 (.09) and 5.02 (.11);
In grade 9: means (sd): 4.70 (.07) and 4.76 (.10);
And in grade 10: means (sd): 4.34 (.09) and 5.02 (.11)] for Jews and Muslims respectively.

9.2.4. Studying believability in math abilities or math self-concept

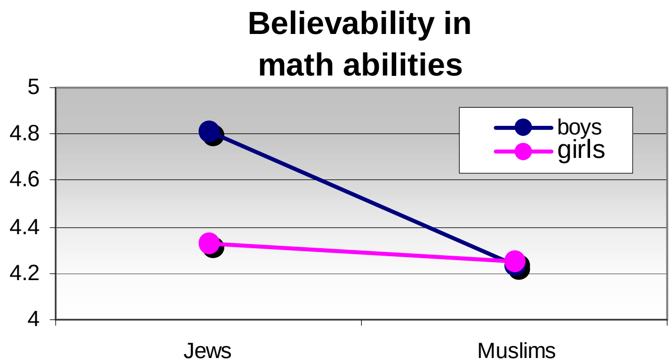
9.2.4.1. Believability in math abilities: Gender
Significant gender differences were found [F(1,790)=10.36, p=.001)]
Boys scored higher than girls [means (sd): 4.56 (.06), 4.29 (.05) respectively].

9.2.4.2. Believability in math abilities: Religion
Significant differences between Jews and Muslims were found [F(1,790)=16.36, p<.001)]
Jews scored higher than Muslims: [means (sd): 4.57 (.05), 4.24 (.06) respectively].

9.2.4.3. Believability in math abilities: Grade
Significant differences were found among the four examined grades [F(1,790)=11.90, p<.001]
Significant decreases were observed from grade 7 to 8 and 8 to 9; significant increases – from grade 9 to 10 [means (sd): 4.71 (.08), 4.36 (.08), 4.11 (.07), and 4.52 (.07) for grades 7-10 respectively].

9.2.4.4. Believability in math abilities: Gender*Religion

Significant interactions were found [F(1,790)=8.51, p<.01]



Among Jews large significant gender difference were found [means (sd) 4.81 (.07), 4.33 (.06) for boys and girls respectively];

Among Muslims no significant gender differences were found [means (sd): 4.23 (.10), 4.25 (.08)] for boys and girls respectively].

9.2.5. Studying mathematical helplessness

9.2.5.1. Helplessness: Religion

Significant differences were found [F(1,787)=24.90, p<.001]

Jews scored significantly lower than Muslims [means (sd): 2.44 (.05), 2.99 (.07)] respectively].

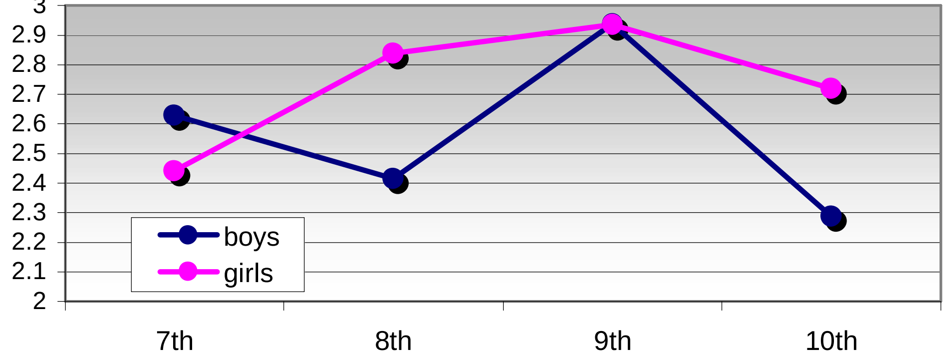
9.2.5.2. Helplessness: Grade

Significant differences were observed [F(3, 787)=4.66, p<.01]

A significant increase was found from grade 7 to 8 and 8 to 9; a significant decline was observed from grade 9 to 10 [means (sd): 2.54 (.09), 2.63 (.09), 2.94 (.08), and 2.58 (.09) in grades 7-10 respectively].

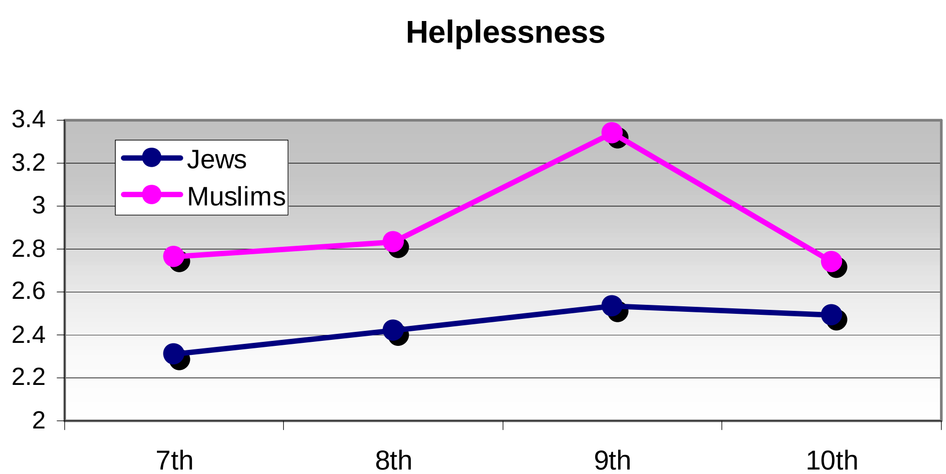
9.2.5.3. Helplessness: Gender*Grade

An almost significant interaction was observed [F(3, 787)=2.42, p=.65]



Boys:
Among boys there was a decline – though not significant – from grade 7 to 8.
The largest significant change between two subsequent grades was a decrease between grade 9 and 10 [means (sd): 2.63 (.24), 2.42 (.13), 2.94 (.11), and 2.29 (.15) for grades 7-10 respectively].
Girls:
Girls scored significantly higher than boys in grades 8 and 10 [grade 8: means (sd): 2.84 (.12), 2.42 (.13); grade 10: means (sd): 2.72 (.10), 2.28 (.15) for girls and boys respectively];
Among girls the largest increase in helplessness occurred between grade 7 and 8.
A large decrease in helplessness occurred between grade 9 and 10 [means (sd): 2.44 (.12), 2.84 (.12), 2.94 (.10), and 2.72 (.10) for grades 7-10 respectively].

<u>9.2.5.4. Helplessness: Religion*Grade</u>
An almost significant interaction was observed [F(3, 787)=2.51, p=.58]



In all grades Muslims scored higher than Jews.
<u>Grade 7</u>: [means (sd): 2.31 (.12), 2.76 (.14) for Jews and Muslims respectively]
<u>Grade 8:</u> [means (sd): 2.42 (.11), 2.83 (.14) for Jews and Muslims respectively]
<u>Grade 9:</u> [means (sd): 2.53 (.09), 3.34 (.13) for Jews and Muslims respectively]
<u>Grade 10:</u> [means (sd): 2.49 (.11), 2.74 (.14) for Jews and Muslims respectively].

9.2.6. Studying IPT

9.2.6.1. IPT: Religion

A significant difference was observed [F(1, 788)=18.97, p<.001]

Jews were holding a higher level of rigid theory of intelligence regarding mathematics than Muslims [means (sd): 2.44 (sd=.04), 2.12 (sd=.06) respectively].

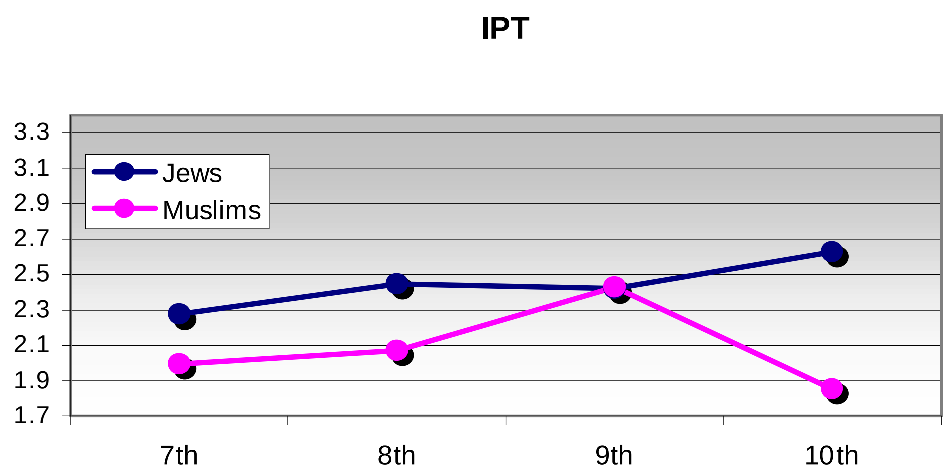
9.2.6.2. IPT: Grade

A significant difference was observed [F(3, 788)=3.21, p<.05]

The perception of intelligence as rigid became stronger from grade 7 to 8 and 8 to 9, and decreased from grade 9 to 10 [means (sd): 2.14 (.07), 2.26 (.07), 2.43 (.06), 2.37 (.07) in grades 7-10 respectively].

9.2.6.3. IPT: Religion*Grade

A significant interaction was observed [F(3, 788)=4.04, p<.01]



A gradual increase was observed from grade 7 to 10 among Jews: [means (sd): 2.28 (.10), 2.25 (.09), 2.42 (.07) and 2.63 (.09) in grades 7-10 respectively];

Muslims scored lower than Jews in grades 7, 8, and 10, namely, they believed more than Jews in incremental theory of intelligence. In addition, a substantial decrease in believability in the perception as intelligent a rigid occurred from grade 9 to 10 [means (sd): 1.99 (.11), 2.07 (.11), 2.43 (.10), and 1.85 (.11) in grades 7-10 respectively].

9.2.7. Stability of math abilities

9.2.7.1. Stability of math abilities: Religion

A significant difference was observed [F(1,787)=7.00, p<.01]

Jews believed more than Muslims in stability of math abilities [means (sd): 2.73 (.04), 2.57 (.05) respectively].

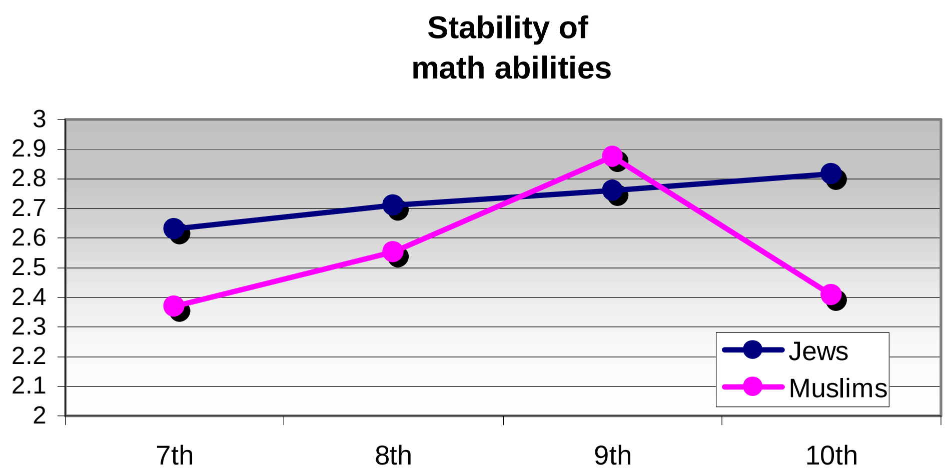
9.2.7.2. Stability of math abilities: Grade

A significant difference was observed [F(3, 787)=4.79, p<.01]

Stability of math abilities increased from grade 7 to 8 and 8 to 9, and decreased from grade 9 t 10 [means (sd): 2.50 (.07), 2.63 (.06), 2.82 (.06), and 2.68 (.06) in grades 7-10 respectively].

9.2.7.3. Stability of math abilities: Religion*Grade

A significant interaction was observed [F(3, 787)=3.37, p<.05]



Among Jews: **A gradual increase from grade 7 to 10; the difference was significant only from grade 7 to 10** [means (sd): 2.63 (.09), 2.71 (.08), 2.76 (.06), and 2.82 (.08) in grades 7-10 respectively];

Among Muslims: **a gradual increase from grade 7 to 9; the difference is significant from grade 8 to 9; A significant decrease from grade 9 to 10** [means (sd): 2.37 (.10), 2.55 (.10), 2.88 (.09), and 2.41 (.10) for grades 7-10 respectively].

9.2.8. Mathematical anxiety

9.2.8.1. Math anxiety: Gender

A significant gender difference was found in math anxiety [F(1, 787)=7.03, p<.01]

Males had a higher anxiety level than females [means (sd): 2.85 (.06), 2.71 (.05) respectively].

9.2.8.2. Math anxiety: Religion

A significant difference was found in math anxiety [F(1, 787)=79.05, p<.001]

Jews had a lower level of anxiety than Muslims [means (sd): 2.45 (.05), 3.15 (.07) respectively].

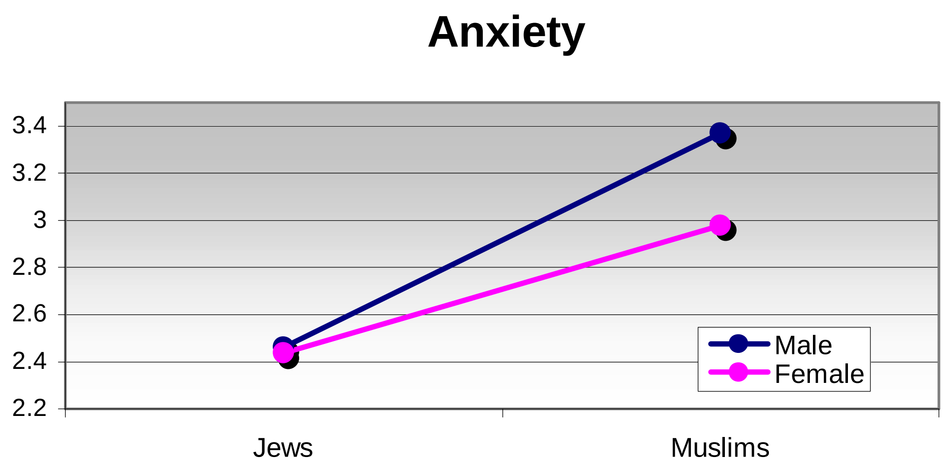
9.2.8.3. Math anxiety: Grade

A significant difference was found in math anxiety [F(3, 787)=5.25, p=.001]

Math anxiety increased from grade 7 to 8 and 8 to 9, and decreased from grade 9 to 10 [means (sd): 2.54 (.09), 2.89 (.08), 2.91 (.07), and 2.76 (.08) in grades 7-10 respectively].

9.2.8.4. Math anxiety: Gender*Religion

A significant interaction was found in math anxiety [F(3, 787)=7.24, p<.01]



Among Jews the levels of math anxiety were similar for the two genders [means (sd): 2.46 (.08), 2.44 (.07) for males and females respectively];
Among Muslims math anxiety was much higher among boys than among girls [means (sd): 3.37 (.11), 2.98 (.82) respectively].

9.2.9. Preference of an afternoon mathematics class

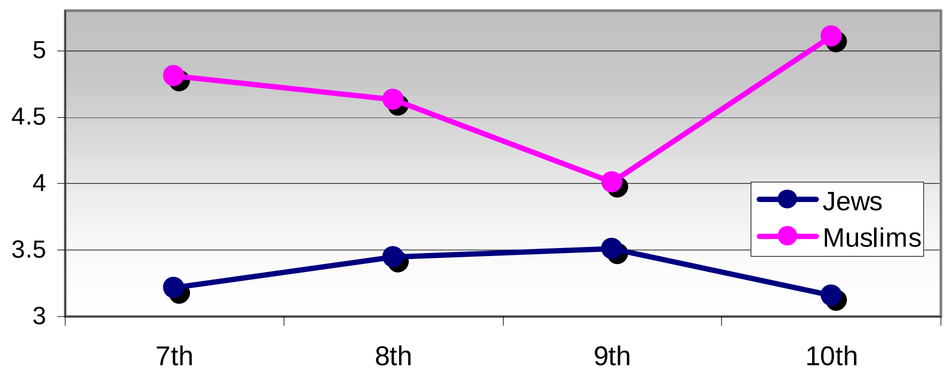
9.2.9.1. Preference: Religion

A significant difference was found in preference of an afternoon math class [F(1, 724)=81.78, p<.001]
Jews scored lower than Muslims [means (sd): 3.33 (.07), 4.57 (.11) respectively].

9.2.9.2. Preference: Religion*Grade

A significant interaction was found in preference of an afternoon math class [F(3, 724)=5.26, p=.001]

Preference



Among Jews an increase was observed from grade 7 to 8 and 8 to 9 and a decline from grade 9 to 10 [means (sd): 3.22 (.17), 3.45 (.15), 3.51 (.12), and 3.16 (.15) in grades 7-10 respectively];

Among Muslims a decrease has been observed from grade 7 to 8 and from grade 8 to 9. A substantial increase occurred from grade 9 to 10 [means (sd): 4.81 (.25), 4.63 (.21), 4.02 (.19), and 5.11 (.20) in grades 7-10 respectively].

II. Gender*Class-type [single-or mixed-sex]*Grade

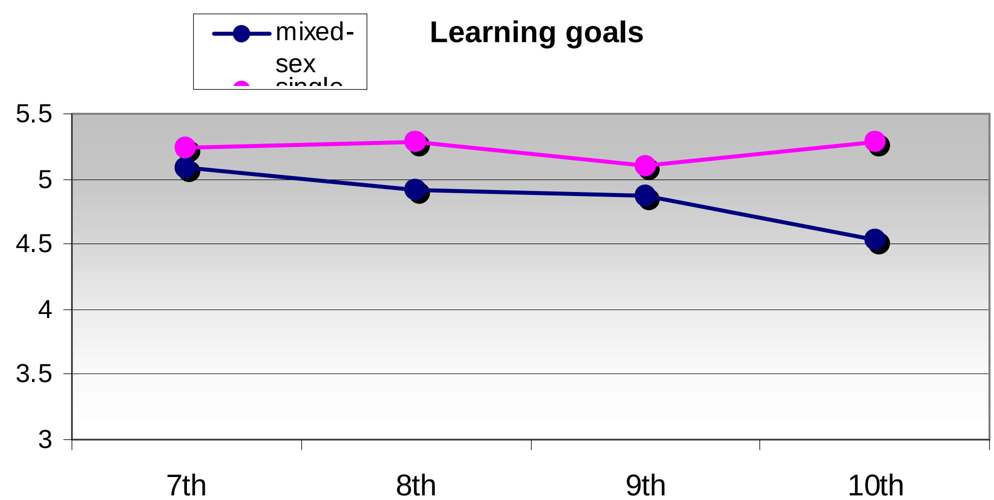
9.2.1a. Motivational orientations: Learning-goal orientation, approach orientation, and avoidance orientation

9.2.1.1a. Studying learning goals

9.2.1.1.1a. Learning goals: Class-type
A significant difference was found [F(1,771)=24.65, p<.001)]
Students in mixed classes had lower learning goal motivation than those in single-sex classes [means (sd): 4.85 (.04), 5.22 (.05) respectively].

9.2.1.1.2a. Learning goals: Grade
An almost significant difference was found [F(3,771)=2.45, p=.062]
A gradual decrease in learning goals was observed from grade 7 to 10 [means (sd): 5.14 (.08), 5.10 (.07), 4.99 (.05), and 4.91 (.07) respectively].

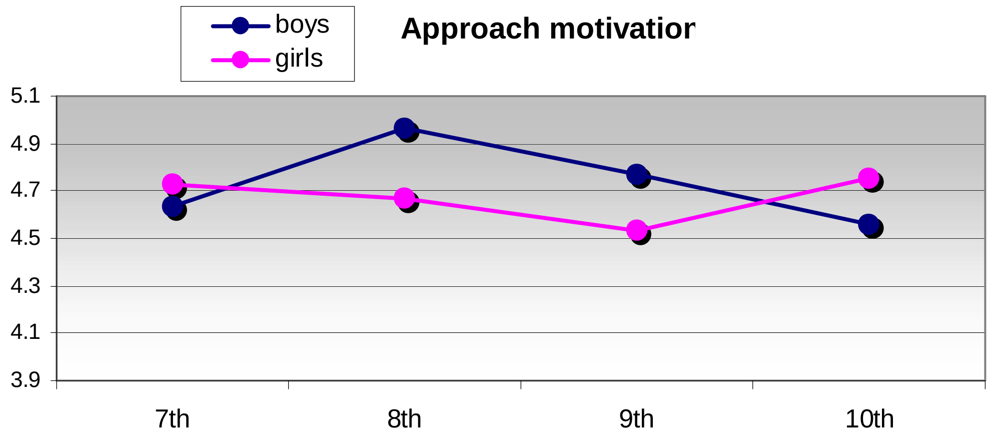
9.2.1.1.3a. Learning goals: Class-type*Grade
A significant interaction was found [F(3,771)=3.87, p<.01)]



In mixed-sex classes learning goal motivation decreased between each two subsequent grades [means (sd): 5.09 (.07), 4.91 (.08), 4.87 (.07), and 4.54 (.11) in grades 7-10 respectively];
In single-sex classes the only significant – though small decrease in comparison to mixed-sex classes - occurred between grade 8 and 9 [means (sd): 5.24 (.18), 5.28 (.11), 5.10 (.08), and 5.28 (.10) respectively].

<u>9.2.1.2a. Studying approach goals</u>

<u>9.2.1.2.1a. Approach goals: Gender*Grade</u>
A significant difference was found [F(3, 768)=2.66, p<.05]



Among boys approach motivation increased from grade 7 to 8 and decreased from grade 8 to 9 and 9 to 10 [means (sd): 4.64 (.12), 4.96 (.12), 4.77 (.09), and 4.56 (.13) in grades 7-10 respectively];
Among girls approach motivation decreased from grade 7 to 8 and 8 to 9 and increased from grade 9 to 10 [means (sd): 4.73 (.12), 4.66 (.11), 4.54 (.09), and 4.75 (.10) in grades 7-10 respectively].

<u>9.2.1.3a. Studying avoidance goals</u>

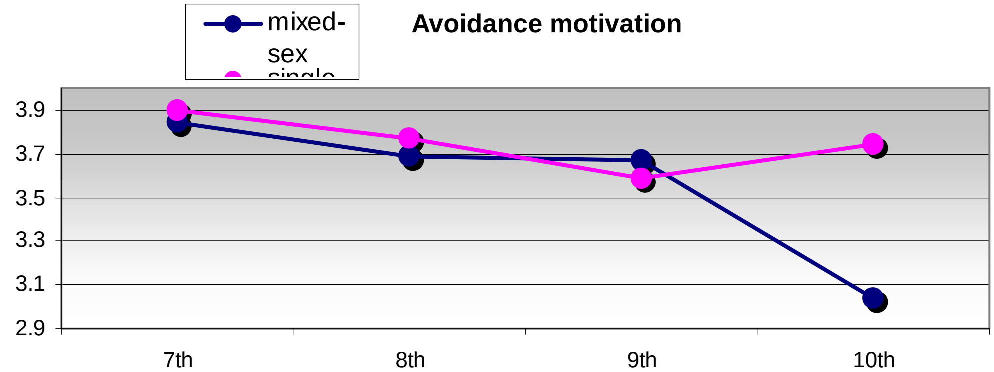
<u>9.2.1.3.1a. Avoidance goals: Gender</u>
A significant difference was found [F(1, 763)=6.38, p<.05]
Boys were higher in avoidance motivation than girls [means (sd): 3.72 (.07), 3.56 (.06) respectively].

<u>9.2.1.3.2a. Avoidance goals: Class-type</u>
A significant difference was found [F(1, 763)=6.16, p<.05]
Students in mixed-sex classes were lower in avoidance motivation than students in single-sex classes [means (sd): 3.56 (0.55), 3.73 (0.70) respectively].

<u>9.2.1.3.3a. Avoidance goals: Grade</u>
A significant difference was found [F(1, 763)=5.77, p<.001]
A decrease in avoidance motivation was found between each pair of subsequent grades [means (sd): 3.86 (.10), 3.73 (.09), 3.63 (.07), and 3.39 (.09) in grades 7-10 respectively].

9.2.1.3.4a. Avoidance goals: Class-type*Grade

Significant interactions were found [F(3,763)=4.01, p<.01]



In mixed-sex classes a decrease in avoidance motivation was observed between each pair of subsequent grades [means (sd): 3.85 (.10), 3.69 (.11), 3.67 (.10), and 3.03 (.14) in grades 7-10 respectively];

In single-sex classes a decrease was found between grade 7 and 8 and 8 and 9, and an increase from grade 9 to 10 [means (sd): 3.90 (.23), 3.77 (.15), 3.58 (.11), and 3.74 (.12) in grades 7-10 respectively].

9.2.2a. Studying achievements and aspirations

9.2.2.1a. Achievement and aspirations: Grade

A significant difference occurred [F(3,634))=4.52, p<.01)]

A grade decline happened in grade 9 [means (sd): 84.45 (.84), 84.43 (.74), 81.27 (.61), and 84.04 (.76) for grades 7-10 respectively].

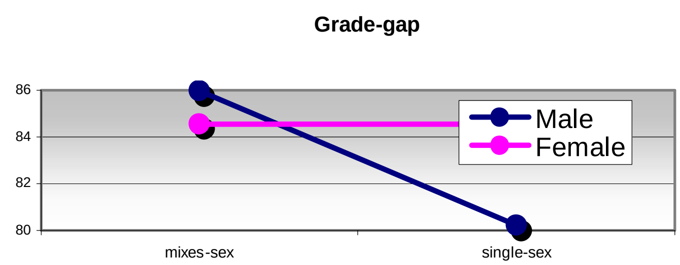
9.2.2.2a. Achievement and aspirations: Class-type

A significant difference occurred [F(1,634)=28.80, p<.001]

Students learning in mixed-sex classes outperformed those in single-sex classes regarding the average between the expected and the actual grade **[means (sd): 85.25 (.48), 81.47 (.57) respectively].**

9.2.2.3a. Achievements and aspirations: Gender*Class-type

A significant interaction occurred [F(1,634)=16.52, p<.001]

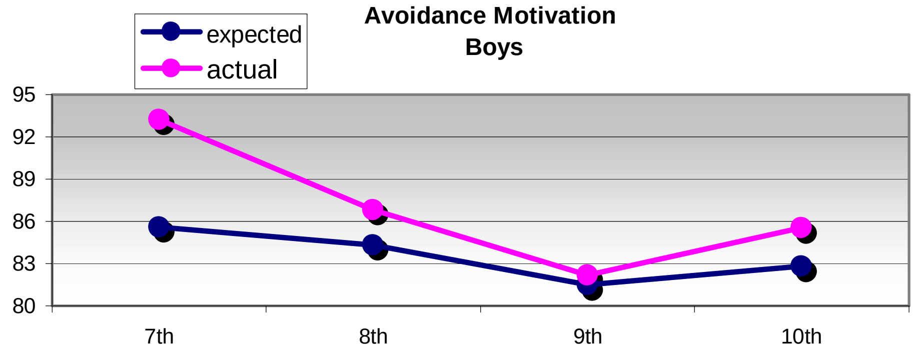


The differences among girls were much smaller than among males [means (sd): **Boys:** 85.95 (.70), 80.20 (.90); **Girls:** 84.55 (.65), 82.43 (.73) in mixed and single-sex classes respectively].

9.2.2.4a. Achievements and aspirations: Grade*Class-type

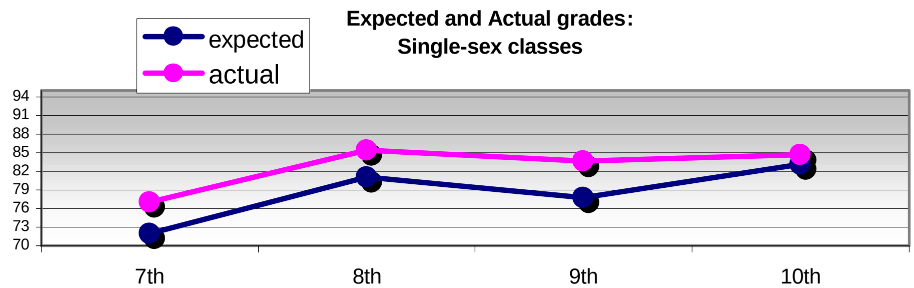
A significant difference occurred [F(3,634)=16.75, p<.001]

In Mixed-sex classes:



The differences between the expected and actual grades decreased substantially after grade 7 [means (sd): 85.69 (.79); 93.21 (1.18); 84.33 (.83), 86.82; 81.48 (.75), 82.19 (1.11); and 82.82 (1.05), 85.54 (1.56) for expected versus actual grades in grades 7-10 respectively];

In single-sex classes:



The differences between the expected and actual grades remained about the same in grades 7-10 until it almost disappeared in grade 10 [means (sd): 72.06 (1.61), 77.04 (2.41); 81.13 (1.05), 85.41 (1.56); 77.76 (.81), 83.64 (1.21); and 83.18 (.88), 84.63 (1.31) for expected versus actual grades in grades 7-10 respectively].

9.2.3a. Studying value of mathematics

9.2.3.1a. Value of math: Class-type

Significant differences were found [F(1,788)=30.90, p<.001]

Students learning in mixed-sex classes valued mathematics less than those learning in single-sex classes [means (sd): 4.55 (.04), 4.97 (.056) respectively].

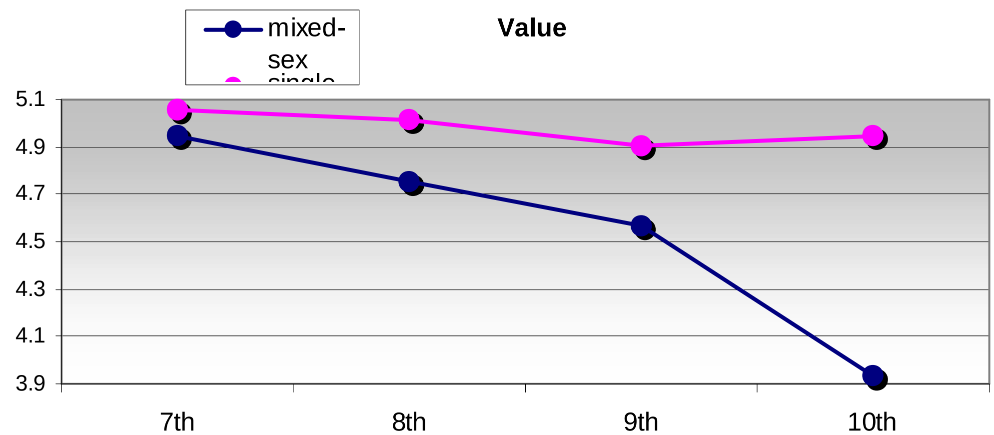
9.2.3.2a. Value of math: Grade

Significant differences were found [F(3,788)=10.49, p<.001]

The value of mathematics decreased from each subsequent grade to the other [means (sd): 4.99 (.08), 4.89 (.07), 4.74 (.05), and 4.44 (.08) in grades 7-10 respectively].

9.2.3.3a. Studying value of math: Class-type*Grade

Significant differences were found [F(3,788)=7.08, p<.001]



In mixed-sex classes a substantial decrease in valuing mathematics occurred between each subsequent two grades [means (sd): 4.95 (.08), 4.76 (.08), 4.57 (.08), and 3.94 (.11) in grades 7-10 respectively];

In single-sex classes no significant difference was observed in valuing mathematics between any two grades [means (sd): 5.06 (.18), 5.01 (.12), 4.90 (.09), and 4.95 (.10) in grades 7-10 respectively].

9.2.4a. Studying believability in math abilities or math self-concept

9.2.4.1a. Believability in math abilities: Gender

A significant difference was found [F(1,790)=16.72, p<.001)]

Boys scored higher than girls [means (sd): 4.63 (.06), 4.30 (.05) respectively].

9.2.4.2a. Believability in math abilities: Class-type

A significant difference was found [F(1,790)=8.34, p<.01]

Students in mixed-sex classes scored lower than in single-sex classes [means (sd): 4.35 (.05), 4.58 (.06) respectively].

9.2.4.3a. Believability in math abilities: Grade

A significant difference was found [F(3,790)=5.60, p<.001]

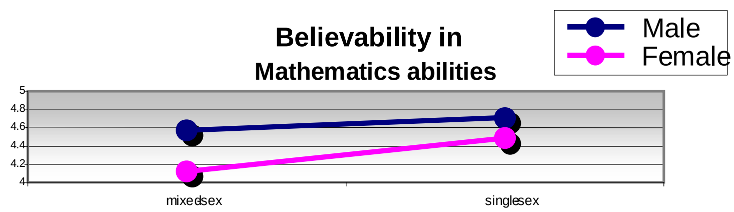
Students in grade 7 scored higher than in grade 8 and in grade 8 higher than in grade 9, students in grade 10 scored higher than in grade 9 [means (sd): 4.66 (.09), 4.44 (.08), 4.24 (.06), and 4.53 (sd=.08) respectively].

9.2.4.4a. Believability in math abilities: Gender*Class-type

An almost significant difference was found [F(1,790)=3.57, p=.059]

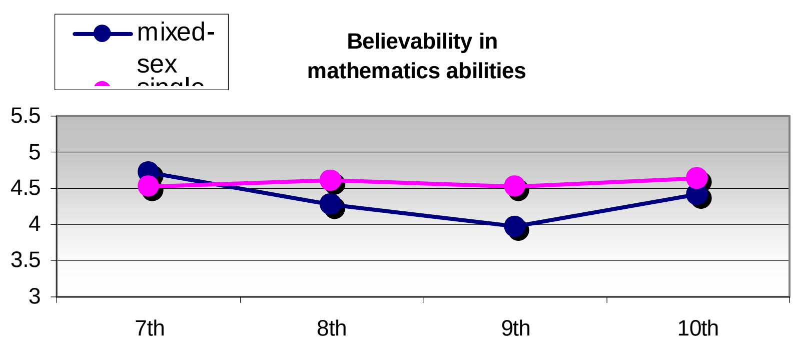
Among boys students in mixed-sex classes scored lower than in single-sex classes [means (sd): 4.57 (.07), 4.70 (.10) respectively];

Among girls students in mixed-sex classes scored much lower than in single-sex classes [means (sd): 4.12 (.07), 4.49 (.08) respectively].



9.2.4.5a. Believability in math abilities: Grade*Class-type

Significant differences have been observed [F(3,790)=3.33, p.05]



In mixed-sex classes a substantial decrease was observed from grade 7 to 8 and another one from grade 8 to 9, followed by an increase from grade 9 to 10 [means (sd): 4.73 (.08), 4.28 (.09), 3.96 (.08), and 4.42 (.12) respectively];

In single-sex classes there was a small increase from grade 7 to 8 and a small increase from grade 7 to 8 followed by a mild increase from grade 9 to 10 [means (sd): 4.54 (.20), 4.60 (.13), 4.52 (.09), and 4.63 (.11) respectively].

9.2.5a. Studying mathematical helplessness

9.2.5.1a. Helplessness: Gender

An almost significant difference was found [F(1,787)=3.61, p=.058]

Boys were lower than girls in mathematical helplessness [means (sd): 2.48 (.07), 2.67 (.06) respectively].

9.2.5.2a. Helplessness: Class-type

A significant difference was found [F(1,787)=9.78, p<.01]

Students in mixed-sex classes were higher than in single-sex classes in mathematics helplessness [means (sd): 2.74 (.06), 2.40 (.07) respectively].

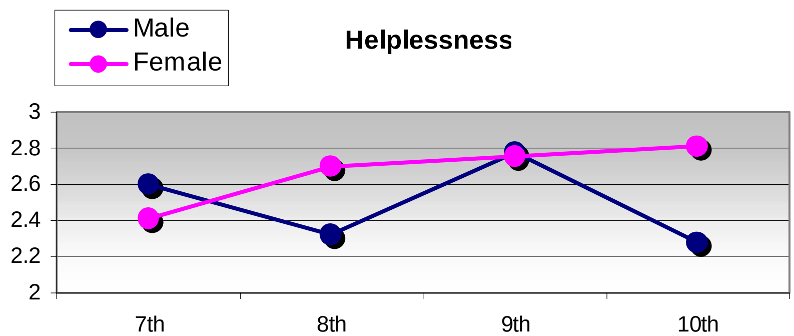
9.2.5.3a. Helplessness: Grade

An almost significant difference was found [F(3,787)=2.52, p=.056]

Mathematics helplessness increased from grade 7 to 8 and from 8 to 9, and decreased from grade 9 to 10 [means (sd): 2.48 (.10), 2.51 (.09), 2.77 (.07), and 2.54 (.10) respectively].

9.2.5.4a. Helplessness: Gender*Grade

A significant difference was found [F(3,787)=3.95, p<.01]

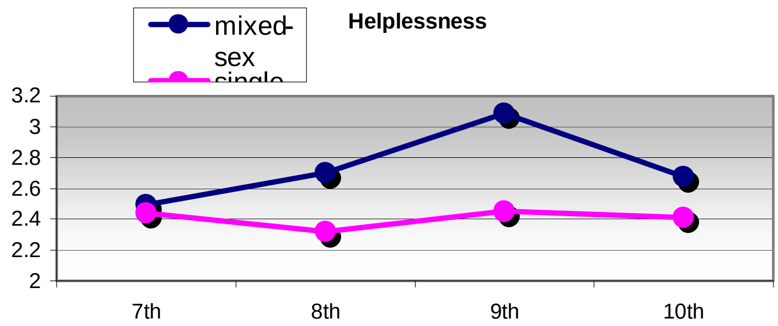


Among boys mathematics helplessness decreased from grade 7 to 8 and from 9 to 10 and increased from grade 8 to 9 [means (sd): 2.61 (.14), 2.32 (.13), 2.78 (.11), and 2.28 (.15) respectively];

Among girls mathematics helplessness increased from grade 7 to 8, from 8 to 9 and from 9 to 10 [means (sd): 2.41 (.14), 2.70 (.13), 2.76 (.10), and 2.81 (.12) from grade 7-10 respectively].

9.2.5.5a. Helplessness: Class-type*Grade

An almost significant difference was found [F(3,787)=2.37, p=.069]



In mixed-sex classes mathematical helplessness increased from grade 7 to 8 and from grade 8 to 9 and decreased from grade 9 to 10 [means (sd): 2.50 (.10), 2.70 (.11), 3.09 (.10), and 2.67 (.15) respectively];

In single-sex classes mathematical helplessness decreased from grade 7 to 8, increased somewhat from grade 8 to 9 and decreased slightly from grade 9 to 10. However, no significant differences were observed between any two grades [means (sd): 2.44 (.24), 2.32 (.15), 2.45 (.11), and 2.41 (.13) respectively].

9.2.6a. Studying IPT

9.2.6.1a. IPT: Class-type

Significant differences were observed [F(1, 788)=17.75, p<.001]

Students learning in mixed-sex classes believed more than those in singles-sex classes in rigidity of mathematical intelligence [means (sd): 2.51 (.04), 2.17 (.06) respectively].

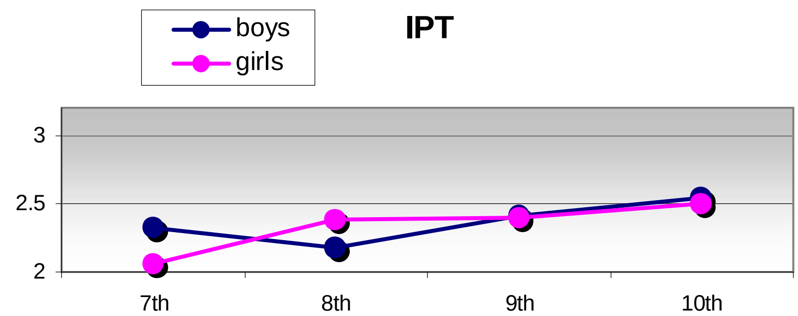
9.2.6.2a. IPT: Grade

Significant differences were observed [F(3, 788)=4.00, p<.01]

The belief that mathematical intelligence is rigid rather than incremental increased between each pair of subsequent grades [means (sd): 2.14 (.08), 2.28 (.07), 2.40 (.06), and 2.52 (.08) respectively].

9.2.6.3a. IPT: Gender*Grade

Significant differences were found [F(3,788)=2.75, p<.05]

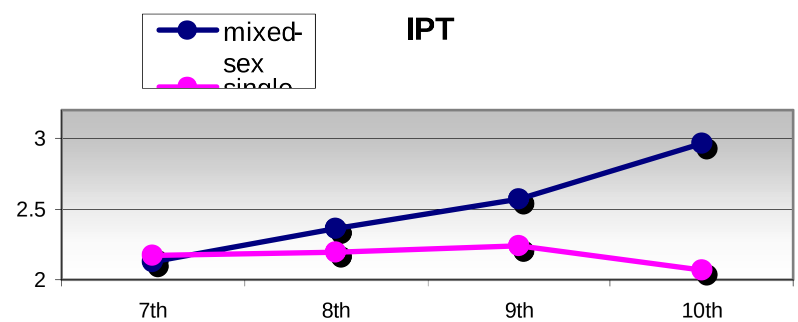


Among boys there were increases in belief of rigidity of mathematical intelligence from grade 8 to 9 and 9 to 10 but a decrease from grade 7 to 8 [means (sd): 2.32 (.11), 2.18 (.10), 2.41 (.08), and 2.54 (.12) in grades 7-10 respectively];

Among girls increases in belief in rigidity of math intelligence were observed between any two subsequent grades [means (sd): 2.06 (.11), 2.38 (.10), 2.39 (.08), and 2.49 (.09) in grades 7-10 respectively].

9.2.6.4a. IPT: Class-type*Grade

Significant differences were found [F(3,788)=7.62, p<.001]



In mixed-sex classes an increase in belief in rigidity of math intelligence was observed between any two subsequent grades [means (sd): 2.13 (.08), 2.36 (.08), 2.57 (.08), and 2.96 (.11) from grade 7-10 respectively];

In single-sex classes the differences in belief in rigidity of math intelligence were not significant between any two years [2.17 (.18), 2.20 (.12), 2.24 (.09), and 2.07 (.10) in grades 7-10 respectively].

9.2.7a. Studying Stability of math abilities

9.2.7.1a. Stability of math abilities: Class-type

A significant difference was found [F(1,787)=14.11, p<.001)]

Students in mixed-sex classes were higher than in single-sex classes: [means (sd): 2.80 (.04), 2.53 (.05) respectively].

9.2.7.2a. Stability of math abilities: Grade

A significant difference was found [F(3,787)=3.44, p<.05)]

An increase was found from grade 7 to 8 and 8 to9 9 and a small decrease from grade 9 to 10 [means (sd): 2.51 (.07), 2.62 (.06), 2.78 (.05), and 2.75 (.07) respectively].

9.2.8a. Studying Mathematical anxiety

9.2.8.1a. Math anxiety: Class-type

A significant difference was found [F(1,787)=5.45, p<.05]

Students in mixed-sex classes were higher in math anxiety than in single-sex classes [means (sd): 2.78 (.06), 2.58 (.07) respectively].

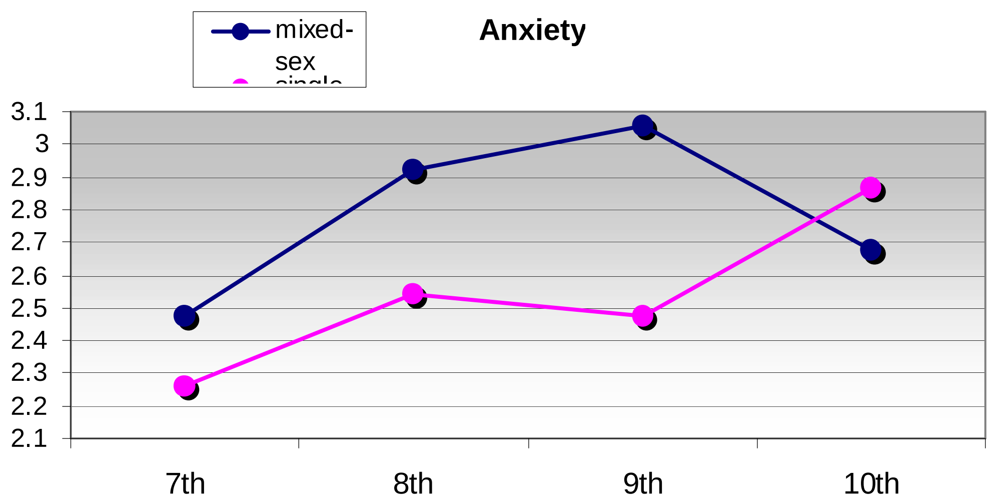
9.2.8.2a. Math anxiety: Grade

A significant difference was found [F(3,787)=3.35, p<.05]

Math anxiety increased from each grade to its subsequent one [means (sd): 2.40 (.10), 2.73 (.09), 2.76 (.07), 2.77 (.10) in grades 7-10 respectively].

9.2.8.3a. Math anxiety: Class-type*Grade

A significant difference was found [F(3,787)=3.66, p<.05]



In mixed-sex classes math anxiety increased from grade 7 to 8 and 8 to 9 and decreased from grade 9 to 10 [means (sd): 2.47 (.10), 2.92 (.10), 3.06 (.10), and 2.68 (.14) in grades 7-10 respectively];

In single-sex classes math anxiety increased from grade 7 to 8 and from grade 9 and 10, and decreased from grade 8 to 9 [means (sd): 2.26 (.23), 2.54 (.15), 2.47 (.11), and 2.87 (.13) in grades 7-10 respectively].

9.2.9a. Studying preference of afternoon mathematics classes

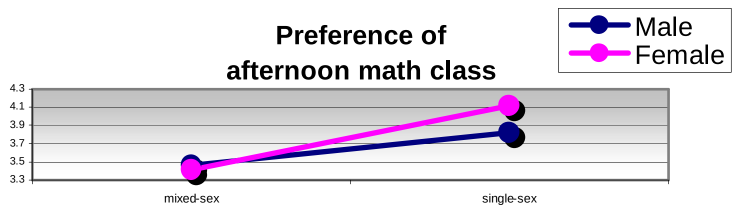
9.2.9.1a. Preference: Class-type

Significant differences were observed [F(1,724)=11.21, p<.001]

Students in mixed-sex classes were lower than those in single-sex classes in preferring afternoon math classes [means (sd): 3.44 (0.84), 3.99 (.10) respectively].

9.2.9.2a. Preference: Gender*Class-type

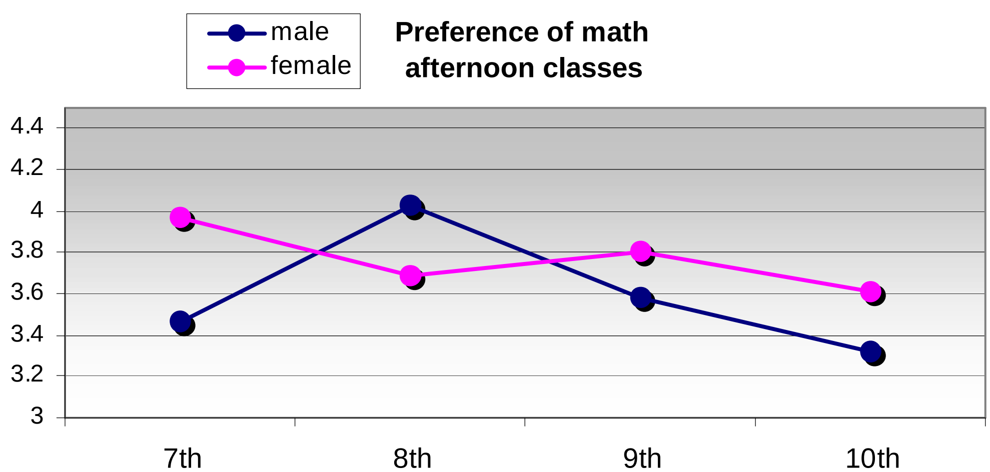
Significant differences were observed [F(1,724)=4.07, p<.05]



Both among boys and girls students of single-sex classes had a higher preference of afternoon math classes.
Among boys: [means (sd): 3.47 (.12), 3.82 (.17) respectively];
Among girls: [means (sd): 3.41 (.12), 4.12 (.13) respectively].

9.2.9.3a. Preference: Gender*Grade

Almost significant differences were found [F(3,724)=2.58, p=.052]

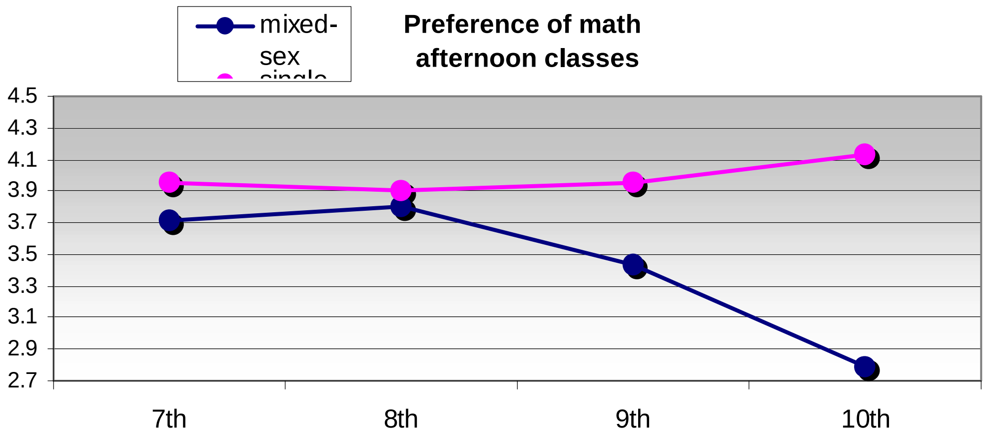


Among boys a sharp increase occurred from grade 7 to 8 and then a decrease from grade 8 to 9 and another one – from grade 9 to 10 [means (sd): 3.46 (.22), 4.02 (.19), 3.59 (.16), and 3.23 (.22) in grades 7-10 respectively];

Among girls decreases were observed from grade 7 to 8 and from grade 9 to 10, and an increase from grade 8 to 9 [means (sd): 3.96 (.20), 3.69 (.18), 3.80 (.15), and 3.61 (.17) in grades 7-10 respectively].

<u>9.2.9.4a. Preference: Class-type*Grade</u>

A significant difference was discovered [F(3,724)=5.19, p<.01]

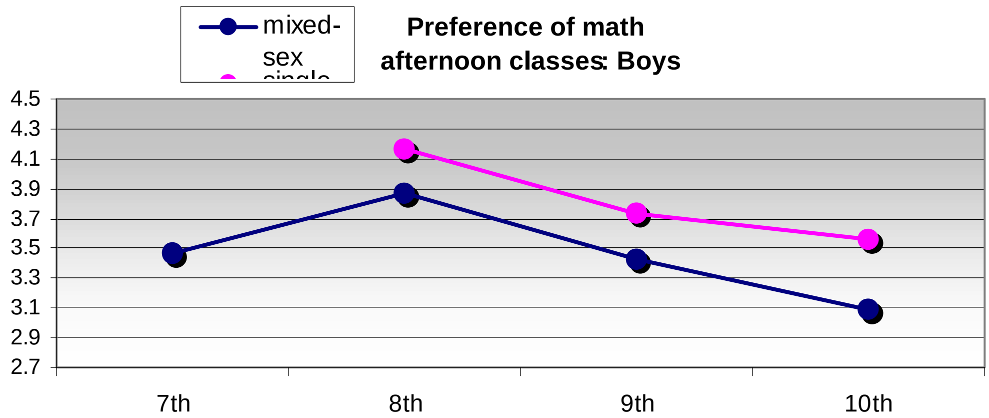


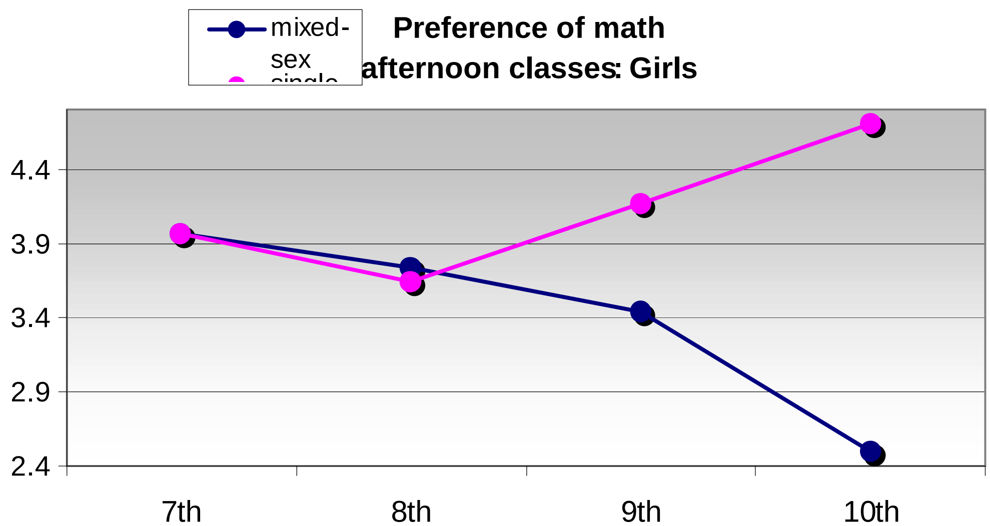
In mixed-sex classes though a tendency towards an increase in preference of afternoon math classes from grade 7 to 8 was observed, the general direction from grade 7 to 10 was of a substantial decrease in preference of an afternoon math class [means (sd): 3.72 (.16), 3.80 (.16), 3.43 (.15), and 2.80 (.21) respectively];

In single-sex classes the level of preference of an afternoon math class remained similar in grades 7, 8, and 9, and increased in grade 10 [means (sd): 3.96 (.33), 3.91 (.21), 3.95 (.16), and 4.13 (.18) respectively].

9.2.9.5a. Preference: Gender*Class-type*Grade

A significant difference was found [$F(2,724)=3.94$, $p<.05$]





Boys in mixed-sex classes increased their preference of taking afternoon math classes from grade 7 to 8, and then decreased it from grade 8 to 9 and from grade 9 to 10 [means (sd): 3.64 (.22), 3.88 (.24), 3.43 (.22), and 3.09 (.29) in grades 7-10 respectively];

Boys in single-sex classes decreased their preference to take afternoon math classes from grade 8 to 9 and 9 to 10 [means (sd): 4.17 (.30), 3.74 (.23), and 3.56 (.32) in grades 8-10 respectively];

Girls in mixed-sex classes decreased their preference to take afternoon math classes between each pair of subsequent grades [means (sd): 3.97 (.21), 3.74 (.20), 3.44 (.20), and 2.50 (.30) in grades 7-10 respectively];

Girls in single-sex classes decrease their preference of afternoon math classes between grade 7 and 8 but increased it from grade 8 to 9 and 9 to 10 [means (sd): 3.96 (.33), 3.65 (.30), 4.16 (.22), and 4.71 (.18) in grades 7-10 respectively].

III. Gender*Religiosity [secular or religious]*Grade

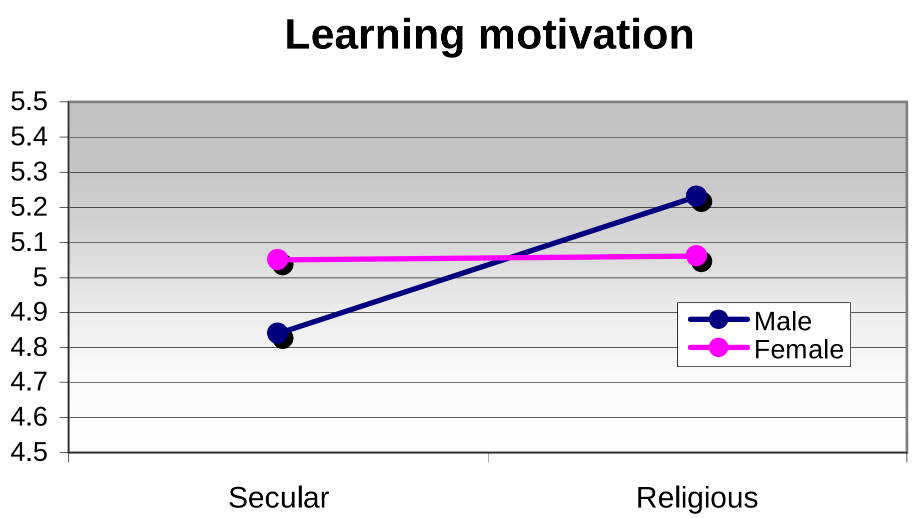
9.2.1aa. Motivational orientations: Learning-goal orientation, approach orientation, and avoidance orientation

9.2.1.1aa. Studying learning goals

9.2.1.1.1aa. Learning goals: Religiosity
A significant difference was found [F(1,771)=8.19, p<.01]
Secular students had a lower level of learning goals than religious ones [means (sd): 4.94 (.04), 5.13 (.06) respectively].

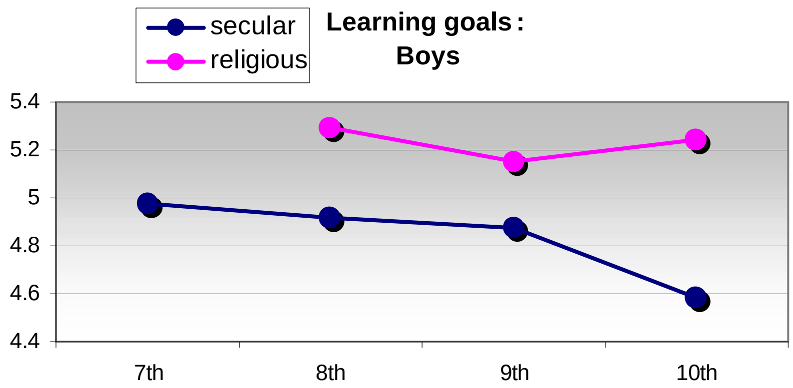
9.2.1.1.2aa. Learning goals: Grade
An almost significant difference was found [F(3,771)=2.40, p<.067]
A gradual decrease in learning goals was observed from grade 7-10 [means (sd): 5.14 (.08), 5.10 (.07), 5.00 (.06), and 4.94 (.08) respectively].

9.2.1.1.3aa. Learning goals: Gender*Religiosity
A significant interaction was found [F(1,771)=8.05, p<.01]



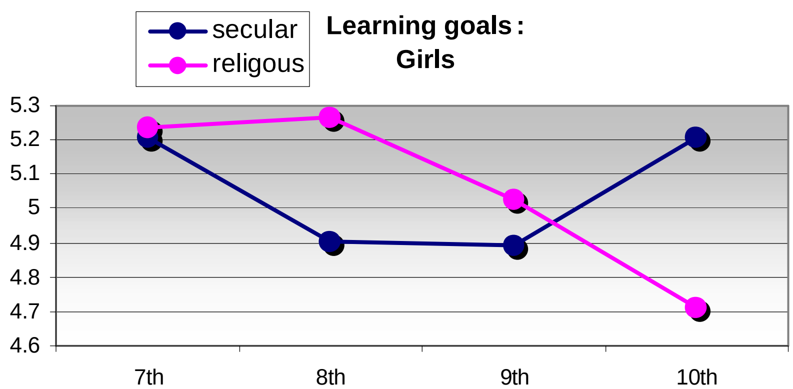
Among boys secular students had a lower level of learning goals than religious ones [means (sd): 4.84 (.06), 5.23 (.09) respectively];
Among girls differences between secular and religious students regarding learning goals were minimal [means (sd): 5.05 (.05), 5.06 (.08) respectively].

9.2.1.1.4aa. Learning goals: Religiosity*Gender*Grade
A significant interaction was found [F(2,771)=4.79, p<.01]



Among secular boys learning goal motivation decreased between each pair of subsequent grades [means (sd): 4.97 (.11), 4.92 (.12), 4.87 (.11), and 4.59 (.15) respectively];

Among religious boys almost no changes in learning goals were observed in grades 8-10 [means (sd): 5.29 (.16), 5.15 (.120, and 5.24 (.17) respectively].

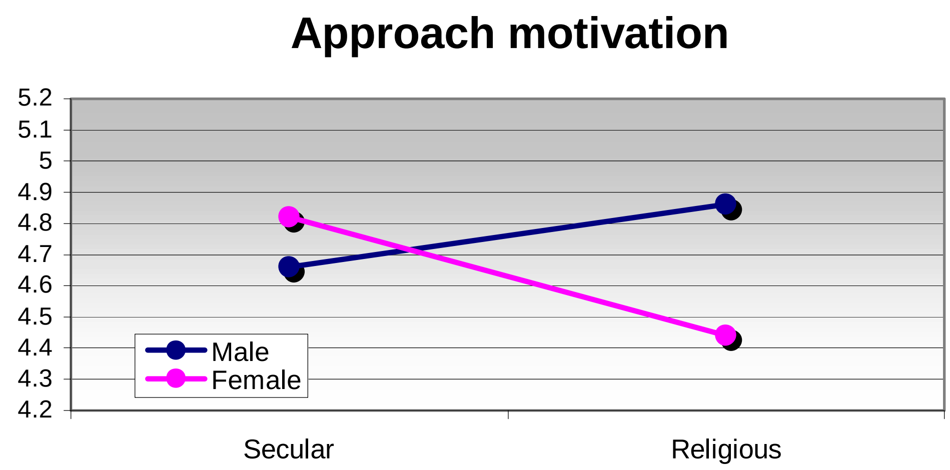


Among secular girls learning goals decreased from grade 7 to 8 and 8 to 9, and increased from grade 9 to 10 [means (sd): 5.20 (.10), 4.90 (.11), 4.89 (.10), and 5.21 (.09) in grades 7-10 respectively];

Among religious girls learning goals decreased between each pair of subsequent grades [means (sd): 5.24 (.18), 5.26 (.16), 5.03 (.11), and 4.71 (.17) in grades 7-10 respectively].

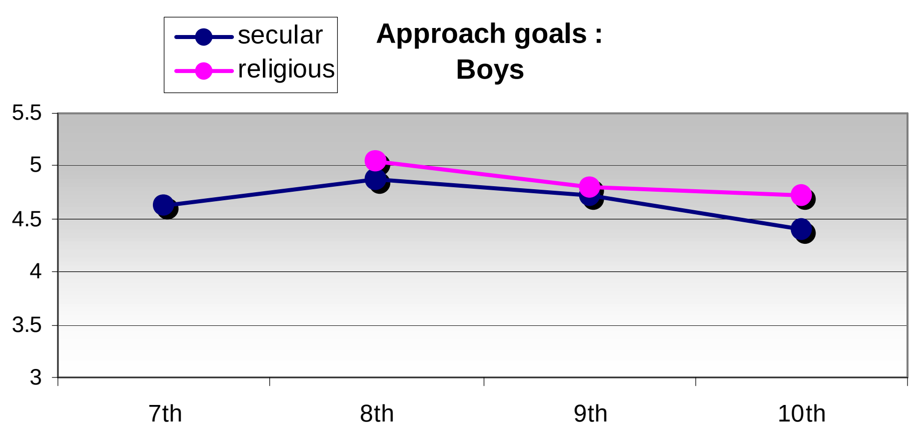
9.2.1.2aa. Studying approach goals

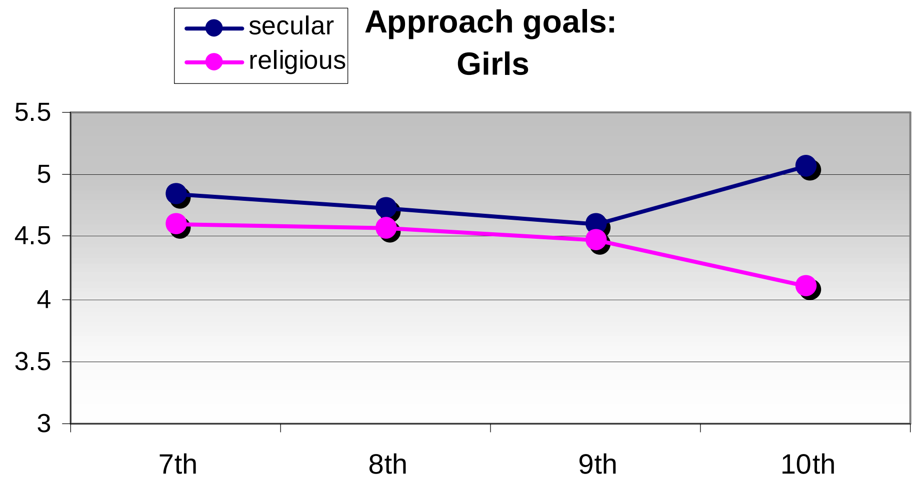
9.2.1.2.1aa. Approach goals: Gender*Religiosity
A significant interactions was found [F(1,768)=11.52, p<.001]



Among boys secular students were lower in approach goals than religious ones [means (sd): 4.66 (.07), 4.86 (.10) respectively];
Among girls secular students were higher in approach goals than religious ones [means (sd): 4.82 (.06), 4.44 (.09) respectively].

9.2.1.2.2aa. Approach goals: Gender*Religiosity*Grade
Significant interactions were found [F(2,768)=3.38, p<.05]





Among secular boys approach goals increased somewhat between grade 7 and 8 and then decreased from grade 8 to 9 and 9 to 10 [means (sd): 4.64 (.12), 4.88 (.14), 4.73 (.13), and 4.40 (.18) in grades 7-10 respectively];

Among religious boys approach goals decreased from grade 8 to 9 and 9 to 10 [means (sd): 5.05 (.19), 4.81 (.14), and 4.72 (.20) respectively].

Among secular girls approach goals decreased from grade 7 to 8 and 8 to 9 and increased from grade 9 to 10 [means (sd): 4.85 (.12), 4.73 (.13), 4.61 (.11), and 5.08 (.10) respectively];

Among religious girls approach goals decreased between each pair of subsequent grades [means (sd): 4.60 (.21), 4.58 (.18), 4.47 (.23), and 4.11 (.20) in grades 7-10 respectively].

9.2.1.3aa. Studying avoidance goals

9.2.1.3.1aa. Avoidance goals: Gender

A significant difference was found [F(1,763)=7.44, p<.01]

Boys scored higher in avoidance motivation than girls [means (sd): 3.72 (.07), 3.56 (.06) respectively].

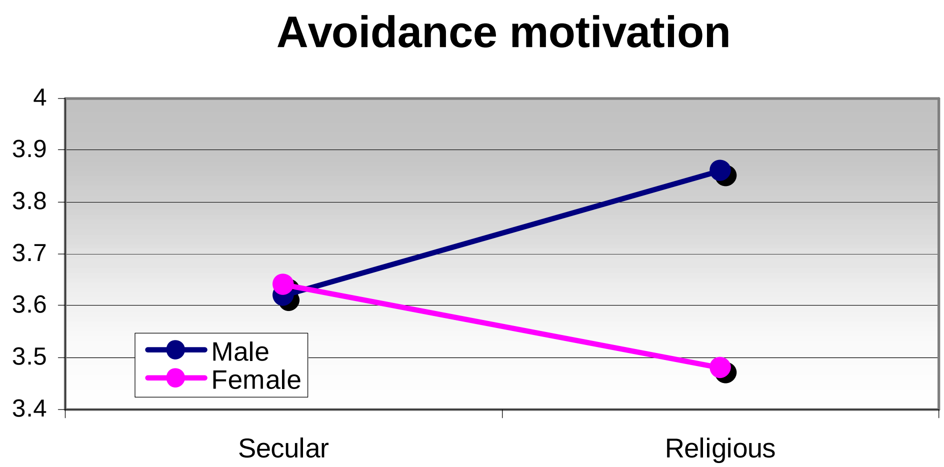
9.2.1.3.2aa. Avoidance goals: Grade

A significant difference was found [F(3,763)=5.96, p<.001]

A decrease between each pair of subsequent grades was found in avoidance motivation [means (sd): 3.86 (.10), 3.73 (.09), 3.63 (.07), and 3.38 (.10) respectively].

9.2.1.3.3aa. Avoidance goals: Gender*Religiosity

A significant interaction was found [F(1,763)=9.62, p<.01]

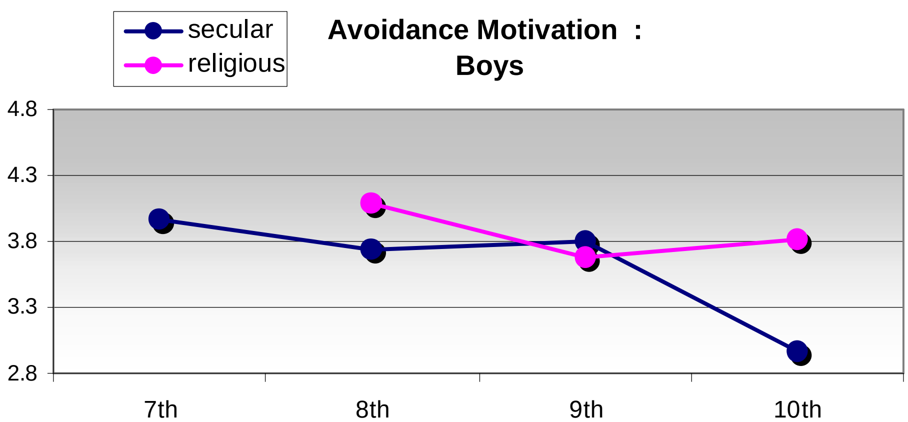


Among boys religious students were higher than secular ones in avoidance motivation [means (sd): 3.86 (.11), 3.62 (.08) respectively];

Among girls secular students were higher than religious ones in avoidance motivation [means (sd): 3.64 (.06), 3.48 (.10) respectively].

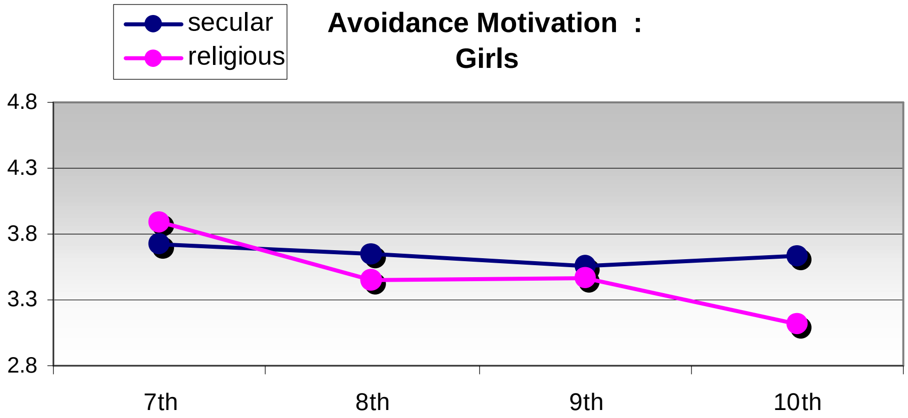
9.2.1.3.4aa. Avoidance goals: Gender*Religiosity*Grade

Significant interactions were was found [F(2,763)=4.18, p<.05]



Among secular boys a general tendency of decrease in avoidance motivation was observed although a negligible increase was found between grade 8 and 9 [means (sd): 3.97 (.14), 3.73 (.16), 3.80 (.14), and 2.97 (.20) in grades 7-10 respectively];

Among religious boys a decrease in avoidance motivation was observed from grade 8 to 9 and an increase from grade 9 to 10 [means (sd): 4.09 (.21), 3.68 (.15), and 3.81 (.22) in grades 8-10 respectively].



Among secular girls a decrease in avoidance motivation was observed from grade 7 to 8 and 8 to 9, and an increase from grade 9 to 10 [means (sd): 3.73 (.13), 3.64 (.14), 3.56 (.13), and 3.63 (.11) in grades 7-10 respectively];

Among religious girls a decrease in avoidance motivation was found between grade 7 to 8 and 9 to 10 [means (sd): 3.90 (.23), 3.45 (.20), 3.47 (.15), and 3.12 (.23) in grades 7-10 respectively].

9.2.2aa. Studying achievements and aspirations

9.2.2.1aa. Achievements and aspirations: Grade

A significant difference was found [$F(3,634)=4.63$, $p<.01$]

A decline in the mean grade was observed in grade 9; in grade 10 the level of estimated means returned to its level in grades 7 and 9 [means (sd): 84.45 (.84), 84.43 (.74), 81.24 (.61), 84.06 (.78) in graded 7-10 respectively].

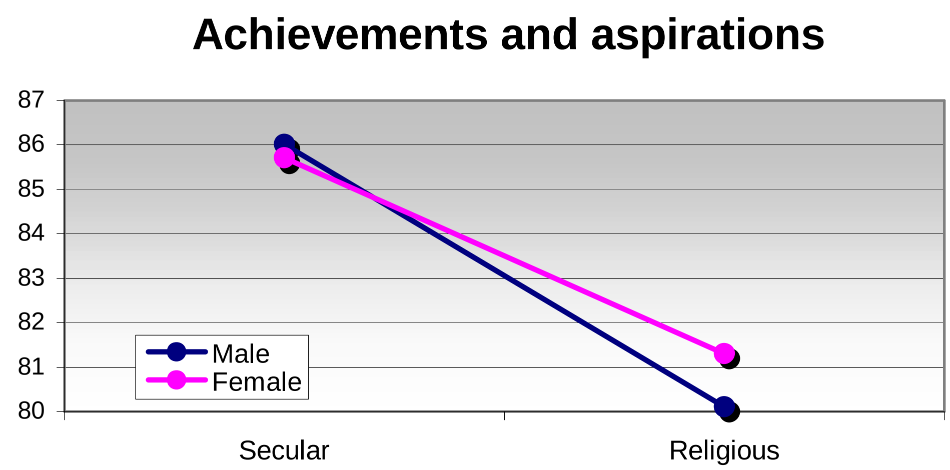
9.2.2.2aa. Achievements and aspirations: Religiosity

A significant difference was found [$F(1,634)=44.85$, $p<.001$]

Secular students were found to have higher mean grades than religious ones [means (sd): 85.85 (.45), 80.78 (.61) respectively].

9.2.2.3aa. Achievements and aspirations: Gender*Religiosity

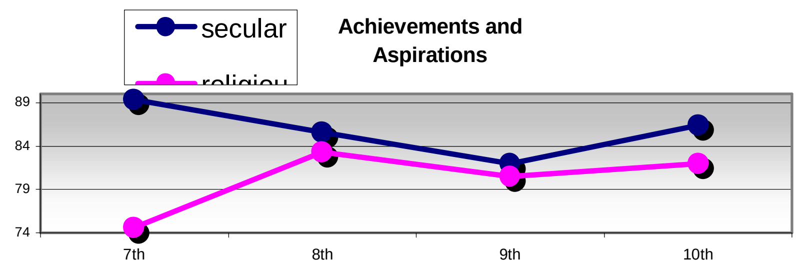
A significant interaction was found [$F(1,634)=5.32$, $p<.05$]



Among girls the grade gap between secular and religious students was smaller than between boys [For boys: means (sd): 86.01 (.70), 80.09 (.90) respectively; For girls: means (sd): 85.69 (.55), 81.30 (.82) respectively].

9.2.2.4aa. Achievements and aspirations: Grade*Religiosity

A significant interaction was found [F(2,634)=12.16, p<.001]



In grade 7 the difference between secular and religious students was very large; it decreased substantially in grade 8 and remained about the same in grade 9. In grade 10 the gap became somewhat larger, but still just about as third as large as it was in grade 7 [means (sd) for secular versus religious classes: 89.41 (.88), 74.55 (1.79); 85.58 (.92), 83.27 (1.16); 81.95 (.83), 80.53 (.91); and 86.46 (.94), 81.66 (1.25) for grades 7-10 respectively].

9.2.3aa. Studying value of mathematics

9.2.3.1aa. Value of math: Religiosity

A significant differences was found [F(1,788)=15.81, p<.001]

Secular students valued mathematics less than religious ones [means (sd): 4.65 (.04), 4.94 (.06) respectively].

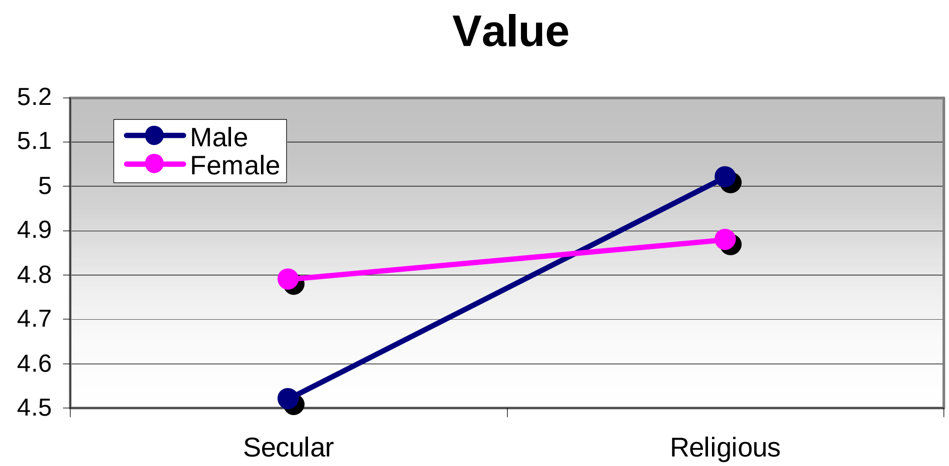
9.2.3.2aa. Value of math: Grade

A significant difference was found [F(3,788)=5.96, p<.001]

Between each pair of subsequent grades there was decline in valuing mathematics [means (sd): 4.99 (.08), 4.89 (.07), 4.74 (.06), and 4.58 (.08) in grades 7-10 respectively].

9.2.3.3aa. Value of math: Gender*Religiosity

A significant interaction was found [F(1,788)=7.83, p<.01]

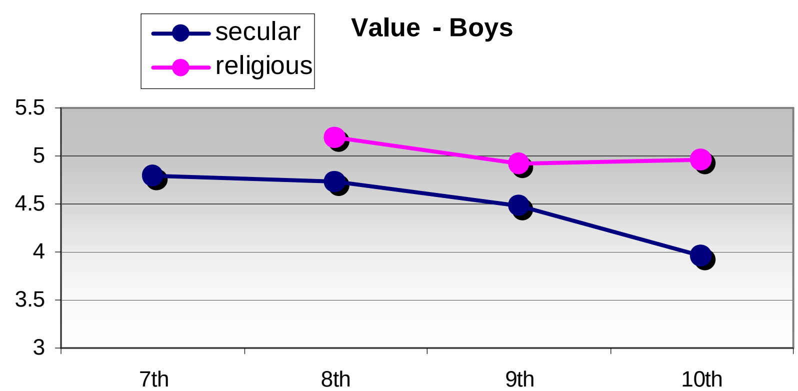


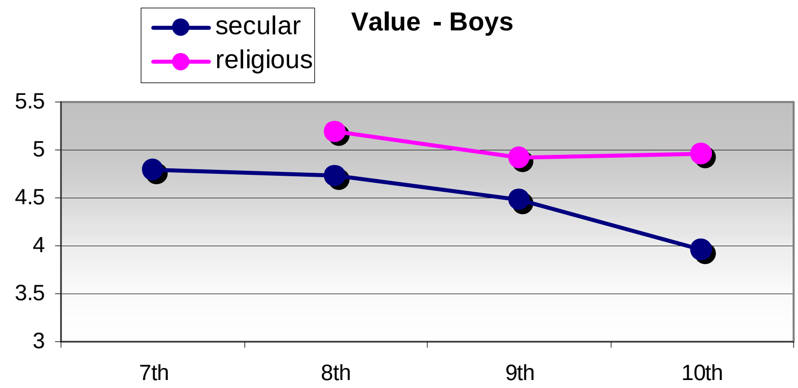
Among boys secular students scored much lower in valuing mathematics than religious ones [means (sd): 4.52 (.07), 5.02 (.09) respectively];

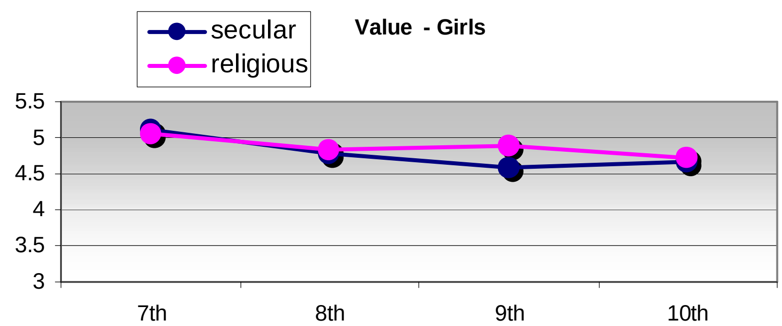
Among girls secular students scored somewhat lower in valuing mathematics than religious ones [means (sd): 4.79 (.05), 4.88 (.08) respectively].

9.2.3.4aa. Value of math: Gender*Religiosity*Grade

An almost significant interaction was found [F(2,788)=2.90, p=.056]







II. **Among secular boys valuing math decreased between each pair of subsequent grades** [means (sd): 4.79 (.11), 4.73 (.12), 4.58 (.12), and 3.96 (.16) in grades 7-10 respectively];

III. **Among religious boys there was a small decrease in valuing math between grade 8 and 9 and a small increase from grade 9 to 10** [means (sd): 5.18 (.17), 4.91 (.13), and 4.96 (.18) in grades 8-10 respectively].

IV. **Among secular girls there were decreased in valuing math between grade 7 and 8 and 8 and 9, and a small increase between grade 9 and 10** [means (sd): 5.11 (.11), 4.78 (.11), 4.57 (.11), and 4.68 (.09) respectively];

V. **Among religious girls a decrease in valuing math was observed between each pair of subsequent grades** [means (sd): 5.06 (.19), 4.84 (.17), 4.89 (.12), and 4.71 (.19) respectively].

VI.

VII.

VIII. **9.2.4aa. Studying believability in math abilities**

9.2.4.1aa. Believability in math abilities: Gender

Significant gender differences were found [F(1,790)=9.32, p<.01]

Boys believed more in their math abilities than girls [means (sd): 4.63 (.06), 4.37 (.05) respectively].

9.2.4.2aa. Believability in math abilities: Religiosity

Significant differences were found [F(1,790)=8.44, p<.01]

Secular students were lower in believability in own math abilities than religious ones [means (sd): 4.38 (.04), 4.62 (.07) respectively].

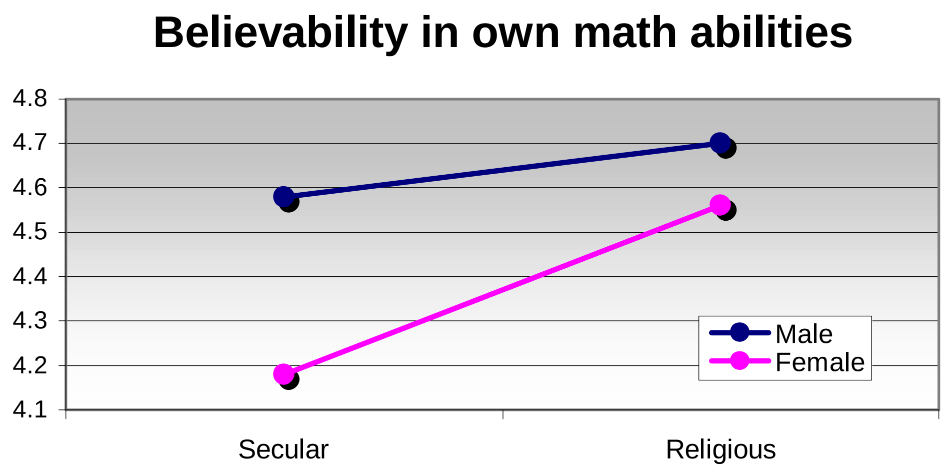
9.2.4.3aa. Believability in math abilities: Grade

Significant differences were found [F(3,790)=7.39, p<.001]

Decreases in believability in own math abilities occurred from grade 7 to 8 and 8 to 9; an increase - from grade 9 to 10 [means (sd): 4.66 (.09), 4.44 (.08), 4.24 (.06), and 4.66 (.09) in grades 7-10 respectively].

9.2.4.4aa. Believability in math abilities: Gender*Religiosity

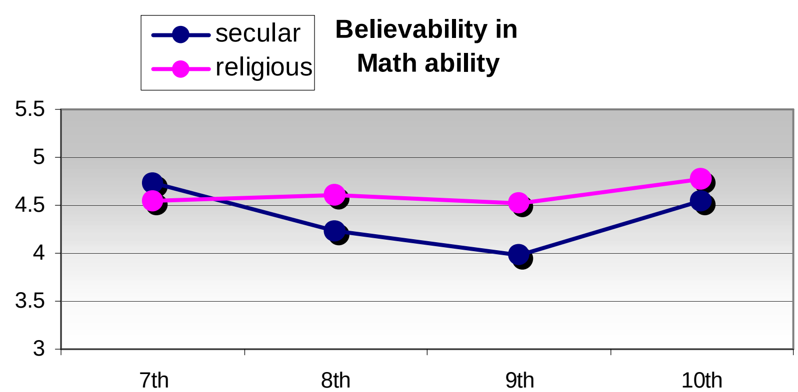
Significant interactions were found [F(1,790)=4.03, p<.05]



Both among boys and girls religious students believed in their own math abilities more than secular ones [boys' means (sd): 4.58 (.07), 4.70 (.10); girls' means (sd): 4.18 (.06), 4.56 (.09) respectively].

9.2.4.5aa. Believability in math abilities: Religiosity*Grade

Significant interactions were found [F(3,790)=3.26, p<.05]



Among secular students a substantial decrease happened between grade 7 and 8 and between grade 8 and 9, followed by an increase between grade 9 and 10 [means (sd): 4.73 (.08), 4.28 (.09), 3.97 (.08), and 4.54 (.10) in grades 7-10 respectively];

Among religious students the level of believability in own math abilities remained almost steady between grades 7 and 9, and then increased

between grade 9 and 10 [means (sd): 4.54 (.20), 4.61 (.13), 4.52 (.09), and 4.78 (.14) in grades 7-10 respectively].

9.2.5aa. Studying mathematical helplessness

9.2.5.1aa. Helplessness: Religiosity

A significant difference was discovered [F(1, 787)=10.60, p<.001]

Secular students had a higher level of mathematical helplessness than religious ones [means (sd): 2.72 (.05), 2.36 (.08) respectively].

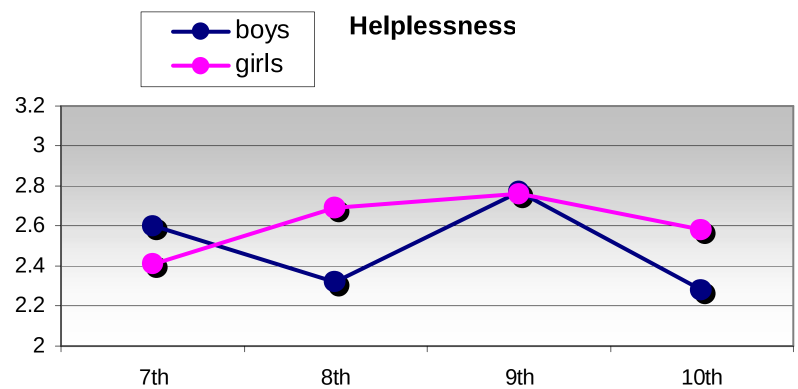
9.2.5.2aa. Helplessness: Grade

A significant difference was discovered [F(3, 787)=10.60, p<.001]

The level of mathematical helplessness increased from grade 7 to 8 and from 8 to 9, and decreased from grade 9 to 10 [means (sd): 2.48 (.10), 2.51 (.09), 2.77 (.07), and 2.43 (.10) in grades 7-10 respectively].

9.2.5.3aa. Helplessness: Gender*Grade

A significant interactions was discovered [F(3, 787)=3.15, p<.05]

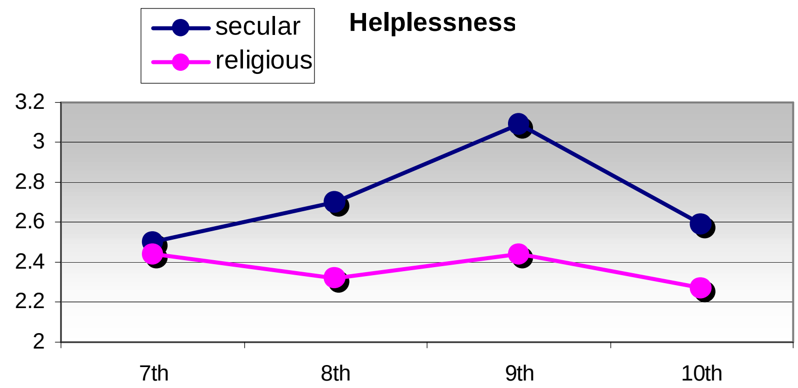


Among boys decreases in mathematical helplessness were observed between grade 7 and 8 and between grades 9 and 10; an increase was found between grade 8 and 9 [means (sd): 2.61 (.14), 2.32 (.13), 2.77 (.11), and 2.78 (.15) in grades 7-10 respectively];

Among girls an increase in mathematical helplessness was found between grades 7 and 8 and 8 and 9 followed by a decreased from grade 9 to 10 [means (sd): 2.41 (.14), 2.70 (.13), 2.76 (.10), and 2.58 (.13) in grades 7-10 respectively].

9.2.5.4aa. Helplessness: Religiosity*Grade

An almost significant interaction was discovered [F(3, 787)=2.39, p=.068]



Among secular students the level of mathematical helplessness was increased from grade 7 to 8 and 8 to 9, and decreased from grade 9 to 10 [means (sd): 2.50 (.10), 2.70 (.11), 3.09 (.10), and 2.59 (.12) in grades 7-10 respectively];

Among religious students the level of mathematical helplessness remained almost the same during grades 7, 8, and 9, and decreased in grade 10 [means (sd): 2.44 (.24), 2.32 (1.15), 2.46 (.11), and 2.27 (.16) in grades 7-10 respectively].

9.2.6aa. Studying IPT

9.2.6.1aa. IPT: Religiosity

A significant difference was discovered [F(1, 788)=6.35, p<.05]

Secular students believed more than religious ones in rigidity of mathematical intelligence [means (sd): 2.40 (.04), 2.21 (.06) respectively].

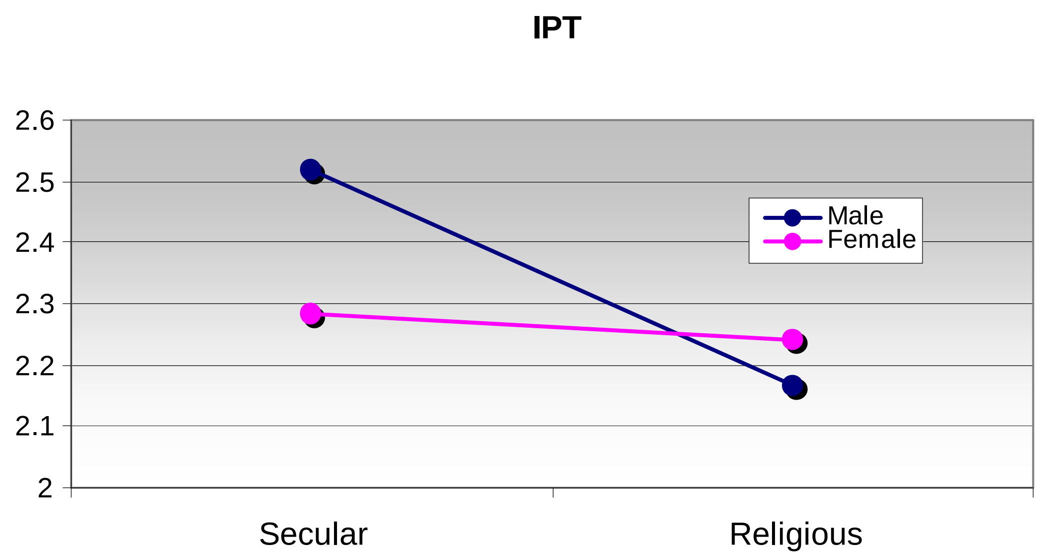
9.2.6.2aa. IPT: Grade

An almost significant difference was found [F(3,788)=2.49, p=.059]

Belief in rigidity of math intelligence increased from grade 7 to 8 and 8 to 9, and decreased somewhat from grade 9 to 10 [means (sd): 2.14 (.08), 2.28 (.07), 2.40 (.06), and 2.38 (.08) in grades 7-10 respectively].

9.2.6.3aa. IPT: Gender*Religiosity

An almost significant interaction was found [F(1,788)=3.07, p=.08]

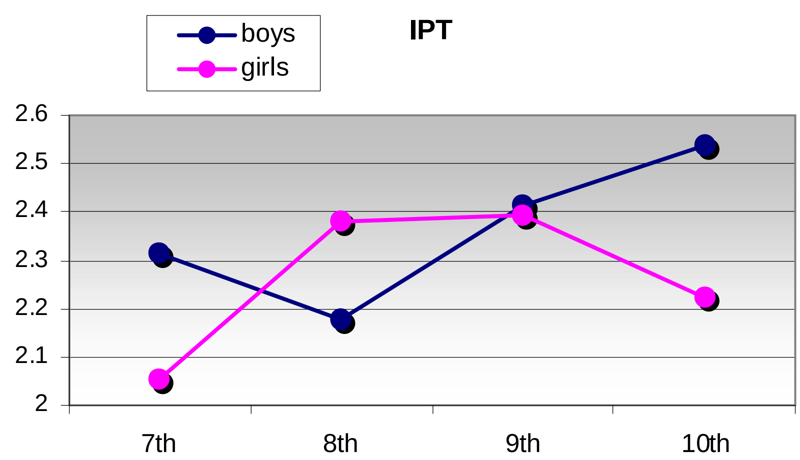


Among boys secular students were much higher than religious ones in believing in rigidity of math intelligence [means (sd): 2.52 (.06), 2.17 (.09) respectively];

Among girls believing in rigidity of math intelligence was similar among secular and religious girls [means (sd): 2.29 (.05), 2.24 (.08) respectively].

9.2.6.4aa. IPT: Gender*Grade

An almost significant interaction was found [F(3,788)=2.32, p=.074]



Among boys a decrease was found in IPT from grade 7 to 8 and then an increase from grade 8 to 9 and 9 to 10 [means (sd): 2.32 (.11), 2.18 (.11), 2.41 (.09), and 2.54 (.12) in grades 7-10 respectively];

Among girls an increase was found in IPT from grade 7 to 8, another increase – though insignificant and minimal – from grade 8 to 9, and a decrease from grade 9 to 10 [means (sd): 2.06 (.11), 2.38 (.10), 2.39 (.08), and 2.22 (.10) in grades 7-10 respectively].

9.2.7aa. Studying Stability of math abilities

9.2.7.1aa. Stability of math abilities: Religiosity

Significant differences were found [F(1,787)=6.18, p<.05]

Secular students believed more than religious ones in stability of their math abilities [means (sd): 2.73 (.04), 2.56 (.06) respectively].

9.2.7.2aa Stability of math abilities: Grade

Significant differences were found [F(3,787)=3.28, p<.05]

An increase in belief on stability of math abilities occurred from grade 7 to 8 and from 8 to 9, and a decrease from grade 9 to 10 [means (sd): 2.51 (.07), 2.62 (.07), 2.78 (.05), and 2.66 (.07) in grades 7-10 respectively].

9.2.8aa. Studying Mathematical anxiety

9.2.8.1aa. Math anxiety: Religiosity

A significant difference was found [F(1,787)=11.23, p<.001]

Secular students had a higher level of math anxiety than religious ones [means (sd): 2.81 (.05), 2.48 (.08) respectively].

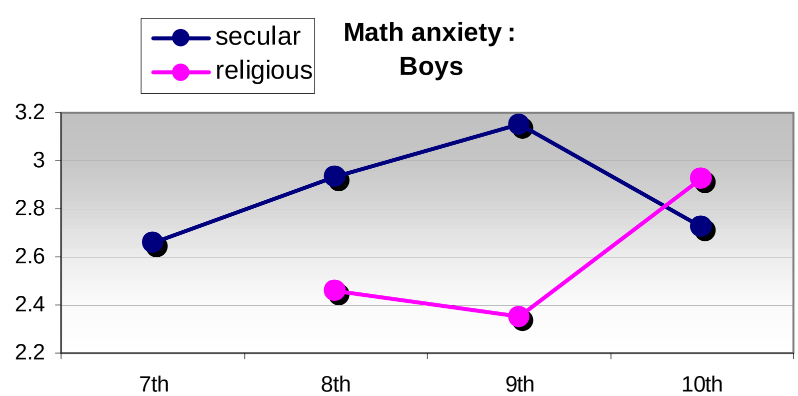
9.2.8.2aa. Math anxiety: Grade

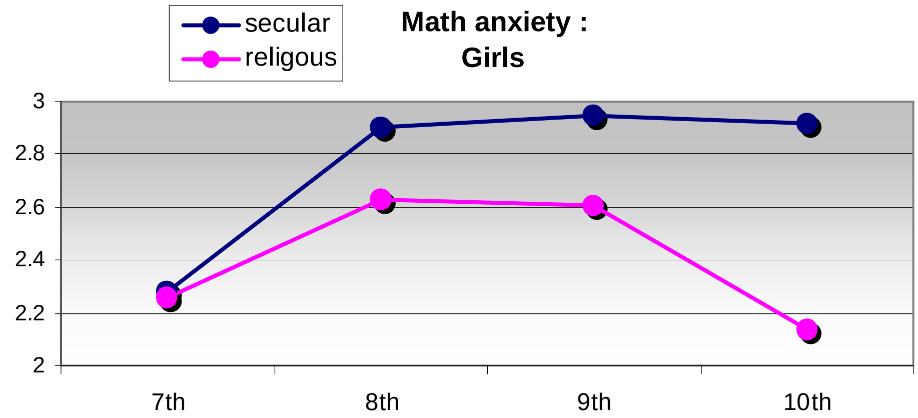
An almost significant difference was found [F(3,787)=2.42, p=.065]

Math anxiety increased from grade 7 to 8 and 8 to 9 and decreased from grade 9 to 10 [means (sd): 2.40 (.10), 2.73 (.09), 2.76 (.07), and 2.68 (.10) respectively].

9.2.8.3aa. Math anxiety: Gender*Religiosity*Grade

A significant interaction was found [F(2,787)=4.54, p<.05]





Among secular boys math anxiety increased from grade 7 to 8 and 8 to 9 and decreased from grade 9 to 10 [means (sd): 2.66 (.14), 2.94 (.15), 3.15 (.14), and 2.72 (.20) respectively];

Among religious boys math anxiety decreased somewhat between grade 8 and 9 and increased substantially between grade 9 and 10 [means (sd): 2.46 (.21), 2.35 (.21), and 2.93 (.22) respectively].

Among secular girls math anxiety increased substantially from grade 7 to 8 and increased somewhat more from grade 8 to 9; a small decrease was observed from grade 9 to 10 [means (sd): 2.28 (.14), 2.90 (.14), 2.94 (.13), and 2.91 (.11) respectively];

Among religious girls math anxiety increased substantially from grade 7 to 8, decreased somewhat between grade 8 and 9 and decreased substantially between grade 9 and 10 [means (sd): 2.26 (.23), 2.63 (.21), 2.61 (.15), and 2.14 (.23) respectively].

9.2.9aa. Studying Preference of mathematics afternoon classes

No difference was significant.

9.2.10. Summary

The summary of the results of the interactions of gender, grade, religion, class-type, and religiosity for mathematical anxiety, valuing mathematics, stability of mathematical ability, believability in mathematical abilities, learning, approach, and avoidance motivation, preference of afternoon mathematics classes, belief in rigidity on intelligence, and mathematical helplessness is presented in table 9.2.10.

Table 9.2.10. Interactions of gender, religion, grade, class-type, and religiosity for the "Grand 10"

	Math anxiety	**Valuing math**	Stability of math abilities	Believability in math ability	Approach motivation	Avoidance motivation	Learning motivation	Preference of math classes	IPT	**Helpless-ness**
Gender (main effect)	N	N	N	□	N	□	N	N	N	N
Religion (main effect)	□	□	□	□	□	□	□	□	□	□
Grade (main effect)	□	□	□	□	N	□	□	N	□	□
Class-Type (main effect)	□	□	□	□	N	□	□	□	□	□
Religiosity (main effect)	□	□	□	□	N	N	□	N	□	□
Gender*Religion	□			□	□					□
Gender*Grade										□
Gender*Class-Type				□				□		□
Gender*Religiosity		□		□	□	□	□			
Religion*Grade		□	□		□		□	□	□	□
Grade*Class-Type	□	□		□		□	□		□	
Grade*Religiosity				□						
Gender*Religion *Grade[1]										
Gender*Grade *Class-Type								□		
Gender*Grade *Religiosity	□	□			□	□	□		□	

As we can see, gender had main effect only for believability in math abilities and avoidance motivation. All other four demographic independent variables – religion, grade, and religiosity, as well as the class-type had main effects either for all ten measures (grade) or for most of them (religion, religiosity, and class-type).

In the next chapter the meaning of these main effects – as well as the other significant and non-significant interactions will be discussed. In addition, some of the ideas for further research will be stemming from the un-explored analyses presented by the empty lines that have been removed from this table.

[1] There was not even one significant 3-way interaction for any of the "Grand 10" dependent variables.

9.3. Correlations of the grand 10

9.3.1. Introduction to the correlations results

The study of correlations between the components responsible to various aspects of learning mathematics has a substantial importance due to several reasons:

1. Challenging prejudices, namely, showing, in many cases, that components that have been assumed to be connected positively to each other are in fact unrelated or even relate negatively;
2. Learning about mediators. For example: **Fox (1982**) has stated, that a low mathematics anxiety level is an indicator to high believability in own math abilities, and such belief, in is turn, influences both participation and achievement in math;
3. Differentiating between component who are positively or negatively highly correlated and others that are perceived as identical to each other. That is the case when two "players in game", perceived by the researcher as different from each other, have a correlation close to 1;
4. Help understanding the regressions of each of the "Grand 10" components on the expected and actual grade.

9.3.2. Correlations tables

Table 9.3.2.1. Correlations of valuing mathematics with 5 components

	Valuing mathmatics*	Believ. in math abilities	Stability of math abilities	**IPT**	**Preference**	Learning-Goals
	General	.318**	-.464**	-.872**	.482**	.616**
Gender	Male	.306**	-.416**	-.892**	.462**	.610**
	Female	.345**	-.502**	-.858**	.496**	.619**
Class type	Mixed-sex		-.483**	-.880**	.508**	.653**
	Single-sex	.352**	-.380**	-.846**	.379**	.490**
Religion	Jews	.332**	-.435**	-.911**	.512**	.613**
	Muslims	.385**	-.514**	-.800**	.351**	.598**
Religiosity	Secular	-.298**	-.478**	-.868**	.509**	.640**
	Religious	.344**	-.399**	-.887**	.398**	.527**
Grade	7^{th}	.300**	-.549**	-.853**	.451**	.674**
	8^{th}		-.379**	-.870**	.508**	.666**
	9^{th}	.368**	-.477**	-.880**	.434**	.546**
	10^{th}	.304**	-.459**	-.890**	.558**	.640**

Valuing mathematics correlated positively but weakly with believability in own math abilities (correlation coefficients between .30 and .39) for 11 out of the 13 examined sub-groups, mildly with preference of afternoon math classes (between .35 and .56) for all 13 sub-groups examined, and substantially with the adoption of learning goals (correlation coefficients between .49 and .64) for all sub-groups as well. It had a substantial negative correlation coefficient with stability of math abilities (correlation coefficients between -.55 and -.38), and a very high negative correlation coefficient with belief in rigidity of math intelligence (correlation coefficients between -.91 and -.80), both all sub-groups examined.

Table 9.3.2.2. Correlations of stability of mathematics ability with 5 components

	Stability of mathematics abilities*	Believ. in math abilities	Preference	**IPT**	Anxiety	Learning Goals
	General	-.517**	-.409**	.552**	.311**	-.479**
Gender	Male	-.472**	-.462**	.532**	.327**	-.453**
	Female	-.556**	-.433**	.569**	.301**	-.501**
Class type	Mixed-sex	-.551**	-.438**	.585**	.310**	-.508**
	Single-sex	-.415**	-.303**	.443**	.298**	-.370**
Religion	Jews	-.524**	-.431**	.514**	.310**	-.425**
	Muslims	-.560**	-.337**	.598**	.411**	-.548**
Religiosity	Secular	-.539**	-.430**	.580**		-.513**
	Religious	-.424**	-.332**	.443**	.349**	-.352**
Grade	7^{th}	-.504**	-.364**	.577**	.354**	-.557**
	8^{th}	-.552**	-.424**	.519**		-.523**
	9^{th}	-.462**	-.361**	.541**	.316**	-.351**
	10^{th}	-.538**	-.486**	.556**		-.519**

Stability of math abilities had a positive mild correlation coefficient with belief in rigidity of math intelligence (correlation coefficients between .44 and .60) in all 13 sub-groups, and a modest correlation coefficient with math anxiety (correlation coefficients between .30 and .41) among 10 of the 13 sub-groups.

Stability of math abilities correlated negatively with believability in math abilities (correlation coefficients between -.42 and -.56) in all examined sub-groups, with preference of math afternoon classes (correlation coefficients: from -.30 to -.49) among all sub-groups, and with adoption of learning goals (correlation coefficients between -.35 and -.56) for all 13 sub-groups.

Table 9.3.2.3. Correlations of Mathematical helplessness with 5 components

	Mathematical helplessness*	Believ. in math abilities	Preference	IPT	Anxiety	Learning Goals
	General	-.659**		.577**	.561**	
Gender	Male	-.596**		.557**	.553**	
	Female	-.704**		.602**	.573**	
Class type	Mixed-sex	-.667**		.559**	.578**	
	Single-sex	-.629**		.593**	.522**	
Religion	Jews	-.677**	-.408**	.619**	.496**	-.333**
	Muslims	-.628**		.661**	.579**	-.310**
Religiosity	Secular	-.663**		.580**	.555**	
	Religious	-.623**	-.364**	.646**	.476**	
Grade	7^{th}	-.608**		.621**	.573**	-.329**
	8^{th}	-.680**		.557**	.534**	
	9^{th}	-.622**		.605**	.606**	
	10^{th}	-.719**		.522**	.509**	-.519**

Mathematical helplessness was found to be negatively correlated only to 4 of the sub-groups: it was moderately correlated to adopting learning goals (correlation coefficients between -.31 and -.33) in 3 sub-groups, and mildly correlated only among 10^{th} grade students (r=-.52).

Only in 2 sub-groups there was a significant correlation coefficient larger than |.3| between mathematical helplessness and preference of an afternoon math classes (correlation coefficients: -.37 for religious students, and -.41 for Jews).
Mathematics helplessness correlated positively for all 13 sub-groups both with belief in rigid intelligence (correlation coefficients between .52 and .65) and math anxiety (correlation coefficients between 48 and .61). It had a high negative correlation coefficient with believability in own math abilities (correlation coefficients between -.60 and -.72) for all 13 sub-groups.

Table 9.3.2.4. Correlations of Approach goals with 5 components

	Approach goals*	Value	Preference	IPT	Anxiety	Learning Goals
	General	.333**		-.318**		.494**
Gender	Male	.380**		-.356**	.327**	.498**
	Female	.300**				.494**
Class type	Mixed-sex	.384**		-.387**		.520**
	Single-sex			-.443**		.458**
Religion	Jews					.376**
	Muslims	.422**		-.435**		.614**
Religiosity	Secular	.365**	.312**	-.385**		.535**
	Religious					.426**
Grade	7^{th}	.369**		-.375**		.506**
	8^{th}	.448**	.346**	-.348**		.551**
	9^{th}	.327**		-.301**		.495**
	10^{th}		.298**			.430**

Approach goals had but low positive correlation coefficients with valuing mathematics (the magnitude of the correlation coefficient for the general population was .33; all values were between .30 and .45), and modest to medium correlation coefficients with adopting learning goals (correlation coefficients between .38 and .61).
Approach goals were also weakly correlated to IPT in 9 of the 13 examined sub-groups (the magnitude of the correlation coefficient for the general population was -.32; all values were between -.30 and -.44).

Table 9.3.2.5. Correlations of Learning goals with 5 components

	Learning goals*	Believ. in math abilities	Anxiety	IPT	Preference	Avoidance Goals
	General			-.589**	.418**	
Gender	Male			-.579**	.352**	
	Female			-.595**	.461**	

Class type	Mixed-sex			-.633**	.460**	
	Single-sex			-.446**		
Religion	Jews			-.558**	.391**	
	Muslims			-.600**	.350**	
Religiosity	Secular			-.628**	.477**	
	Religious	.350**		-.448**	.350**	
Grade	7th	.302**		-.661**	.432**	
	8th	.332**		-.600**	.526**	
	9th			-.511**		
	10th			-.615**	.511**	

Adopting of Learning goals had a correlation coefficient larger than .3 with believability in math abilities only among 3 sub-group: religious students, and students in grade 7 and 8. The magnitude of these correlation coefficients was small (between .30 and .35).

Learning goals had no significant correlation coefficients larger than |.30| either with math anxiety or with avoidance goals in any of the 13 examined groups.

Learning goals had average to strong correlation coefficients with belief in stability of math intelligence (between -.45 and -.66) for all sub-groups. It correlated positively with preference of afternoon math classes (correlation coefficients between .35 and .53) for 11 of the 13 examined sub-groups.

Table 9.3.2.6. Correlations of Mathematics Anxiety with 5 components

	Mathematics Anxiety*	Believ. in math abilities	Avoidance	IPT	Preference	Value
	General	-.457**	.387**			
Gender	Male	-.468**	.330**			
	Female	-.469**	.423**			
Class type	Mixed-sex	-.471**	.399**			
	Single-sex	-.422**	.367**			
Religion	Jews	-.439**	.303**			
	Muslims	-.446**	.438**	.416**		
Religiosity	Secular	-.452**	.409**			
	Religious	-.440**	.338**			
Grade	7th	-.471**		.330**		
	8th	-.469**	.484**			
	9th	-.492**	.436**	.300**		
	10th	-.355**	.406**			

Anxiety had a mild negative correlation coefficient with believability in own math abilities (correlation coefficients between -.36 and -.49) for all 13 sub-groups.

Anxiety and preference of afternoon classes were not significantly correlated; neither were math anxiety and valuing mathematics in any of the sub-groups examined.

Math anxiety was positively but weakly correlated to math avoidance (correlation coefficients between .30 and .48 for 12 of the 13 examined groups), and weakly correlated only for 3 sub-groups with belief in rigidity of intelligence (correlation coefficients between .30 and .42; no significant correlation efficient larger than .30 for the general population).

9.4. Regression of the "Grand 10": Motivational, educational, and psychological component influencing math achievements

9.4.1. Introduction to the regression results

We hereby regress both the expected math grade – calculated as the average between the grade expected in the next assignment and in the next term report – and the actual math grade – calculated as the average between the grade in the last assignment and the grade in the last term report – on all 10 components measured in my study, and thus find out which of these motivational, educational, and psychological ingredients influence mathematics achievement.

Since there have been over 800 questionnaires, divided among 23 sub-groups, each larger than 25, it was possible to regress the expected and actual grades on all 10 measured components for each of the following subgroups: The general population, boys and girls, boys in mixed-sex and in single-sex classes, girls in mixed-sex and single-sex classes, boys in each of the 4 grades: 7^{th}, 8^{th}, 9^{th}, and 10^{th}, girls in each of these 4 grades, secular boys, secular girls, religious boys, religious girls, Jewish boys, Jewish girls, Muslim boys, and Muslim girls

Let us look at the regression tables where all "Grand 10" predictors are regressed first for the expected and then – for the actual mathematics grade.

9.4.2. Regression tables

Table 1E: Simultaneous Regression for Expected Grade by the Grand 10: GENERAL			
Predictors	**B**	**ß**	**t**
Anxiety	.61	.08	1.76+
Value	-2.17	-.25	-2.77**
Stability of math abilities	.28	.03	.55
Believability in math ability	2.71	.32	6.28***
Approach motivation	.70	.08	1.85+
Avoidance motivation	-.98	-1.32	-3.05**
Learning motivation	.85	.09	1.72+
Preference of math classes	.12	.02	.52
IPT	-2.88	-.32	-3.09**
Helplessness	.31	.04	.67
Intercept=79.20			
R^2=.43, $F_{10,628}$ =14.28***			

p<0.085+ p<0.05* p<0.01** p<0.001***

For the whole population only valuing mathematics, believability in own math abilities, avoidance motivation, and belief in stability of intelligence had a significant influence on the expected math grade. Math anxiety, approach motivation, and learning motivation had but an almost significant such influence.

Table 2E: Simultaneous Regression for Expected Grade by the Grand 10 for Boys			
Predictors	**B**	**ß**	**t**
Anxiety	.41	.05	.67
Value	-.28	-.03	-.16
Stability of math abilities	.34	.03	.40
Believability in math ability	4.50	.49	6.07***
Approach motivation	-.39	-.04	-.62
Avoidance motivation	-.41	.05	-.78
Learning motivation	.34	.03	.44
Preference of math classes	.15	.03	.41
IPT	-.35	-.04	-.19
Helplessness	-.54	-.07	-.69
Intercept=62.36			
R^2=.49, $F_{10,245}$ =7.74***			

p<0.001***

Table 3E: Simultaneous Regression for Expected Grade by the Grand 10 for Girls			
Predictors	**B**	**ß**	**t**
Anxiety	.65	.10	1.54
Value	-2.31	-.28	-2.58**
Stability of math abilities	.27	.03	.43
Believability in math ability	2.12	.28	3.92***
Approach motivation	1.37	.18	2.95**
Avoidance motivation	-1.13	-.16	-2.84**
Learning motivation	.87	.09	1.39
Preference of math classes	1.14	.03	.51
IPT	-3.10	-.37	-2.93**
Helplessness	.42	.06	.72
Intercept=80.55			
R^2=.46, $F_{10,372}$ =9.76***			

p<0.01** p<0.001***

Only believability in own math abilities had a significant influence on the expected grade for boys; for girls, in addition of believability in own math abilities also valuing mathematics, approach- and avoidance motivation, and belief in stability of intelligence had such influence.

Table 4E: Simultaneous Regression for Expected Grade by the Grand 10 for Boys in Mixed Classes			
Predictors	**B**	**ß**	**t**
Anxiety	.51	.25	1.17
Value	1.99	.25	1.17
Stability of math abilities	.22	.03	.24
Believability in math ability	4.60	.53	5.56***
Approach motivation	-.38	-.05	-.53
Avoidance motivation	-.60	-.08	-1.00
Learning motivation	1.00	.11	1.14
Preference of math classes	.23	.05	.55
IPT	1.70	.21	.83
Helplessness	-.40	-.06	-.45
Intercept=45.96			
R^2=.57, $F_{10,142}$ =6.90***			

p<0.001***

Table 5E: Simultaneous Regression for Expected Grade by the Grand 10 for Boys in Single-sex Classes			
Predictors	**B**	**ß**	**t**
Anxiety	-.72	-.08	-.70
Value	.66	.06	.22
Stability of math abilities	.70	.05	.46
Believability in math ability	4.25	.39	3.12**
Approach motivation	-.18	-.02	-.15
Avoidance motivation	.17	.02	.20
Learning motivation	.35	.03	.25
Preference of math classes	.17	.03	.27
IPT	1.13	.10	.31
Helplessness	-1.17	-.13	-.88
Intercept=52.46			
R^2=.47, $F_{10,92}$ =2.57**			

p<0.01**

For boys in mixed- and single-sex classes – as for boys in general – only believability in math abilities significantly influenced the expected math grade.

Table 6E: Simultaneous Regression for Expected Grade by the Grand 10 for Girls in Mixed Classes			
Predictors	**B**	**ß**	**t**
Anxiety	-.14	-.02	-.26
Value	-1.39	-.20	-1.20
Stability of math abilities	.44	.05	.58
Believability in math ability	1.85	.29	2.64**
Approach motivation	1.37	.18	2.30*
Avoidance motivation	-1.22	-.19	-2.48*
Learning motivation	.28	.04	.38
Preference of math classes	.36	.09	1.08
IPT	-1.96	-.28	-1.38
Helplessness	.00	.00	-.02
Intercept=80.83			
R^2=.54, $F_{10,190}$ =7.70**			

p<0.05* p<0.01**

Unlike boys in mixed-sex classes, girls' expected grades in mixed-sex classes were influenced significantly not only by believability in own math abilities but by approach and avoidance motivation as well.

Table 7E: Simultaneous Regression for Expected Grade by the Grand 10 for Girls in Single-sex Classes			
Predictors	**B**	**ß**	**ß**
Anxiety	1.42	.20	2.24*
Value	-3.09	-.29	-2.22*
Stability of math abilities	-.24	-.02	-.24
Believability in math ability	2.55	.28	3.06**
Approach motivation	.97	.12	1.33
Avoidance motivation	-1.02	-.13	-1.53
Learning motivation	2.33	.20	2.26*
Preference of math classes	.22	.04	.49
IPT	-4.00	-.39	-2.55*
Helplessness	.95	.11	1.03
Intercept=74.84			
R^2=.47, $F_{10,171}$ =4.73***			

$p<0.05$* $p<0.01$** $p<0.001$***

Except for believability in own math abilities, that significantly influenced both the expected grade of girls in mixed- and single-sex classes, the other components that influenced these two sub-groups were different from each other: while the expected grade of girls learning in mixed-classes was significantly influenced only by motivational orientations – approach and avoidance, the expected grade of girls learning in single-sex classes was influenced only by educational-psychological components: math anxiety, valuing mathematics, and belief in rigidity of intelligence, as well as by learning motivation.

<u>For boys in grade 7 F was insignificant.</u>

Table 9E: Simultaneous Regression for Expected Grade by the Grand 10 for Boys in Grade 8			
Predictors	B	**ß**	**ß**
Anxiety	1.63	.20	1.45
Value	-3.34	-.29	-.87
Stability of math abilities	.79	.07	.41
Believability in math ability	7.87	.68	4.40***
Approach motivation	-.84	-.09	-.62
Avoidance motivation	.00	.01	.05
Learning motivation	4.11	.40	2.31*
Preference of math classes	-1.08	-.19	-1.57
IPT	-1.20	-.11	-.28
Helplessness	.82	.09	-.50
Intercept=46.79			
R^2=.70, $F_{10,49}$ =4.60***			

p<0.05* p<0.001***

IX. <u>For Boys in grade 9 F was not significant</u>

Table 11E: Simultaneous Regression for Grade Expectancy by the Grand 10 for Boys in Grade 10			
Predictors	**B**	**ß**	**t**
Anxiety	1.18	.13	.83
Value	.27	.04	.08
Stability of math stability	.48	.06	.31
Believability in math ability	2.74	.32	1.50
Approach motivation	-.31	-.04	-.27
Avoidance motivation	-2.31	-.36	-.22*
Learning motivation	-1.26	-.14	-.86
Preference of math classes	.13	.03	.17
IPT	-.33	-.05	-.08
Helplessness	-1.40	-.20	-.81
Intercept=80.92			
R^2=.60, $F_{10,45}$ =2.47*			

p<0.05*

While for boys in grade 7 and 9 no component was significantly influencing the expected grade, for boys in grade 8 believability in own math abilities and learning motivation were significantly influencing the expected grade, and for boys in grade 10 only avoidance motivation had such influence.

For Girls in grade 7 F was not significant

Table 13E: Simultaneous Regression for Expected Grade by the Grand 10 for Girls in Grade 8			
Predictors	**B**	**ß**	**t**
Anxiety	1.5	.22	1.48
Value	-.98	-.12	-.44
Stability of math abilities	.54	.06	.39
Believability in math ability	2.05	.30	1.60
Approach motivation	.48	.06	.44
Avoidance motivation	-1.79	-.27	-1.90+
Learning motivation	1.43	.17	1.04
Preference of math classes	.00	.01	.08
IPT	-2.22	-.28	-.89
Helplessness	.00	-.01	-.02
Intercept=74.88			
R^2=.56, $F_{10,74}$ =3.41***			

p<0.07+ p<0.001***

Table 14E: Simultaneous Regression for Grade Expectancy by the Grand 10 for Girls in Grade 9			
Predictors	**B**	**ß**	**t**
Anxiety	-.62	-.10	-.80
Value	-.89	-.11	-.47
Stability of math abilities	.00	.00	-.02
Believability in math ability	2.11	.30	2.10*
Approach motivation	1.58	.23	2.01*
Avoidance motivation	-1.61	-.24	-2.16*
Learning motivation	-.85	-.10	-.88
Preference of math classes	.00	.02	.19
IPT	-1.52	-.18	-.64
Helplessness	.66	.11	.63
Intercept=81.67			
R^2=.47, $F_{10,100}$ =2.80**			

p<0.05* p<0.01**

Table 15E: Simultaneous Regression for Expected Grade by the Grand 10 for Girls in Grade 10			
Predictors	**B**	**ß**	**t**
Anxiety	.36	.06	.53
Value	-.56	-.08	-.38
Stability of math abilities	.78	.09	.70
Believability in math ability	1.32	.18	1.52
Approach motivation	1.53	.21	1.72
Avoidance motivation	-.68	-.10	-.93
Learning motivation	2.25	.27	1.89+
Preference of math classes	.51	.12	1.09
IPT	-1.23	-.17	-.70
Helplessness	.00	.00	-.03
Intercept=63.59			
R^2=.55, $F_{10,98}$ =4.23***			

p<0.07+ p<0.001***

For girls in grade 7 no component was significantly influencing the expected grade; for girls in grade 8 – avoidance motivation was influencing it almost significantly; for girls in grade 9 – believability in own math abilities, approach- and avoidance motivation had significant influence, and for girls in grade 10 – only learning motivation had an almost significant influence on the expected grade.

Table 16E: Simultaneous Regression for Expected Grade by the Grand 10 for Secular Boys			
Predictors	**B**	**ß**	**t**
Anxiety	.41	.05	.60
Value	1.97	.25	.15
Stability of math abilities	.13	.01	.14
Believability in math ability	4.61	.53	5.56***
Approach motivation	-.35	-.04	-.50
Avoidance motivation	-.57	-.08	-.94
Learning motivation	1.02	.11	1.16
Preference of math classes	.23	.05	.55
IPT	1.64	.20	.80
Helplessness	-.24	.03	-.28
Intercept=46.02			
R^2=.57, $F_{10,143}$ =6.93***			

p<0.001***

Table 17E: Simultaneous Regression for Expected Grade by the Grand 10 for Religious Boys			
Predictors	**B**	**ß**	**t**
Anxiety	-.53	-.06	-.52
Value	1.41	.13	.47
Stability of math abilities	1.14	.09	.75
Believability in math ability	4.31	.40	3.21**
Approach motivation	-.27	-.03	-.24
Avoidance motivation	.00	.01	.08
Learning motivation	.28	.03	.20
Preference of math classes	.12	.02	.20
IPT	2.22	.20	.62
Helplessness	-1.75	-.20	-1.30
Intercept=47.02			
R^2=.48, $F_{10,91}$ =2.66**			

p<0.01**

For secular-, as well as for religious boys – only believability in own math abilities had a significant influence on the expected math grade.

Table 18E: Simultaneous Regression for Expected Grade by the Grand 10 for Secular Girls			
Predictors	**B**	**ß**	**t**
Anxiety	.43	-.07	.92
Value	-2.04	-.27	-2.10*
Stability of math abilities	.16	.02	.24
Believability in math ability	2.15	.31	3.68**
Approach motivation	1.26	.16	2.23*
Avoidance motivation	-.96	-.14	-2.18*
Learning motivation	.78	.10	1.10
Preference of math classes	.38	.10	1.31
IPT	-2.49	-.33	-2.12*
Helplessness	.13	.02	.20
Intercept=80.62			
R^2=.55, $F_{10,271}$=10.42***			

p<0.05* p<0.01** p<0.001***

Table 19E: Simultaneous Regression for Expected Grade by the Grand 10 for Religious Girls			
Predictors	**B**	**ß**	**t**
Anxiety	1.14	.17	1.47
Value	2.27	.25	1.21
Stability of math abilities	.31	.03	.26
Believability in math ability	2.66	.32	2.60**
Approach motivation	.00	-.01	-.07
Avoidance motivation	-.82	-.12	-1.12
Learning motivation	.46	.05	.42
Preference of math classes	-.39	-.08	-.72
IPT	1.77	.19	.85
Helplessness	-1.71	-.21	-1.40
Intercept=54.62			
R^2=.39, $F_{10,118}$ =2.15*			

$p<0.05$* $p<0.01$**

While for secular girls, in addition to believability in own math abilities valuing mathematics, approach- and avoidance motivation, and belief in rigidity of intelligence had all significant influence on the expected math grade, for religious girls only believability in own mathematical abilities had such influence.

Table 20E: Simultaneous Regression for Expected Grade by the Grand 10 for Jewish Boys			
Predictors	**B**	**ß**	**t**
Anxiety	.00	.00	-.01
Value	.00	.00	.02
Stability of math abilities	1.97	.16	1.91+
Believability in math ability	4.71	.46	5.64***
Approach motivation	-.43	-.05	-.66
Avoidance motivation	-.42	-.06	-.79
Learning motivation	.00	.05	.42
Preference of math classes	.00	.01	.12
IPT	.44	.05	.20
Helplessness	-1.40	-.17	-1.52
Intercept=58.31			
R^2=.51, $F_{10,198}$ =6.79***			

$p<0.06$+ $p<0.001$***

Table 21E: Simultaneous Regression for Expected Grade by the Grand 10 for Muslim Boys			
Predictors	**B**	**ß**	**t**
Anxiety	.00	.00	-.04
Value	6.50	.50	2.05*
Stability of math abilities	-4.16	-.37	-2.14*
Believability in math ability	3.73	.43	2.83**
Approach motivation	-.78	-.08	-.52
Avoidance motivation	-2.51	-.25	-1.92+
Learning motivation	2.05	.19	.88
Preference of math classes	-.55	-.10	-.72
IPT	8.26	.76	2.28*
Helplessness	-1.91	-.26	-1.41
Intercept=40.57			
R^2=.80, $F_{10,36}$ =6.42***			

p<0.07+ p<0.05* p<0.01 ** p<0.001***

For Jewish boys only believability in own math abilities significantly influenced the expected grade and stability of math abilities almost significantly influenced it. For Muslim boys, in addition to believability in own math abilities, also valuing mathematics, stability of math abilities, and belief in rigidity of intelligence significantly influenced the expected grade, and avoidance motivation influenced it almost significantly.

Table 22E: Simultaneous Regression for Expected Grade by the Grand 10 for Jewish Girls			
Predictors	**B**	**ß**	**t**
Anxiety	.24	.04	.46
Value	.49	.07	.39
Stability of math abilities	.57	.07	.80
Believability in math ability	1.51	.22	2.15*
Approach motivation	.77	.11	1.45
Avoidance motivation	-1.00	-.15	-2.02*
Learning motivation	-.25	-.03	-.35
Preference of math classes	-.25	-.06	-.66
IPT	.00	.01	.03
Helplessness	-.91	-.14	-1.12
Intercept=73.57			
R^2=.31, $F_{10,237}$ =2.59**			

p<0.05* p<0.01**

Table 23E: Simultaneous Regression for Expected Grade by the Grand 10 for Muslim Girls			
Predictors	**B**	**ß**	**t**
Anxiety	.46	.07	.71
Value	-1.38	-.13	-.93
Stability of math abilities	.72	.07	.66
Believability in math ability	3.15	.43	3.95***
Approach motivation	.73	.08	1.45
Avoidance motivation	-1.00	-.15	.80
Learning motivation	2.02	.20	1.82+
Preference of math classes	.00	.01	.09
IPT	-.75	-.08	-.48
Helplessness	-.65	-.10	-.74
Intercept=68.06			
R^2=.31, $F_{10,124}$ =5.93***			

p<0.07+ p<0.001***

Among Jewish girls both believability in own math abilities and avoidance motivation significantly influenced the expected math grade; for Muslim girls – believability in own math abilities significantly influenced it, and learning motivation almost significantly influenced the expected grade in mathematics.

<u>In summa:</u>

In three sub-populations out of the 23 F was not significant, thus in 20 sub-groups it was possible to present the “10 Grand” motivational and psychological-educational components as influencing the expected grade. In one sub-group – Girls in grade 8 – only avoidance motivation – had an almost significant influence (p<.07) on the expected grade. In six subgroups (Boys, Boys in mixed-sex classes, Boys in single-sex classes, Secular boys, Religious boys, and Religious girls), only believability in own math abilities had a significant influence on the expected grade. For boys in grade 10 only avoidance motivation had such influence.

<u>Let us now see the regression tables for the actual grade.</u>

Table 1A: Simultaneous Regression for Actual Grade by the Grand 10			
Predictors	**B**	**ß**	**t**
Anxiety	-1.25	-.11	-2.63**
Value	-3.19	-.24	-2.94**
Stability of math abilities	.77	.05	1.12
Believability in math ability	3.70	.30	6.35***
Approach motivation	.00	.00	-.06
Avoidance motivation	.00	-.01	-.13
Learning motivation	.27	.02	.40
Preference of math classes	.50	.07	1.67
IPT	-3.87	-.29	-3.07**
Helplessness	-.96	-.09	-1.56
Intercept=94.18			
R^2=.53, $F_{10,653}$ =24.92***			

p<0.01** p<0.001***

Believability in own math abilities, math anxiety, valuing mathematics, and belief in rigidity of intelligence had a significant influence on the actual math grade of the whole population.

Table 2A: Simultaneous Regression for Actual Grade by the Grand 10 for Boys			
Predictors	**B**	**ß**	**t**
Anxiety	-1.95	-.17	-2.64**
Value	-3.72	-.29	-1.97*
Stability of math abilities	1.44	.10	1.40
Believability in math ability	4.72	.36	5.24***
Approach motivation	-.96	-.08	-1.21
Avoidance motivation	-.12	.01	-.18
Learning motivation	.41	.03	.42
Preference of math classes	.38	.05	.84
IPT	-3.79	-.29	-1.71
Helplessness	-.77	-.07	-.83
Intercept=93.54			
R^2=.55, $F_{10,266}$ =11.44***			

p<0.001***

Table 3A: Simultaneous Regression for Actual Grade by the Grand 10 for Girls			
Predictors	**B**	**ß**	**t**
Anxiety	-.87	-.08	-1.37
Value	-2.26	-.16	-1.65
Stability of math abilities	.35	.02	.38
Believability in math ability	3.20	.27	3.97***
Approach motivation	.66	.05	.93
Avoidance motivation	.00	.01	.13
Learning motivation	-.25	-.02	-.26
Preference of math classes	.47	.07	1.18
IPT	-3.42	-.25	-2.17*
Helplessness	-1.55	-.14	-1.85+
Intercept=92.43			
R^2=.54, $F_{10,376}$ =15.44***			

p<0.07+ p<0.05* p<0.01** p<0.001***

For boys in addition to believability in own math abilities also math anxiety and valuing mathematics had a significant influence on the actual math grade. For girls the only significant component – in addition to believability in own math abilities – significantly influencing the actual math grade was belief in rigidity of intelligence; an almost significant component influencing the actual grade among girls was mathematical helplessness.

Table 4A: Simultaneous Regression for Actual Grade by the Grand 10 for Boys in Mixed Classes			
Predictors	**B**	**ß**	**t**
Anxiety	-1.38	-.12	-1.56
Value	-2.74	-.22	-1.26
Stability of math abilities	2.42	.18	2.02*
Believability in math ability	5.70	.46	5.42***
Approach motivation	.00	.00	.06
Avoidance motivation	-.13	-.01	-.16
Learning motivation	1.91	.09	1.02
Preference of math classes	.44	.06	.82
IPT	-2.63	-.21	-.04
Helplessness	-1.23	-.12	-1.15
Intercept=72.91			
R^2=.63, $F_{10,163}$ =19.50***			

P<0.05* p<0.001***

Table 5A: Simultaneous Regression for Actual Grade by the Grand 10 for Boys in Single-sex Classes			
Predictors	**B**	**ß**	**t**
Anxiety	-4.22	-.34	-3.27**
Value	.63	.04	.17
Stability of math abilities	1.86	.11	.97
Believability in math ability	3.41	.25	2.03***
Approach motivation	-3.23	-.28	-.2.25*
Avoidance motivation	1.05	.11	.95
Learning motivation	1.10	.08	.63
Preference of math classes	.41	.05	.52
IPT	-.21	-.01	-.05
Helplessness	-.53	-.05	-.31
Intercept=74.34			
R^2=.51, $F_{10,92}$ =3.25***			

P<0.05* p<0.01** p<0.001***

Believability on own math abilities and stability of math abilities significantly influenced the actual math grade of boys in mixed-sex classes; boys in single-sex classes were influenced – in addition to believability in own math abilities – also by math anxiety and by approach motivation.

Table 6A: Simultaneous Regression for Actual Grade by the Grand 10 for Girls in Mixed Classes			
Predictors	**B**	**ß**	**t**
Anxiety	-1.49	-.12	-1.52
Value	.61	.05	.28
Stability of math abilities	.00	.00	.03
Believability in math ability	3.36	.28	2.87**
Approach motivation	-.44	-.03	-.40
Avoidance motivation	-.15	-.01	-.18
Learning motivation	-.36	-.03	-.26
Preference of math classes	.73	.10	1.34
IPT	-.48	-.04	-.18
Helplessness	-2.32	-.21	-1.94+
Intercept=82.10			
R^2=.60, $F_{10,188}$ =10.80***			

p<0.06+ p<0.01** p<0.001***

Table 7A: Simultaneous Regression for Actual Grade by the Grand 10 for Girls in Single-sex Classes			
Predictors	**B**	**ß**	**t**
Anxiety	-.42	-.05	-.51
Value	-4.67	-.32	-2.58*
Stability of math abilities	-.84	.05	.63
Believability in math ability	3.38	.28	2.99**
Approach motivation	1.42	.13	1.33
Avoidance motivation	.00	.00	-.02
Learning motivation	.43	.03	.31
Preference of math classes	.26	.03	.44
IPT	-5.40	-.39	-2.74**
Helplessness	.59	-.05	-.48
Intercept=96.25			
R^2=.49, $F_{10,177}$ =5.48***			

p<0.05* p<0.01** p<0.001***

Girls' actual math grade was significantly influenced by believability in own math abilities and almost significantly influenced by mathematical helplessness when learning in mixed-sex classes; while in single-sex classes girls' actual math grade was influenced, in addition to believability in own math abilities, by valuing mathematics, and by belief in rigidity of intelligence.

Table 8A: Simultaneous Regression for Actual Grade by the Grand 10 for Boys in Grade 7			
Predictors	**B**	**ß**	**t**
Anxiety	-2.75	-.44	-3.39**
Value	.21	.03	.10
Stability of math abilities	1.67	.23	1.57
Believability in math ability	6.00	.67	4.80***
Approach motivation	.98	.16	1.14
Avoidance motivation	1.00	.16	1.34
Learning motivation	-1.46	-.20	-1.15
Preference of math classes	.63	.16	1.24
IPT	.86	.11	.37
Helplessness	.85	.141	.81
Intercept=57.14			
R^2=.79, $F_{10,37}$ =6.21***			

p<0.01** p<0.001***

Table 9A: Simultaneous Regression for Actual Grade by the Grand 10 for Boys in Grade 8			
Predictors	**B**	**ß**	**t**
Anxiety	-.40	-.06	-.42
Value	-3.55	-.34	-1.09
Stability of math abilities	1.05	.11	.67
Believability in math ability	2.48	.27	1.88+
Approach motivation	-1.73	-.21	-1.49
Avoidance motivation	-.66	-.09	-.69
Learning motivation	1.21	.13	.79
Preference of math classes	.00	-.01	-.09
IPT	-2.92	-.29	-.79
Helplessness	-2.06	-.27	-1.54
Intercept=108.65			
R^2=.61, $F_{10,58}$ =3.38**			

p<0.07+ p<0.01**

Table 10A: Simultaneous Regression for Actual Grade by the Grand 10 for Boys in Grade 9			
Predictors	**B**	**ß**	**t**
Anxiety	-2.02	-.16	-1.31
Value	-2.77	-1.74	-.73
Stability of math abilities	3.95	.20	1.79+
Believability in math ability	3.83	.28	2.40*
Approach motivation	-.58	-.04	-.35
Avoidance motivation	.29	.03	.21
Learning motivation	1.25	.08	.66
Preference of math classes	.37	.04	.40
IPT	-2.61	-.17	-.61
Helplessness	-2.39	-.21	-1.32
Intercept=78.38			
R^2=.53, $F_{10,91}$=3.58***			

P<0.08+ p<0.05* p<0.001***

Table 11A: Simultaneous Regression for Actual Grade by the Grand 10 for Boys in Grade 10			
Predictors	**B**	**ß**	**t**
Anxiety	.17	.01	.08
Value	-10.41	-.99	-2.53*
Stability of math abilities	-.87	-.06	-.38
Believability in math ability	6.77	.47	2.82**
Approach motivation	1.56	.12	.88
Avoidance motivation	-5.62	-.50	-3.51***
Learning motivation	-.56	-.04	-.26
Preference of math classes	1.28	.15	1.02
IPT	12.15	-1.00	-2.48*
Helplessness	4.98	.42	1.96+
Intercept=128.55			
R^2=.70, $F_{10,47}$ =4.57***			

p<0.06+ <0.05* p<0.01** p<0.001***

The actual grade of grade 7 boys was influenced by their believability in their own math abilities and math anxiety; in grade 8 believability in own math abilities had but an almost significant influence on their actual abilities; in grade 9 believability in own math abilities had a significant influence, and stability of math abilities an almost significant influence on the actual grade, and in grade 10 four components had a significant influence on the actual grade: believability in own math abilities, valuing math, avoidance motivation, and belief in rigidity of intelligence; math helplessness had but an almost significant influence on the actual math grade.

F was insignificant for girls in grade 7.

Table 13A: Simultaneous Regression for Actual Grade by the Grand 10 for Girls in Grade 8			
Predictors	**B**	**ß**	**t**
Anxiety	-.97	-.09	-.57
Value	-2.26	-.17	-.62
Stability of math abilities	-.73	-.05	-.31
Believability in math ability	2.76	.26	1.34
Approach motivation	-1.80	-.15	-1.03
Avoidance motivation	.81	.08	.52
Learning motivation	.14	.01	.06
Preference of math classes	1.32	.19	1.15
IPT	-1.22	-.09	-.29
Helplessness	-1.56	-.17	-.76
Intercept=96.01			
R^2=.55, $F_{10,70}$ =3.06**			

p<0.07+ p<0.001***

Table 14A: Simultaneous Regression for Actual Grade by the Grand 10 for Girls in Grade 9			
Predictors	**B**	**ß**	**t**
Anxiety	-.48	-.04	-.36
Value	-5.78	-.35	-1.67
Stability of math abilities	-2.07	-.12	-1.20
Believability in math ability	5.34	.38	3.10**
Approach motivation	2.10	.15	1.60
Avoidance motivation	-.93	-.07	-.71
Learning motivation	-1.73	-.10	-1.04
Preference of math classes	.12	.02	.17
IPT	-3.71	-.24	-.97
Helplessness	-2.62	-.21	-1.55
Intercept=114.00			
R^2=.66, $F_{10,103}$ =7.79***			

p<0.01** p<0.001***

Table 15A: Simultaneous Regression for Actual Grade by the Grand 10 for Girls in Grade 10			
Predictors	**B**	**ß**	**t**
Anxiety	-.64	-.07	-.64
Value	.29	.03	.15
Stability of math abilities	3.49	.26	2.18*
Believability in math ability	3.20	.29	2.45*
Approach motivation	.74	.06	.57
Avoidance motivation	.33	.03	.32
Learning motivation	1.67	.12	.99
Preference of math classes	.79	.12	1.17
IPT	-2.86	-.24	-1.19
Helplessness	-1.66	-.16	-1.14
Intercept=59.58			
R^2=.62, $F_{10,104}$ =6.41***			

$p<0.05$* $p<0.001$***

No motivational or psychological-educational measured component was significantly influencing the actual grade of girls in grades 7 and 8. Believability in own math ability had a significant influence on the actual of girls in grade 9; stability of math abilities and believability in own math abilities had a significant influence on the actual grade of 10th grade girls.

Table 16A: Simultaneous Regression for Actual Grade by the Grand 10 for Secular Boys			
Predictors	**B**	**ß**	**t**
Anxiety	-1.44	-.13	-1.65
Value	-2.75	-.23	-1.26
Stability of math abilities	2.37	.18	1.99*
Believability in math ability	5.71	.46	5.44***
Approach motivation	.00	.01	.07
Avoidance motivation	-.10	-.01	-.13
Learning motivation	1.21	.09	1.04
Preference of math classes	.44	.06	.82
IPT	-2.66	-.22	-1.05
Helplessness	-1.15	-.11	-1.08
Intercept=72.94			
R^2=.62, $F_{10,164}$ =10.57***			

$P<0.05$* $p<0.001$***

Table 17A: Simultaneous Regression for Actual Grade by the Grand 10 for Religious Boys			
Predictors	**B**	**ß**	**t**
Anxiety	-4.07	-.33	-3.14**
Value	1.19	.08	.32
Stability of math abilities	2.21	.13	1.14
Believability in math ability	3.47	.25	2.06*
Approach motivation	-3.30	-.28	-2.30*
Avoidance motivation	.96	.10	.87
Learning motivation	1.05	.07	.60
Preference of math classes	.37	.05	.47
IPT	.61	.04	.13
Helplessness	-1.00	-.08	-.56
Intercept=70.19			
R^2=.51, $F_{10,91}$ =3.23***			

$p<0.05$* $p<0.001$***

Believability in own math abilities and stability of math abilities significantly influenced the actual grade of secular boys. Among religious boys the components significantly influencing the actual grade were, in addition to believability in own math abilities, math anxiety, and approach motivation.

Table 18A: Simultaneous Regression for Actual Grade by the Grand 10 for Secular Girls			
Predictors	**B**	**ß**	**t**
Anxiety	-.99	-.09	-1.28
Value	-1.67	-.12	-1.03
Stability of math abilities	.28	.02	.26
Believability in math ability	3.78	.32	4.08***
Approach motivation	.00	-.01	-.09
Avoidance motivation	.39	.03	.54
Learning motivation	.00	.00	-.04
Preference of math classes	.57	.08	1.24
IPT	-2.98	.22	-1.55
Helplessness	-1.52	-.14	-1.54
Intercept=88.80			
R^2=.59, $F_{10,251}$ =13.53***			

$p<0.05$* $p<0.01$**

Table 19A: Simultaneous Regression for Actual Grade by the Grand 10 for Religious Girls			
Predictors	**B**	**ß**	**t**
Anxiety	-1.08	-.11	-.93
Value	-1.41	-.10	-.48
Stability of math abilities	.51	.03	.28
Believability in math ability	1.57	.12	.94
Approach motivation	.84	.08	.74
Avoidance motivation	.00	.00	.00
Learning motivation	-.82	-.05	-.48
Preference of math classes	.11	.01	.13
IPT	-1.72	-.12	-.55
Helplessness	-3.35	-.27	-1.82+
Intercept=97.52			
R^2=.45, $F_{10,114}$ =2.96**			

p<0.08+ p<0.01**

Table 20A: Simultaneous Regression for Actual Grade by the Grand 10 for Jewish Boys			
Predictors	**B**	**ß**	**t**
Anxiety	-2.64	-.20	-2.83**
Value	-1.76	-.14	-.74
Stability of math abilities	2.38	.16	1.94+
Believability in math ability	5.36	.37	4.75***
Approach motivation	-1.23	-.10	-1.37
Avoidance motivation	.29	.03	.38
Learning motivation	.00	.05	.42
Preference of math classes	.38	.05	.70
IPT	-1.37	-.10	-48
Helplessness	-1.40	-.12	-1.12
Intercept=77.13			
R^2=.52, $F_{10,200}$=7.51***			

p<0.06+ p<0.01** p<0.001***

Table 21A: Simultaneous Regression for Actual Grade by the Grand 10 for Muslim Boys			
Predictors	**B**	**ß**	**t**
Anxiety	-2.30	-.22	-1.93+
Value	-3.99	-.25	-1.18
Stability of math abilities	.00	-.01	-.05
Believability in math ability	4.21	.37	3.08**
Approach motivation	-1.308	-.10	-.79
Avoidance motivation	-.62	-.12	-1.12
Learning motivation	1.84	.13	.80
Preference of math classes	-.72	-.10	-.91
IPT	57ץ2	-.19	-.68
Helplessness	-1.68	-.19	-1.25
Intercept=112.47			
R^2=.78, $F_{10,55}$ =8.27**			

p<0.06+ p<0.01 **

The actual grades of both Jewish and Muslim boys were significantly influenced by believability in own math abilities; Jewish boys' actual grades were also significantly influenced by math anxiety and almost significantly influenced by stability of math abilities. Anxiety influenced the actual grades of Muslims almost significantly.

Table 22A: Simultaneous Regression for Actual Grade by the Grand 10 for Jewish Girls			
Predictors	**B**	**ß**	**t**
Anxiety	-1.59	-.14	-1.85+
Value	.96	.08	.47
Stability of math abilities	1.32	.09	1.15
Believability in math ability	1.67	.14	1.45
Approach motivation	.17	.01	.19
Avoidance motivation	.53	.05	.66
Learning motivation	-.95	-.06	-.77
Preference of math classes	.69	.09	1.18
IPT	.96	.07	.39
Helplessness	-4.48	-.38	-3.51***
Intercept=73.57			
R^2=.31, $F_{10,237}$ =2.59**			

p<0.07+ p<0.05* p<0.01** p<0.001***

Table 23A: Simultaneous Regression for Actual Grade by the Grand 10 for Muslim Girls			
Predictors	**B**	**ß**	**t**
Anxiety	-.25	-.03	-.26
Value	-3.70	-.22	-1.62
Stability of math abilities	.72	-5.0	4.40
Believability in math ability	4.86	.41	4.03***
Approach motivation	1.51	.10	1.09
Avoidance motivation	.00	-.01	.10
Learning motivation	-.54	-.04	-.32
Preference of math classes	-.30	-.04	-.48
IPT	-5.44	-.38	-2.29*
Helplessness	.31	.03	.25
Intercept=94.36			
R^2=.58, $F_{10,135}$ =6.86***			

p<0.07+ p<0.001***

The actual grades of Jewish girls were significantly influenced by mathematical helplessness and almost significantly influenced by math anxiety; the actual grades of Muslim girls were significantly influences by believability in own math abilities and belief in rigidity of intelligence.

9.4.3. So what influences math grades?

Let us see who are the components influencing most, who are the ones that influence only a few subgroups, and who have no significant influence on math achievement.

Because some of the sub-populations were rather small (n=25), I have included those that were almost significant ($p<0.07$) as well.

Let us look at the 10 motivational and psychological measures influencing both the expected and actual math grade, starting with the most influencing measure – believability in own math abilities, and closing with math helplessness, the least influencing one:

Table 9.4.3: Number of sub-populations where each of the Grand 10 components significantly influences math achievement

Predictors	Significantly influencing (No. of groups*)	Not influencing (No. of groups*)	Non-influencing Models
Believability in math ability	**17**/*20*	**2**/*2*	**4**/*1*
Approach motivation	**9**/*1*	**10**/*21*	**4**/*1*
IPT	**5**/*5*	**14**/17	**4**/*1*
Learning motivation	**5**/*0*	**14**/*22*	**4**/*1*
Value	**5**/*4*	**14**/*18*	**4**/*1*
Avoidance motivation	**7**/*1*	**12**/*21*	**4**/*1*
Anxiety	**2**/*8*	**17**/*14*	**4**/*1*
Stability of math abilities	**2**/*5*	**17**/*17*	**4**/*1*
Preference of math classes	**0**/*0*	**19**/*22*	**4**/*1*
Helplessness	**0**/*5*	**19**/*17*	**4**/*1*

* **Bold** letters – expected grade; *italics* – actual grade.

9.4.3.1. Believability in own math abilities and its influence on math achievement

As can be seen from table 9.4.3, believability in own math abilities was the most dominant component predicting both expected and actual math grades. Among four sub-groups – boys in grade 8 and 9, and girls in grade 9 and secular girls – it was the only significant (or almost significant in one case) component predicting the actual grade.

For other measures there was a significant influence only on 0-9 sub-groups of the 23 examined. Let us see who were the sub-groups influenced by each of these measures.

9.4.3.2. Motivational orientations: Who are the sub-groups they influence?

Learning goals were significantly influenced the following 4 sub-groups:

1. The general population: Almost significant influence only on expected grade;
2. Girls in single-sex classes – Significant influence only on expected grade;
3. Boys in grade 8 – Significant influence on expected grade;
4. Muslim girls – Almost significant influence only on expected grade.

In two sub-groups of girls and one sub-group of boys math grade was significantly influenced by learning goals motivation.

Approach goals were significantly influenced the following 7 sub-groups:

1. The general population: Almost significant influence only on expected grade;
2. Girls – Significant influence only on expected grade;
3. Boys in single-sex classes – Significant influence only on actual grade;
4. Girls in mixed-sex classes – Significant influence only on expected grade;
5. Girls in grade 9 – Significant influence only on expected grade;
6. Secular girls – significant influence on expected grade;
7. Religious boys – Significant influence only on actual grade.

Four sub-groups of girls and two sub-groups of boys had their math grade be significantly influenced by approach goals motivation**.**

Avoidance goals were significantly influenced the following 9 sub-groups:

1. The general population: Significant influence only on expected grade;
2. Girls – Significant influence only on expected grade;
3. Girls in single-sex classes – Significant influence only on expected grade;
4. Boys in grade 10 – Significant influence both on actual and expected grade;
5. Girls in grade 8 – Almost significant influence only on expected grade;
6. Girls in grade 9 – Significant influence only on expected grade;
7. Secular girls – significant influence on expected grade;
8. Muslim boys – Almost significant influence only on expected grade;
9. Jewish girls – Almost significant influence only on expected grade.

In six sub-groups of girls and two sub-groups of boys math grade was significantly influenced by avoidance goals motivation.

9.4.3.3. Belief in rigidity of intelligence – IPT – and its influence on math actual and expected grades

1. The general population: Significant influence on both expected and actual grades;
2. Girls: Significant influence on both expected and actual grades;
3. Girls in single-sex classes – Significant influence on both expected and actual grades;
4. Boys in grade 10 – Significant influence only on actual grade;
5. Secular girls – Significant influence only on expected grade;
6. Muslim boys – Significant influence only on expected grade;
7. Muslim girls – Significant influence only on actual grade.

In four sub-groups of girls and two sub-groups of boys math grade was significantly influenced by belief in rigidity of intelligence.

9.4.3.4. Stability of math abilities: Its influence on math actual and expected grades

1. Boys in mixed-sex classes – Significant influence only on actual grade;

2. Boys in grade 9 – Almost significant influence only on actual grade;
3. Girls in grade 10 – Significant influence only on actual grade;
4. Secular boys – Significant influence only on actual grade;
5. Jewish boys – Almost significant influence on both expected and actual grades;
6. Muslim boys – Significant influence only on expected grade.

In one sub-group of girls and five sub-groups of boys math grade was significantly influenced by belief in stability of math abilities.

9.4.3.5. Valuing mathematics: Its influence on math actual and expected grades

1. The general population – Significant influence on both expected and actual grades;
2. Boys – Significant influence only on actual grade;
3. Girls: Significant influence only on expected grade;
4. Girls in single-sex classes – Significant influence on both expected and actual grades;
5. Boys in grade 10 – Significant influence only on actual grade;
6. Secular girls – Significant influence only on expected grade;
7. Muslim boys – Significant influence only on expected grade.

Only among five sub-groups – the general population, three girls' sub-groups and one boys' – valuing mathematics has a significant influence on the expected grade. Only in four sub-groups – the general population, one of girls' and two boys' – it had a significant influence on the actual grade.

9.4.3.6. Math anxiety: Its influence on math actual and expected grades

1. The general population – Almost significant influence on the expected and significant influence on the actual grade;
2. Boys – Significant influence only on actual grade;
3. Boys in single-sex classes – Significant influence only on actual grade;
4. Girls in single-sex classes – Significant influence only on expected grade;
5. Boys in grade 7 – Significant influence only on actual grade;
6. Religious boys – Significant influence only on actual grade;
7. Jewish boys – Significant influence only on actual grade;
8. Muslim boys – Almost significant influence only on expected grade;
9. Jewish girls – Almost significant influence only on expected grade.

Two sub-group of girls and six sub-groups of boys had their math grade be significantly influenced by their mathematical anxiety.

9.4.3.7. Mathematical helplessness: Its influence on math actual and expected grades

1. Girls – Almost significant influence on actual grade;
2. Girls in mixed-sex classes – Almost significant influence on actual grade;
3. Boys in grade 10 – Almost significant influence on actual grade;
4. Religious girls – Almost significant influence on actual grade;
5. Jewish girls – significant influence on actual grade.

In four sub-groups of girls and one sub-group of boys math grade was significantly influenced by their mathematical helplessness.

9.4.3.8. Preference of math afternoon classes: Its influence on math actual and expected grades

Preference of math afternoon classes had – among Israeli students – no influence either on the expected or the actual math grade.

9.4.4. Summary

Five "actors" claimed themselves as "non-participants" in the game: boys in grade 7 and 9 and girls in grade 7 and 8 when the expected grade was regressed, and girls in grade 7 when the actual grade was regressed.

However, from the 41 sub-groups that did participate (19+22), namely, that were significantly influenced at least by one of the motivational and educational-psychological measures, we can conclude, that many interesting findings have been observed. Measures that have been perceived as influencing grades, such as mathematical anxiety and helplessness were found as hardly influencing. Sub-populations commonly-perceived as "not-easily influenced" have been found as more vulnerable than expected; for example – 10th grade boys. But above all – in spite of the high correlation between expected and actual grades, the influence of the "Grand 10" measures on the expected grade was different than on the actual grade in almost all cases. These findings will be further discussed in the next chapter.

Chapter 10:
Discussion

10.1. Introduction

In this chapter I shall discuss issues stemming from the findings:

1. The influence of demographic variables and class-type on the results of the examined variables;
2. The correlations between each two of the motivational and psychological-educational items examined: learning-, approach-, and avoidance motivation, valuing mathematics; believability in own math abilities; mathematical helplessness; believing in incremental versus rigidity of mathematical intelligence; stability of mathematical abilities; mathematical anxiety; and preference of afternoon mathematics classes. These correlations will be examined for each of the following 15 sub-groups: the general population, boys versus girls, students in mixed-sex versus those in single-sex classes, Jews versus Muslims, secular versus religious students, and students in grades 7, 8, 9, and 10.
3. An examination of the variables that influence both the expected and the actual grades for each of the 23 sub-populations examined: the general population, boys and girls, boys and girls in mixed- and single-sex classes; religious boys and girls, Jewish and Muslims boys and girls, and boys and girls in each of the 4 grades: 7th, 8th, 9th, and 10th.

10.2. The influence of demographic variables and class-type on the results

As I have shown in the theoretical chapters of this work, demographic variables, such as gender, age, religion, socio-economic status, and ethnic origin have a substantial influence on achievements and aspirations in general and in mathematics in particular. In the previous chapter I have presented the results of this study, where I found that indeed – many significant differences were observed in all motivational, educational, and psychological items examined among the different sub-populations. Let us try to explain the reasons for these differences for each measured variable.

10.2.1. Differences in motivational orientations

In this part I will discuss the reasons for the significant differences in the results of learning-, approach-, and avoidance motivation in the different sub-populations.

10.2.1.1. Significant interactions in learning motivation

Gender was not a significant variable in any of the analyses of learning goals. In the relevant literature there is a debate between those who found no gender differences in motivational styles (e.g. **Miller et al., 1996; Rogers et al., 1998**) and those who found that girls had a higher level of learning motivation than boys (e.g. **Patrick, Ryan, & Pintrich, 1999**). In Israel no research was done in before regarding motivational orientations in mathematics among junior high school graders. Having no hypothesis concerning gender differences in learning motivation this result was neither expected or a surprise. Its main importance is to serve as a first brick of building a theoretical ground for motivation study for Israeli students in general, and in the subject of mathematics – in particular.

As expected, Jews scored lower than Muslims in learning motivation. Both Jews and Muslims experienced decrease in learning goals from grade 7 to 8, but while among Jews there was an increase from grade 8 to 9, among Muslims there was a decrease between these two grades. This might indicate that Muslims are more vulnerable to the transition from elementary to junior high school, and indeed – the other indication for this vulnerability has been the double dropout rate among Muslims than among Jews (**Statistics, Israel, 2002a**). In grade 9 the level of learning goals was similar among Jews and Muslims – probably because at this grade decisions about the future level of learning mathematics are being made, and achievements become more important than any other component connected to mathematical education. In grade 10 the level of learning goals increased substantially among Muslims – probably because only Muslim girls have participated in the study. Among these girls – all learning in single-sex classes – learning for the sake of learning was considered both important and popular more than in any other sub-group, as can be seen from the results of “preference of afternoon math classes”, where Muslim 10th grade females scored 5.11 on the 1-6 Lickert scale, the highest of all sub-groups.

The fact that secular boys adopted a lower level of learning goals than religious ones might be caused by the "Li'shma" ["for its own sake"] religious value

(***Mishna, Nezikin, Avot,* 1988**), used mainly for learning of the holly scripts in religious schools, but applied in other areas as well. The lack of the "Li'shma" value from the general education system, and the materialistic values typical to secular schools – especially those located in high socio-economic status areas, as the *Alliance* one, might explain this difference.

> The decreasing learning goal motivation among secular boys and its almost steady level among religious ones can also be explained by the value of "learning for its own sake" which serves as one of the basics of religious education.

The fact that among girls differences between secular and religious students regarding learning goals were small is probably because girls in general tend more than boys to adopt learning for the sake of deepening their level of knowledge.

Maehr, & Anderman (1993) have found, that the amount of variance in motivation explained by school culture not only increased from grade 6 to 8 and from grade 8 to 10, but the increase doubled between grade 8-10 than betwen grade 6 and 8. I have found – as expected – that learning goals were decreasing gradually during grades 7-10.

The decrease in learning goals from grade 7 to 8 among secular girls can be explained by the low value of learning for the sake of learning in general, and the low value of learning mathematics in particular. The increase from grade 9 to 10 has been influenced mainly by Muslim girls – consisting about two thirds of 10th grade girls learning in secular institutions, who scored as high as 5.11 on the 1-6 Lickert scale for leaning motivation.

<u>In summa</u>: Gender per se had no main effect on learning motivation. We can conclude that as expected, age in general decreases the adoption of learning goals, especially during the critical time of grades 7-8.

<u>10.2.1.2. Significant interactions in approach motivation</u>

No gender differences per se were found – in accordance to what was expected.

Israeli Muslims belong to a lower average SES than Jewish Israelis (**Semyonov & Lewin-Epstein, 1987; Semyonov et al, 1998, 1999)**. The fact that no significant difference regarding approach motivation was observed between Jews and Muslims might seem a contradiction to the hypothesis, according to which students from lower SES suffer from a reduced motivation to succeed (**Van Laar, 2001; Van**

Laar, & Sinadius, 2001). The explanation of my finding has probably to do with the fact, that the vast majority of Israeli Muslims learn in Arab institution, and thus the socio-economic group they compare themselves to is other Arabs – in most cases Muslims as well – rather than Jews. Research on social comparison has shown that people tend to compare themselves to those in their immediate neighborhood rather than to the larger society around them (e.g. **Rovner, 1981; Simmons, 1978**). As a result, in spite of the many disadvantages of the segregated education system, it seems to protect self-esteem, and minimize self-handicapping (e.g. **Midgley, Arunkumar, & Urdan, 1996; Midgley, & Urdan, 1995, 2001)**. That explains that <u>in my tudy Jews were lower than Muslims in approach motivation</u>. As expected (**Mittelberg & Lev-Ari, 1999**), Jewish boys had higher level of approach goal motivation than girls; among Muslims it was the other way round **(ibid**).

The fact that secular boys were lower in approach goals than religious ones might be because religious boys are expected, even more than secular boys, to perform well in schools by their families. That has to do with the special value traditionally attributed to education in state religious schools, that "combine religious instruction with a variety of secular subjects" (**Ayalon & Yogev, 1996, p. 11**). For males the demand in doubled:

> The worldview of *Torah im derech eretz* [Torah, the Pentateuch, with a profession, literally: an "earthy" occupation/business] attaches importance to the preparation of students for secular vocations, especially through the pursuit of higher education (**ibid, p. 16)**.

The decrease of approach motivation from grade 8 to 9 and 9 to 10 among religious boys might reflect their becoming similar to secular boys, namely, the influence of their home education and their adoption of general standards and ways of behavior. Taking into account that a high percentage of the *Zeitlin* religious school either come from non-religious homes or become non-religious during their high school years, it is quite understandable why religious boys in my study have behave, in many aspects, gradually more like secular ones.

Among religious girls approach goal motivation decreased between each pair of subsequent grades. This might point at a socialization process, when the population most influenced is the more traditional one. The increase in approach goals from grade 9 to 10 among secular girls is mainly because of the 73 *Hadige* Muslim girls whose mean approach goal motivation was 5.34 in the 1-6 Lickert scale, significantly higher than 10th grade Jewish girls (4.32) and even boys (4.54).

A gender difference in approach goals favoring boys has been opened – as found in my study – some time during grade 7. While in the beginning of grade 7 girls were somewhat higher in approach motivation orientation, as should be expected from their high grades and high participation during elementary school, a decline in their approach goal motivation occurred between grade 7 and 8 while an increase occurred among boys during the same period of time. Thus, in the beginning of grade 8 a gender difference in approach motivation, favoring boys, already existed. This difference was quite steady until the beginning of grade 9, which in Israel is crucial regarding choice of future level of studying mathematics. Thus, in spite of the fact that in the beginning of grade 10 a gender difference favoring girls occurred, many girls might have already found it is too late to study mathematics at the highest possible level because they have already been tracked to a lower level group.

10.2.1.3. Significant interactions in avoidance motivation

In contrast to studies conducted in the 80ies in different contries and to many studies taken place in the US, **Midgley et al (1993, 1998),** and **Shi et al (2001)**, who studied Chinese and American students, I have found that male students were holding a higher level of effort avoidance strategies than females. As no research regarding avoidance motivation has been done among Israeli students, the fact that in my sample boys scored significantly higher in avoidance motivation than girls was neither expected nor unexpected.

Muslims were significantly higher than Jews in avoidance motivation. This might be one of the reasons that in spite of similarity between Jews and Muslims in many psychological and educational components, success rates in the matriculation examinations are much higher in the Jewish sector and dropout rates are much higher among Muslims.

While in grade 7 the level of avoidance motivation among boys in religious and secular classes was quite similar, in grade 10 boys in religious classes were significantly lower than in secular classes. It can thus be concluded, that regarding avoidance motivation being religious was proved to be more adaptive to boys than being secular. When examining, in the next paragraph, whether learning in single-sex or mixed classes significantly influenced avoidance motivation we shall be able to conclude whether it is being religious, or rather – learning in a school with religious values – that contributes to adaptive attitudes regarding avoidance motivation, or it is the class-type, namely, that single-sex classes proved to be more adaptive both for males and females.

Religious girls, who all learnt in single-sex classes, were lower in avoidance motivation than secular ones in general, and in grade 10 in particular. This might be explained by the fact that girls in single-sex classes were not socialized to behave in a "typical feminine" way, and thus did not adopt this maladaptive behavior. Since all 10th grade Muslim females in my study learnt in single-sex classes, and among them avoidance motivation was much higher than among female Jews (3.87 and 3.11 in a 1-6 Lickert scale), we can conclude that the cause of low level of avoidance motivation among religious girls was probably not their class-type, because the same class-type did not result in a low avoidance motivation among Muslim girls.

Class-type did not have a major influence on the level of avoidance motivation in grades 7, 8, and 9, but in grade 10 it did. In grade 10 avoidance motivation was higher in single-sex classes than in mixed-sex classes. The reason for this result is probably that more than two thirds of the girls examined were Muslim. Among them avoidance motivation was higher than among Jewish girls, as I have already shown.

Avoidance goal orientation decreased with age. It reached its highest level in grade 7 and its lowest – in grade 10. The explanation for this phenomenon might be the influence of transition from elementary school to junior high school, which is, according to many studies (e.g. **Anderman & Maher, 1994**; **Anderman, & Midgley, 1998**; **Middleton, & Spanias, 1999; Midgley, 1993; Midgley, Anderman, & Hicks, 1995; Midgley, Feldlaufer, & Eccles, 1989; Midgley, & Urdan, 1995)** maladaptive for many students, regarding many educational and psychological aspects.

10.2.2. Differences in achievement and aspirations

No significant gender differences either in expectations or in actual grades were observed in my study. This contradicts the findings according to which females tend to expect lower grades than males even when their actual performance is no lesser than that of their male peers (e.g. **Licht, & Dweck, 1984; Dweck, 1986)**.

Daly, & Shuttleworth (1997) have found that between 1980 and 1991 girls in Northern Ireland were closing math performance gaps with boys. In a research done by **Wolters & Pintrich (1998)** among American 7th and 8th graders, girls achieved higher than boys in mathematics, as in other subjects. In Israel girls have achieved a higher average than boys in 26 out of the 27 matriculation subjects in the 2000/1 school year **(Eshet, 13.12.2002; Travelsi-Hadad, 1.6.2002)**, including mathematics and all scientific and technological subjects. In light of these findings it was quite surprising that no significant difference favoring girls regarding either expected of actual math grade were found in my study.

It is interesting, though, that while in grades 7 and 8 boys outperformed girls, in grades 9 and 10 girls outperformed boys. These results contradict the hypothesis of selectivity according to which as the level of learning gets higher gender differences in achievement become larger (e.g. **Benbow, 1986, 1988, 1992; Leder & Taylor, 1995; Stanley & Benbow, 1986; Undheim et al., 1995**). Nevertheless, this finding might also reflect the fact that in grade 10 all schools already have separate mathematics tracks for better, average, and weak students, and the percentage of girls in the highest level track is 50% lower than that of boys (**David, 2000a, 2000d, 2002a, 2002b**; **Mevarech, 2000; Statistics, Israel, 2001a**), which is connected to higher grades for girls.

Religion plays an important role on the individual's life (**Batson, Schoenrade, & Ventis, 1993; Erickson, 1992; Markstrom, 1999; Peterson, & Roy, 1985)** in general, and in Israel – in particular. As already explained, about 40% of the Israeli Jewish population prefer to send their children to institutes belonging to the religious education system, while a large amount of the non-Jewish population, especially the largest minority – the Muslims have become gradually more religious. Some examples to this phenomenon are:

- The mayor of Um el-Fachm, where I conducted the Arab part of my study, resigned in the year 2000 in order to serve as the head of the fundamentalist Islamic movement (**David, 2002c**);
- During the month of Ramadan every year less and less children – even as young as 8-10-year old – are seen eating in the streets;
- The number of young females covering their heads increases among Muslims. In the school year 2001/2 15-40% of the 12-15 year old girls of the *El-Razi* mixed junior high school already covered their heads; in the *Hadige* high school for girls this percentage was about 75 (**ibid**);
- A sight quite common just a few years ago, of a female Arab in a traditional

dress sitting in a restaurant or even in a coffee house, has become very rare in the late 90ies;

- In 2001 a large mosque has been built lately in Nazareth, one of holiest cities not only to the Israeli Christians but also to pilgrims from all over the world.

However, unlike as is the case with the Ultra-Orthodox Jews who object to higher education in state institutions, it has been argued by many Arab educators that Islam does not object to education in general and to higher education for females in particular. Thus, a special importance would be on studying the role of religion and the level or religiosity regarding mathematics – which is the key to advancement in all scientific and other high prestige areas.

As expected, Jews received significantly lower grades in math than Muslims. It seems that Muslim teachers tend to give unrealistically high grades to their students, and thus impair their abilities to strive towards higher achievements. One of the results of this tendency can be demonstrated by the high percentage of examinees in the matriculation examinations in the Arab sectoer, coupled with the high percentage of failures among Arabs in general and non-Christians in particular (e.g. **Sa'ar, 10.7.2002; Shachar, 26.11.2001; http://www.cbs.gov.il.shnaton53)**.

It should be mentioned that religion was found to influence also elsewhere. For example: **Daly, & Shuttleworth (1997)** have found religion small effects in a study of Catholics and non-Catholics from North Ireland and Great Britain. **Riordan (1985, 1990)** and **Harris & Riordan (1997)**, as well as **Baker & Riordan (1998)**, and **Greeley (1998)** have studied the implications of Catholic education in the US on students' achievements. In general religious schools have proven more successful than schools belonging to the public sector.

Both actual and expected grades decreased from grade 7 to 8 and from grade 8 to 9. This is probably the result of the perception of mathematics as a difficult subject, one that is becoming more and more difficult when getting older. Mathematics serves in the Israeli high school as a tracking mean, namely, those who do well in it are allowed to choose the more prestigious tracks for the matriculation examinations (**Ayalon, 1994, 1995; Ayalon & Yogev, 1997**). Teachers do not hesitate to let many students fail in mathematics so that they will be forbidden to choose a scientific track. Between grade 9 and 10 an increase in math grade has been found; it might be that teachers feel they do not need to fail students any more. They rather believe that from now on they should help their students achieve high grades in order to be perceived as "good" teachers.

A case study: The *Zeitlin* and *Alliance* junior- and high schools

As has already been described, *Alliance* is a highly selective school, while *Zeitlin* is the only State Religious School in Tel Aviv for both boys and girls. In addition, most of *Zeitlin* students are of Asian-African origin, and they live in the less well-off parts of Tel Aviv, while the *Alliance* students are mostly of European-American origin, living in the northern part of Tel Aviv and belong to a higher socio-economic class. No wonder that at the beginning of grade 7 a substantial significant grade difference between students of these two schools was found. It is remarkable, however, that within one year this difference almost disappeared, and in grade 9 there is already a grade advantage to the *Zeitlin* students over the *Alliance* ones.

10.2.3. Differences in valuing mathematics

Mixed results as to the existence of gender differences in valuing mathematics have been found. **Eccles et al (1993**) and **Wigfield et al (1991)** have found that boys valued mathematics more than girls; **Anderman et al (2001**) found no such differences. In Israel **Mittelberg & Lev-Ari** (1999) found that Arab girls have tended to value mathematics more than Jewish ones. Among Jewish students gender differences regarding valuing mathematics were found (**ibid**), while among Arabs no such differences were observed. **Eccles, & Jacobs (1986)** have found that valuing mathematics was one of the major factors explaining gender differences in mathematics achievements. I have found no gender differences per se in valuing mathematics.

As expected from the **Mittelbeg & Lev-Ari (1999**) study, in my research Muslims valued mathematics significantly more than Jews. This finding has probably to do with the belief of members of a deprived minority can improve their economic and social situation by education (**Al-Haj, 1995; Semyonov, Lewin-Epstein, & Brahm, 1998, 1999)**.

In my study the religious students valued mathematics more than secular ones. The difference in valuing mathematics was much larger between religious and secular boys than between religious and secular girls. This might be the result of both the commitment of the religious boy to excel in school, especially in a subject as important as mathematics, so as to secure his professional future and help him function as the main breadwinner of his intended household. Secular girls did not differ substantially from religious ones in this regard. The reason could be either because they were more mature than boys their age and thus understood better than them the importance of mathematics as the filter for future desired professions (**Ayalon, 1994, 1995, 2000; Ayalon & Yogev**, **1996; David & Zorman, 1999; Rekdal, 1984; Sells, 1973, 1981)**, or because they were striving towards professions non-typical to their gender more than religious girls, and as a result valued mathematics comparatively high.

Unlike in many other places, in Israel single-sex classes are practically no option for students studying in the general education system (**Ayalon & Yogev, 1996, 1997; Sa'ar, 20.5.2001**). However, both the results from the few single-sex schools functioning mainly in the non-Jewish sector (e.g. **David, 2002c**) and the scarce occasions where single-sex classes were opened in the general education system, mainly for studying mathematics and physics (**Sa'ar, 20.6.2001; IlIl Shachar, 7.3.2002**), it was expected that single-sex classes would be more adaptive, at least for girls. Thus, it is no surprise that in my study <u>students learning in single-sex settings valued mathematics significantly more than those learning in mixed classes</u>. I have also found that the advantage of single-sex- over mixed-sex classes increased with the grade, namely, while in the beginning of grade 7 valuing mathematics was similar for students learning in mixed-sex- and single-sex classes, a substantial decline in valuing mathematics in mixed-sex classes between each pair of subsequent grades caused an increasing gap in valuing mathematics between these two class-types.

As was already mentioned, <u>single-sex classes proved to be more adaptive regarding valuing of mathematics for boys as well.</u>

The decrease in the valuing of mathematics between each pair of subsequent grades has probably to do with the age of adolescence: learning mathematics becomes less popular in general, and in the Israeli culture in particular (e.g. **Bredenstein, 23.12.2002**).

In addition, while among Jews the decline of valuing mathematics continued during all four examined grades, among Muslims there was an increase in valuing mathematics in grade 10. Since in my sample there were only 10^{th} grade Muslim girls, this increase was due to the high level of 10^{th} grade female Muslims of valuing math: 5.02 in 1-6 Lickert scale, in consistence with the **Ayalon (2000**) and **Mittelberg & Lev- Ari (1999**) findings

10.2.4. Differences in believability in own math abilities

In my study a gender difference that favored boys was found in believability in own math abilities. Believability in own math abilities has proved to be the major motivational components influencing both participation and achievements in mathematics (e.g. **Brew et al, 1996)**. Results of studies examining gender differences in math self-efficacy or believability in own math abilities are mixed, depending mainly on time and place. For example: **Marsh (1989**) found differences favoring boys among high school American students. The general tendency is towards declining of such gaps with time; however, **Fredricks & Eccles (2002**) have found they still existed in 2001 in a sample of 514 American first through 12th grade students.

The disappearance of gender differences regarding believability in own math abilities depends also on where the study took place. According to **Wolters, & Pintrich (1998)**, in the USA such differences have started to disappear. In the Far East they have disappeared in most countries and in most subjects studied, including mathematics. On the other hand in some European countries, mainly in the "Germanic" ones: Germany, Austria, Switzerland, Holland (e.g. **Vermeer et al, 2000**), and Denmark they still exist.

Jews scored higher than Muslims in believability in their own math abilities **Mittelberg & Lev- Ari (1999**). This might be one of the reasons that in spite of the Muslims' advantage over Jews in school grades they score lower in objective examinations like national feedback exams (e.g. **Aviram et al**, **1998a, 1998b)**, and their matriculation success rates are lower **(Statistics, Israel, 2002a**).

As was expected from both the **Mittelberg & Lev-Ari (1999**) research the gender difference that favored boys in believability in their own abilities was substantial among Jews, while among Muslims a non-significant gender difference that favored girls was found.

Religious students believed in their own math abilities more than secular ones. Religious boys believed in their math abilities more than secular boys, and religious girls – more than secular girls.

In 7th grade of the *Zeitlin* religious junior high school students were significantly lower than secular ones in their believability in own math abilities, probably because most of the religious students of my sample have graduated from low prestige elementary schools. In grade 8 a gap favoring religious students was opened; in grade 9 this gap increased. The significant difference found in grades 8 and 9 between religious and secular settings regarding believability in math abilities might have a crucial importance on classroom- and report math grades, and thus on the decision what level of math the students will study in the future. In grade 10 the gap almost closed, namely, religious students were still higher than secular ones in believability in own math abilities, but not significantly.

In any case, since in grade 10 all students have already chosen how much mathematics they intended to study for the matriculation exam the influence of believability in math ability though important for the students' grades had no importance for their chosen level of mathematics.

Both boys and girls in single-sex classes scored higher in believability in their own abilities than students in mixed-sex classes. This finding contradicts one of the main cones used in the debate of single- versus mixed-sex classes, namely, that single-sex classes might have positive influences on girls on the account of negative ones on boys (e.g. **Jimenez & Lockheed, 1989)**. However, the advantage for girls in single-sex classes regarding believability in their own math abilities was larger than for boys.

In addition, the advantage of single-sex classes over mixed-sex one is larger in grades 8 and 9 than in grade 10. As already explained, during grades 8 and 9 future academic plans are made in Israel, and thus this advantage is maximal in this important educational junction.

This finding was in accordance with the **Cipriani-Sklar (1997)** study, that 9th grade American girls learning in single-sex classes had a significantly positive higher math self-concept than girls attending co-educational settings. **Rowe (1988**) has also found, among grade 7 and 8 Australian students, that class-type was the only demographic component influencing confidence of both male and females students in their abilities.

Believability in own math abilities decreased significantly – as expected (**Fredericks & Eccles, 2002**) – from grade 7 to 8 and 8 to 9. At the beginning of grade 7 most students have positive feelings about learning math: in elementary school they normally do not fail in this subject, and their future professional success in not threatened by it. In grade 7 they learn the importance attributed to mathematics and many of them experience failures in this subject. As a result their belief in their abilities deteriorates. This tendency continues until grade 9, when decisions about tracking are made. In grade 10 each student is tracked into the level found most suitable for her or him. For many girls this track is in a lower level than their actual abilities (e.g. **Mevarech, 2000**), and this contributes to an increase in believability in their own abilities.

10.2.5. Differences in mathematical helplessness

A vast amount of literature about gender differences in learned helplessness in general and mathematical helplessness in particular has been written. The findings of these studies vary with age, culture, domain, background, and other environmental and cultural components. Some support the assumption that mathematical helplessness is higher among females than among males (e.g. **Dweck, & Bush, 1976; Dweck et al, 1978, 1980**), but others contradict it (e.g. **Ziegler et al, 2002**). **Valas (2001**), who conducted his research in Norway, and **Leo & Galloway (1994)**, and **Rogers et al (1998)**, whose studies took place in England, found a higher level of academic helplessness among boys. The majority of works studying helplessness conducted until the mid 80ies found that academic helplessness was higher among girls, while those conducted in the 90ies and later found no gender differences regarding academic helplessness in general (e.g. **Blair, 2000; Rozell et al, 1998**) and in mathematics in particular (e.g. **Lee, 1999**).

In my study girls were somewhat higher than boys in mathematical helplessness. This finding can be explained by characteristics typical to the Israeli culture, that on the one hand is very "westernized", namely, the law regarding gender equity is considered advanced not only by most European criteria, but by American ones as well (e.g. **Swirski, Safir, 1991)**, but on the other it is substantially influenced by the tradition of the two dominant male institutions: religion, whether Judaism or Islam, and the army **(e.g. Jerby, 1996; Ziegler, David, in press)**.

The fact that Muslims scored significantly higher than Jews in mathematical helplessness might also be one of the reasons for their relatively low achievements in objective tests. Muslims were higher than Jews in math helplessness in all grades; the largest difference was in grade 9, the most important grade regarding future tracking and the most vulnerable for Muslim boys regarding dropping out of school (**http://www.cbs.gov.il.shnaton53**). Taking into account the low level of Muslims in comparison to Jews in national feedback exams and in the matriculation examinations, math helplessness can be perceived as a natural reaction to the educational situation.

Secular students were found to be more mathematically helpless than religious ones. In grade 7 the level of helplessness was similar between these two groups, but while among religious students the level of helplessness declined from grade 7 to 8, it increased among secular ones. The maximal difference between secular and religious students regarding helplessness occurred in grade 9, the most important stage for future decisions about participation in high-level math. Both among secular and religious students the level of mathematical helplessness decreased in grade 10, but its level still remained higher among secular students than among religious ones. This difference favoring religious students goes in lines with those already found, namely, that religious education was found to be more adaptive than secular.

As found in all other maladaptive behaviors, students in single-sex classes were significantly lower also in math helplessness than students in mixed-classes. The largest difference was found in grade 9, the most important one for future decision regarding participation in high level mathematics. However, as already mentioned, further research is needed in order to find out whether this finding was the result of the class-type, religiosity, or both.

Girls scored lower than boys in mathematical helplessness in grade 7, probably as an influence from elementary school where girls – including high ability ones – outperformed boys in all subjects **(Callahan & Reis, 1996; Ziv, 1990)**. In grade 8 girls were significantly higher than boys in math helplessness. The explanation for this lies probably in the junior high school environment, that in many cases in not adaptive for girls who wish to specialize in math and science, but rather stress social success and conformity. It has also to do with the legitimization given to girls but not for boys to drop out of high-level mathematics, frequent mainly in general, secular education institutions. In grade 9 there was a sharp increase in boys' math helplessness, probably due to the objective difficulty of the material learned, as well as the pressure to do well in order to be able to choose the high-level math track in high school. A much milder increase of math helplessness was observed among girls, probably because of the lesser pressure on them to excel in order to have the possibility to choose a scientific track in high school. As a result gender differences in mathematical helplessness disappeared in grade 9. In grade 10 a gender difference favoring boys was re-opened. Unfortunately the largest gender difference favoring boys in math helplessness occurred in grade 8, when it might be connected to loss of mathematical self-concept, achievements decline, and dropout of high-level mathematics. The reduced level of math helplessness in grade 10 is in accordance with girls' better grades both in school and in the matriculation exams; however, in grade 10 it is usually too late to change a track to a more prestigou one even when excelling.

<u>10.2.6. Differences in believing in incremental versus rigidity of mathematical intelligence – IPT</u>

Leggett (1985), Midgley et al (1993, 1998), and **Shi et al. (2001)** have found that male students believed more than females that intelligence could be changed. <u>In this study I have found no gender differences regarding Intelligence Personality Theories</u>.

<u>Jews believed more than Muslims in rigidity of math intelligence</u> (2.44 versus 2.12 in 1-6 Lickert scale), as was expected (**Ayalon, 2000; David, 2002b; Mittelberg & Lev-Ari, 1999**).

<u>Secular students were</u> – as in many other maladaptive measures – <u>less adaptive than religious</u> <u>ones regarding IPT</u> (2.40 versus 2.21 in 1-6 Lickert scale). This difference among boys was significant and large: 2.52 versus 2.17 in 1-6 Lickert scale. Among girls the difference was small and insignificant: 2.29 versus 2.24 in 1-6 Lickert scale.

<u>Gender differences favoring girls were observed among secular students regarding IPT. No such significant difference was observed among religious students</u>. It seems that minority girls: religious, Muslim (e.g**. Mittelberg & Lev-Ari, 1999**), or those learning in single-sex settings behave more like majority boys, in our case – boys learning in secular classes. The "minority within minority" theory (**David, 2002b)** described in the Israeli educational system and elsewhere proved indeed to be double-edged. On the one side members who belong to this group might suffer from a double discrimination, but on the other – since they don't have to conform to the minority rigid norms, they feel in many times free to act as the majority group, mainly when social norms are at stake.

<u>Students in single-sex classes were more adaptive regarding IPT than those in mixed-sex classes</u>. In addition, while in mixed-sex classes a gradual increase in belief in rigidity of intelligence was observed from grade 7 to 10, in single-sex classes no such tendency was observed. It seems that students of both genders in single-sex

classes were more adaptive regarding IPT, namely, they believed more in changeability of math intelligence.

Believability in rigidity of math intelligence increased from grade 7 to 9. The reason has probably to do with the increasing competition in the classroom and with the policy of many schools – especially secular – not to allow students who do not study high-level math to choose a scientific track (**Ayalon, & Yogev, 1996; David, 2000d)**. The decrease in IPT in grade 10 was influenced by the 73 *Hadige* Muslim girls who scored the lowest among all sub-groups – 1.85 in the 1-6 Lickert scale – in holding a rigid theory of math intelligence.

In grade 7 girls were much lower than boys in believing in rigid theories of intelligence. In grade 8 – when in most schools deciding about participation in high-, average-, or low-level math classes takes place; a gap that favored boys was opened. In grade 9 this gap closed, namely no significant gender differences have been observed, and in grade 10 such differences favoring girls re-opened. Though girls had an advantage over boys in grades 7 and 10 at the crucial point of grade 8 boys had an advantage, and that might influence the decision of many girls not to take the highest-level math courses.

10.2.7. Differences in stability of math abilities

The fact that Jews believed more than Muslims in stability of math abilities is double-edged regarding math achievement: on one hand, the belief that math abilities can improve helps motivating students (e.g. **Dweck, 1999; Dweck, Chiu, & Hong, 1995a, 1995b)**. On the other hand, exaggerated self-confidence and believability that one can get high grades might impair potential achievements when reality contradicts this belief. In the case of Muslim students it seems, that the gap between their own belief in their abilities and their actual low achievements should be treated by changing their learning techniques and help them be more self-regulated rather than change their belief about their math abilities.

Religious students did not believe as highly as secular ones in stability of math abilities (2.56 versus 2.73 in 1-6 Lickert scale). A similar finding was observed in other traditional societies (e.g. Chinese **– Salili, 1995; Salili, Chiu, & Hong, 2001a, 2001b)**. Judaism has explicitly recommended investing effort in order to improve oneself, as stated in **the *Mishna***:

> Rabbi Tarfon used to say: “The day is short, the work is numerous, the workers are

> lazy, and the boss is pushing them". He said: "You do not have to finish the work, but you are not free to be idle" (***The Mishna, Nezikin***, **Avot, Chapter 3, 15-16**).

Thus, in religious schools students are pushed towards exhausting their abilities, rather than believing that there is no use doing it because of stable abilities.

As expected, students in mixed-sex classes were higher in believing in stability of their math abilities than those learning in single-sex classes. Unfortunately there is not enough information to distinguish whether this result was due to the class-type or to the religiosity level. Also as expected, believing in stability of math abilities increased from grade 7 to 8 and 8 to 9.

While among Jews there was a gradual increase in stability in math abilities from grade 7 to 10, among Muslims, who scored in the 1-6 Lickert scale 0.26 point lower than Jews in stability of math abilities in grade 7, the increase from grade 7 to 9 was more than double than among Jews. Thus, in grade 9 Muslims scored already higher than Jews in stability of math ability. This finding is in accordance with the high dropout rate among Muslims, reaching its maximal point after grade 9. In grade 10 the picture was reversed: the level of stability of math abilities was 0.41 point higher among Jews. Since the only Muslims in grade 10 were females from the single-sex *Hadige* school it is not clear whether their learning in single-sex classes or other factors typical to this school were responsible for their low belief in stability of math abilities. In any case, 10th grade Muslim girls scored 2.41 in the 1-6 Lickert scale, the lowest of all examined sub-groups.

10.2.8. Differences in mathematics anxiety

Eccles, & Jacobs (1986) have found that mathematics anxiety was one of the major factors explaining gender differences in mathematics achievements. In my study, boys had a higher level of math anxiety – maybe because math has such a great influence on students' future. In Israel it is quite acceptable for a girl to take the 4-point level math classes, or even the lowest one; that is not the case with boys (**Ayalon, 1994)**.

Muslims had a higher level of math anxiety than Jews – probably because of objective lower achievements, and their perceiving mathematics as means for a better education and future. Competition on the labor market is much more difficult for non-Jews (e.g. **Abu-Saad, 1999**; **Al-Haj, 1995; Semyonov & Lewin-Epstein, 1987; Semyonovet al, 1998, 1999**), thus math anxiety, when there is so much at stake, was expected to be higher among Muslims than among Jews. The significantly lower level of math anxiety among female Muslims than among males was also expected because of: 1. The relative high educational level of Muslim girls **(Ayalon, 2000; David, 2000d, 2002a, 2002b; Mittelberg & Lev-Ari, 1999)**; 2. The limited participation of Muslim females in the labor market **(Perl, 27.12.2002; Semyonov et al, 1998, 1999)** decreases pressures to succeed in mathematics for acquiring a prestigious profession.

In my study religious students were less math-anxious than secular ones. The reason might be that in religious schools religious subjects are considered as important as scientific ones; thus not doing very well in mathematics does not necessarily influence either the social or educational standing of the student (**Ayalon & Yogev, 1996**). In addition, in a religious school it is possible to learn many scientific subjects without taking the highest-level classes offered in mathematics; thus, a student who is not so bright in mathematics can still choose a scientific track (**Ayalon, 1994; Ayalon & Yogev, 1996, 1997)**.

The fact that among secular boys math anxiety increased from grade 7 to 8 and 8 to 9 and decreased from grade 9 to 10 has probably to do with the tracking system taking place both in *Alliance* and *El-Razi* junior high schools. Boys are expected to learn high level mathematics, and by the end of grade 9 it is already clear who are those who will make it and who will have to compromise for a lower track. Thus, between grade 9 and 10 anxiety is expected to decrease, as striving for higher achievement does not usually influence a track change.

The decrease in math anxiety among religious students from grade 8 to 9 and the increase between grade 9 and 10 has also to do with the special factors of the *Zeitlin* high school. As we have already explained, most of *Zeitlin* students come from low socio-economic neighborhoods, and many experience psychological and educational difficulties at the beginning of grade 7. Those surviving these difficulties get support from the school staff, and they are encouraged to stretch their potential. However, since in *Zeitlin* tracking takes place at the end of grade 8, and since many boys are pushed to learn in the highest level math track, they are exposed to math anxiety more than in schools where higher achievements are needed in order to be allowed to take the 5-point math matriculation exam. And indeed, one of the results of the school policy to let even average students take the 5-point level math matriculation exam is that it is quite common in this school to move to a lower math track in grade 10 and even 11. This phenomenon – quite uncommon in other municipal schools – might contribute to the increase of math anxiety after the tracking of math learning.

The increase of math anxiety among secular girls from grade 7 to 8 and from grade 8 to 9 is in accordance with the literature about the increase of math anxiety among female students both in Israel and abroad **(Ben-Zur & Zeidner, 1988; Carr, 1996; Cramer, 1989; Hyde, 1993**; **Lupkowski & Schumaker, 1991**; **Osborne, 2001; Zeidner, 1996a, 1996b)**. It should be mentioned, though, that unlike in all other measured factors, where Muslim girls were more adaptive than Muslim boys and Jewish girls, Muslim 10th graders scored 3.04 in math anxiety, higher than any Jewish sub-group. That might explain the fact that in spite of the fact that *Hadige* is one of the best Muslim schools in Israel **(David, 2001c)**, only five of its students chose in the year 2000/1 to take the most prestigious combination: the 5-point math and the 5-point physics exams **(ibid)**.

Among religious girls math anxiety increased substantially from grade 7 to 8. This is understandable when we take into consideration that in grade 7 religious girls were the sub-group scoring the lowest in math anxiety among all examined (2.26 in the 1-6 Lickert scale). It should be noted, though, that even after the substantial increase between grade 7 and 8 religious girls still scored lower than secular ones. This can be explained by the fact that unlike the vast majority of the *Zeitlin* boys, many of the *Zeitlin* girls are graduates of better, "northern" schools, and thus adopt achievement orientation motivation, that contributes to math anxiety. It can also be that the "minority within minority" principle is applied here, namely, that the *Zeitlin* girls wish to be accepted to high prestige university departments, as is among both religious and secular males, and less among "more-socialized-to-behave-in-a-'feminine'-way" secular girls. This assumption can be confirmed when surveying the list of *Zeitlin* graduates who have become public figures in the Israeli society (**http://www.zeitlin.tlv.k12/boger.html**): females are more than 40% of the outstanding graduates.

A large decrease in math anxiety occurred among the religious girls of my sample between grade 9 and 10. The reasons might be connected to the tracking system which is more adaptive for girls: there is lesser pressure on girls to take the highest level math classes offered, to the single-sex setting of the *Zeitlin* school, or to the school values.

Campbell & Evans (1997) conducted the first study in a catholic college preparatory high school among Algebra I students, that "compared levels of mathematics anxiety among females in coed versus single-sex settings" (**p. 333**). The **Cipriani-Sklar** dissertation, published in the same year **(1997**), revealed similar findings: single-sex classes decreased math anxiety among g 9th grade American students. Thus, there was no surprise that in my study males and females in mixed-sex classes were significantly higher in math anxiety than in single-sex classes.

10.2.9. Differences in preference of mathematics afternoon classes

No gender or religiosity difference was found in preference of math afternoon classes. Since no study was done in the general Israeli population about gender or religiosity differences in preference of extra-curricular math activities; this result was neither expected nor unexpected.

Jews scored significantly lower than Muslims in preference of math afternoon classes: 3.33 versus 4.57 in 1-6 Lickert scale.

The increase among Jews from grade 7 to 8 and 8 to 9 cannot easily be explained; maybe the participants wished to "make a good impression" on the examiner. The decline from grade 9 to 10 is quite clear: in grade 10 most students wish to succeed in school assignments, rather than learn for the enjoyment of learning. The decrease observed among Muslims from grade 8 to 9 has been expected, as we know that motivation in general and math motivation in particular declines during junior high school. The large increase from grade 9 to 10 is because of the *Hadige* girls, who scored the highest among all sub-groups regarding preference of afternoon math classes – 5.11 in the 1-6 Lickert scale.

As expected, single-sex classes were more adaptive regarding preference of afternoon math classes. That was true both for boys and girls. The explanation for this phenomenon is the same as for other more adaptive behaviors of students in single-sex classes: for girls it is consistent with many studies done both in Israel and abroad, and for boys – with the values of the state religious school.

The reason for the general tendency of decrease in preference of afternoon math classes in mixed-sex classes is probably different for each gender: boys become more interested in achieving highly rather than in extra-curricular activities; girls become more socialized, namely, they reject math as a hobby while identifying it as a male domain.

In light of these findings, and taking into account that the *Zeitlin* students though learning in single-sex classes and getting religious education live in Tel Aviv, the most secular city in Israel, it is quite remarkable that the school influence was proved strong enough to prevent a decline in preference of afternoon math classes.

10.2.10. Summary

The discussed findings are important because of at least two reasons:

1. No other research has been done in Israel taking into account motivational orientations, achievements and aspirations, valuing mathematics, believability in own math abilities, mathematical helplessness, believing in incremental versus rigidity of intelligence, stability of mathematics abilities, mathematical anxiety, and preference of afternoon math classes.
2. No other research has taken into account three of the main Israeli sub-populations:

I. Jews learning in the secular education system;

II. Jews learning in state-religious schools;

III. Muslims learning in state-secular schools.

Let us not forget that in Israel there is no "majority" sub-population: more than 50% of its population is either non-Jews or religious Jews that learn in separate educational systems. Of those learning in the Jewish general state school about 20% are new immigrants from the ex-USSR; a substantial part of them continue their mathematical, scientific, and sometimes Russian and literary education in afternoon special courses. Thus, any research done on "Israeli" school students has been limited to a maximum of two minorities included in the body named: "the Israeli student". Thus any research done on "Israeli" school students has been limited to just one or in some cases – two minorities. Here for the first time three sub-populations are examined simultaneously.

Let us summarize the influence of gender, religion, grade, class-type, and religiosity on the educational-psychological and motivational – "Grand 10" measures:

Gender proved to be the least influencing demographic characteristic on any of the motivational, psychological, and educational measures regarding the learning of mathematics. However, gender did play a role when other demographic (religion, religiosity, and grade) or class-type ingredients were taken into account. Thus, although no significant main effect was found for gender in 8 out of the 10 measured components, it can be concluded, in paraphrasing of **Maehr (2001): Goal theory is *NOT* dead – Not yet, anyway – "**Gender theory is not dead yet – And it does not look as if it is going to die"!

Grade had a direct significant influence on 8 of the measured components (except for approach motivation and preference of math afternoon classes) as well as at least on one of the motivational and psychological-educational components measured in 6 of the 7 sub-groups when taking into account gender, class-type, religion, and religiosity. This result was no surprise; both because of what is known about changes adolescents go through, especially from entering junior high school until finishing it, and because of the special conditions under which the Israeli school has to function.

Religion had a significant influence both directly, on ALL measures studied in this research, and as was expected – on four measures: math anxiety, believability in own math abilities, approach motivation, and mathematical helplessness when interacted with gender. This result was no surprise. We have already shown, that while educational achievements of Jews who study in secular institutions are very similar to those of students learning in state religious schools, that is not the case with non-Christian Arabs. In addition, though the study was done in two cities – Tel Aviv and Um el-Fachm, these two cities are very different from each other. Tel Aviv is the largest Israeli city; it offers many educational and cultural opportunities both to its resident students and to those learn in it and living somewhere else. Um el-Fachm is located close to the Palestinian border, it is not an affluent town, and since October 2000, the beginning of the present *Intifadah*, it has suffered economic deterioration because of the recession in general and because Jews have stopped doing business with Muslims in particular.

The fact that the grade proved to be an oppressive variable, namely, that when grade was taken into account the "gender*religion" cut, significantly influencing math anxiety, believability in own math abilities, approach motivation, and mathematical helplessness had no significant influence on any of the 10 psychological-educational or motivational measures, can be explained by the high level of school dropout of Muslims, especially boys. While girls have proven to be more adaptive both to school in general and to the political-economic situation in particular, many Muslim boys become less involved in school when getting older. Those who stay in school and invest energy in learning are probably less influenced by other factors, including the educational-motivational and motivational measured factors.

In spite of the fact that in the Jewish population all religious classes were single-sex and vice versa, Religiosity and class-type proved to influence the psychological-educational and motivational components measured in my study somewhat differently. Class-type had a significant influence on all components measured but approach motivation; religiosity had a significant influence – in addition to approach motivation – on avoidance motivation and preference of afternoon math classes as well. When looking at religiosity versus class-type influence on the measured educational-psychological and motivational components, taking into account other demographic characteristics, such as gender and grade, differences become even larger between the influence of religiosity and class-type.

10.3. Discussion of the correlations between each two variables

10.3.1. Introduction

Studying correlations between each two motivational, psychological and educational components influencing the learning of mathematics helps to build the body of knowledge named “the psychology of learning mathematics”. It helps differentiating between weak, mild, strong, and very strong correlations; it helps differentiating between confirmed correlations and prejudices or unconfirmed general knowledge that might be proved false or a least incorrect. In addition, it helps differentiate between unrelated components and significantly related components on the one side, and between significantly related components and redundant ones – those who are very strongly correlated with others and correlate similarly to all other components – on the other.

In the following discussion I have divided the correlations discussed into three main groups: correlations with motivational orientations, correlations with four “maladaptive” components: math anxiety, rigidity of math intelligence – IPT, mathematical helplessness, and stability of math abilities, and correlations with three “adaptive” components: valuing mathematics, believability in own math abilities, and preference of afternoon math classes.

10.3.2. Discussion of the motivational correlations

10.3.2.1. Correlations of learning goals

Learning goals and believability in own math abilities

According to **Dweck (1986)**, children high in learning goals are usually willing to risk being exposed as bad students in order to gain knowledge (see also **Nicholls, 1984b**). According to **Middleton, & Spanias (1999)**, “intrinsic motivation is related to students’ perceptions of their competence in mathematics” (p. 67). And indeed, in the **Seo, & Park (2001)** study learning goals correlated positively with believability in own abilities among Korean 5th graders. Thus, we should have expected a positive correlation between believability in math abilities and learning goals. In my study, however, only weak such positive correlations – correlation coefficient between .3 and .35 – were observed, and only among three of the examined groups: religious students and students in grades 7 and 8. It might be that the 7th and 8th grades students in my study resembled the 5th graders in the **Seo and Park (ibid**) study more than the older students. However, because of the difference found between religious and secular students regarding this correlation, it is evident that culture plays in this correlation a substantial role, and more research is needed in order to explore it in depth.

Learning goals and valuing mathematics

According to **Middleton & Spanias (1999**), “utility and importance are not sufficient to develop students’ intrinsic motivation” (p. 81). Without trying to estimate the sufficiency level, in my study mild to strong correlations were found between learning goals and valuing mathematics: the correlation coefficient was .62 for the general population, and between .49 and .68 for all sub-groups. The largest difference found was between students learning in mixed-sex classes (correlation coefficient: .65) and those in single-sex classes (correlation coefficient: .49); substantial differences were also found between 7th grade students (correlation coefficient: .67) and 9th graders (correlation coefficient: .55). Since class-type and grade proved to be significantly influencing motivational, as well as psychological and educational measures, it is no surprise that interactions between these measures were influenced by class-type and grade as well. As for the question, namely, why such differences were observed between grades 7 and 9, it seems, that like in many other components, the importance of both these grades as transition stages, grade 7 between elementary and junior high school, and grade 9 between junior- and high school, has to do with these relatively large differences in the correlations coefficients.

Learning goals and belief in rigidity of intelligence, and stability of math abilities

Dweck’s (1986, 1999) assumption, according to which children who believe in intelligence as a flexible trait would tend towards learning goals, was confirmed in my study. Though there were differences among the sizes of the correlation coefficients between learning goals and belief in rigidity of intelligence, the minimal correlation was -.45, and for the sub-group “grade 7 students” it was as high as -.66. Substantial differences were observed only in the class-type groups – the correlation coefficient was -.63 for mixed-sex classes and -.45 for single-sex classes – and the two religiosity ones: the correlation coefficient was -.63 for secular- and -.45 for religious students. This, again, might indicate that in my study since all religious classes were single-sex settings and only two secular classes were single-sex it is difficult to differentiate between single-sex and religious classes.

Learning goals were negatively correlated to stability of math intelligence – as expected. In grade 9 a substantial drop in the correlation between stability of math abilities and learning goals was observed: from a correlation coefficient of -.56 in grade 7, and -.52 in grade 8 to -.35 in grade 9 and again to -.51 in grade 10. In addition, the pattern according to which single-sex classes had lower correlation coefficient than mixed-classes (in this case: -.51 versus -.37); Jews lower than Muslims (-.43 versus -.55), and secular higher than religious (-.51 versus -.35) implies also that higher correlation coefficients are connected to a higher vulnerability level.

10.3.2.2. Correlations of approach goals

Learning- and approach goals

There are studies that have found positive connections between learning and performance/approach motivational orientations (e.g. **Dweck, 1999**; **Harackiewicz & Sansone, 2000, Lee, 1998)**. Such were the findings of my study too.

Dweck and her colleagues **(1990, 1991, 1996b, 1999; Dweck, & Bempechat, (1983; Dweck & Legget, 1988)** have found a significant relation between holding an entity theory of intelligence and preferring performance/approach goals. I have found the opposite correlation in my study, though only in 9 of the 13 examined groups. The magnitude of this correlation coefficient was -.30 to -.44, with correlation coefficient -.32 in the general population. The explanation for this result might be that in Dweck's studies the students were given a choice between actual assignments, while in my study students were asked about their opinion about preferring each motivational orientation.

Approach goals were significantly correlated with math anxiety only among the sub-group "males" of the "gender" category; this correlation was low: the correlation coefficient was .33.

10.3.2.3. Correlations of avoidance goals

Avoidance motivation and believability of own math abilities

In contradiction with **Dweck's (1986**) assumption, according to which a negative substantial correlation was to be expected between avoidance motivation and believability in own abilities, no significant correlation efficient larger than .3 was observed between these two ingredients in any of the 13 sub-groups examined. The explanation of this phenomenon might be the culture differences between American and Israeli students that cause them to perceive the meaning of "avoidance" differently. This assumption can be validated by the more than 100 written notes – both in the Hebrew and Arabic questionnaires – protesting severely against the questions connecting peers', parents', and teachers' attitudes towards the student and her or his math achievements. Such protests were, for example: "my friends would never treat me badly because I'm bad in mathematics", "my parents love me unconditionally; my academic achievements have nothing to do with their feeling towards me", or: "my teacher knows I try hard so he would not treat me badly if I don't do well in math". It should be noted that Muslim girls' protests were written more frequently than any other sub-group's.

Avoidance- and approach motivation

Elliot & Covington (2001) have argued, that approach and avoidance motivational orientations are opposite to each other. As such, it should have been expected that the direction of the correlations coefficients found between approach goals and avoidance goals would be reversed. In my study <u>no correlation coefficient larger than .3 was found between avoidance goals and learning goals in any of the 13 examined sub-groups</u>. This result might be explained in the light of the tracking system of the Israeli education system. Learning goals in general do not play such an important role in junior high school, because students learn in order to get into the most prestigious track in high school, or – in worse cases – not to fail math, which might result in being expelled from school. Under such circumstances the relatively low correlations between avoidance and math anxiety might also be explained: there is no choice of avoiding assignments within the track; the result of avoiding given assignments results either in being "pushed" to a lesser track or failing to stay in the school.

<u>10.3.3. Discussion of correlations of math anxiety, belief in rigidity of intelligence – IPT, math helplessness, and stability of math abilities</u>

<u>10.3.3.1. Correlations of math anxiety</u>

Math anxiety: How was it correlated to math helplessness

As expected, mathematical anxiety had significant correlation coefficients, between .48 and .61 with mathematical helplessness. It should also be mentioned, that within each sub-group belonging to gender, religion, religiosity, class-type, and grade, the magnitude of these correlations did not differ in more than .1, namely, they were quite similar.

Math anxiety and avoidance motivation

The result according to which all correlation coefficients between math anxiety and avoidance motivation were larger than .30 was expected too, but the magnitude of these correlations was substantially different for two of the five divisions: religion and grade. Among Muslims math anxiety had a correlation coefficient of .44 with avoidance motivation while for Jews the magnitude of this correlation coefficient was only .30; for 7th graders it was under .30 while for 8th graders – .48. These differences can be explained also by the importance of both religion and grade to the educational circumstances influencing learning in general and learning mathematics in particular. Muslims are more vulnerable than Jews, and thus the combination of the two maladaptive behaviors – math anxiety and math avoidance influence them more than Jews. On the other hand – 7th graders, especially in the beginning of the year when the study was conducted, do not suffer yet from the negative influences connected to adapting to junior high school, and thus are the least vulnerable sub-group regarding math anxiety combined with math avoidance. At the beginning of grade 8, however, after being familiar with mathematics learning in the junior high school, students are much more vulnerable to the influence of avoidance motivation combined with math anxiety.

Math anxiety and belief in rigidity of intelligence

Correlation coefficients between math anxiety and belief in rigidity of intelligence were larger than .30 only in 3 of the 13 examined sub-groups: Muslims, 7th graders, and 9th graders. This was a somewhat unexpected result; it means that only these sub-groups were vulnerable to the combination of these two maladaptive behaviors. However, while it was no surprise that for Muslims the correlation coefficient between math anxiety and avoidance was the maximal – .42 – it was quite surprising that it was almost a high for 7th graders as well.

Math anxiety and preference of afternoon classes

Math anxiety and preference of math afternoon classes were not significantly correlated. The reason might be that some of the high-ability students, those belonging to "high-achieving" group (**Nakamura, 1988**), preferred afternoon math classes for enlarging their knowledge but on the other hand, low-ability students, who were math anxious, needed extra-help in mathematics, and preferred afternoon classes as well, so these different groups compensated for each other regarding the correlation between anxiety and preference of afternoon math classes.

Math anxiety and valuing mathematics

Math anxiety and valuing mathematics had no correlation coefficient larger than |.30| in any of the sub-groups examined.

Math anxiety and believability in own math abilities

Math anxiety had a mild negative correlation coefficient with believability in own math abilities (between -.36 and -.49) for all 13 sub-groups, as expected (**Hilton, 1981; Otten, & Kuyper, 1988)**.

10.3.3.2. Correlations of belief in rigidity of intelligence – IPT

Belief in rigidity of intelligence – IPT, and learning goals

According to **Middleton, & Spanias (1999),** "An individual with a *mastery or learning goal* orientation values the improvement of skill or knowledge in a given domain and believes that success depends on working hard, attempting to understand the domain, and collaborating with others" (pp. 72-73, italics in the original, H.D.). Thus, we would expect negative correlations between learning goal and belief in rigidity of intelligence. And indeed, modest to mild negative correlations were observed in all the 13 sub-groups examined (correlation coefficients between -.37 and -.56) with substantial differences in 4 of the 5 sub-groups examined: class-type, religion, religiosity, and grade.

Belief in rigidity of intelligence – IPT, and valuing mathematics

The largest [negative] correlation coefficients observed were between belief in rigidity of intelligence and valuing mathematics (for the general population the correlation coefficient was -.87; for all other 12 groups the correlation coefficients were between -.80 and -.91). Such high correlations – in all examined sub-groups – require both repeat study and further research.

In summa: we can conclude that beyond the described differences stability of math abilities "behaved" – as expected – like belief in rigidity of intelligence, and in the opposite direction of believability in own math abilities.

10.3.3.3. Correlations of math helplessness

As expected (e.g. **Dweck, 1986**; **Middleton, & Spanias, 1999)**, mathematical helplessness had a high negative correlation with believability of own math abilities (correlation coefficients between -.60 and -.72). Though among all examined sub-groups this correlation was within these borders, gender as well as grade differences in the magnitude of this correlation was observed: it was found that among males the correlation coefficient was -.60 and among female -.70; in grade 7 the magnitude of this correlation was -.61 and in grade 10 -.72.

Believability of own math abilities was found, as I have shown in the previous chapter, to have a gender main-effect favoring boys. Mathematical helplessness was also favoring boys during the critical time of deciding about the math level in high school. Thus, the magnitude of the correlation between mathematical helplessness and believability in math abilities is of special importance to the Israeli student. However, since there are no other studies confirming my findings, it is needed, as a first step towards finding a way to minimize negative influences of this powerful correlation, to confirm these findings.

10.3.3.4. Correlations of stability of math abilities

Stability of math abilities and belief in rigidity of intelligence

Stability of math abilities, though having positive correlation coefficients with believability in own math abilities, as expected, was not perceived as its opposite, as can be seen from the size of these correlation coefficients (for the general population: -.52). However, two sub-populations – overlapping substantially – had large differences in the magnitude of this correlation: while for mixed-sex classes the magnitude of the correlation coefficient was -.55, it was only -.42 for single-sex classes; while for secular students it was -.54, for religious ones it was just -.42. Before investigating the meaning of these differences it should be recommended to separate the religion component from the class-type, namely, to find out what was the influence of religion and what – of the class-type on the secular, mixed-sex versus the religious, single-sex classes regarding this correlation.

Stability of math abilities and math anxiety

As expected, stability of mathematics abilities correlated positively with math anxiety; however, the correlation coefficient was mild, and higher than .30 only among 10 of the 13 sub-groups examined. Muslims appeared to be somewhat more vulnerable than Jews – the correlation coefficient for them was .41, while for Jews just .31. In any case – since all the correlation coefficients were not higher than .41 we just have to keep in mind that math anxiety might not play such an important role influencing other educational and psychological components involved in mathematical learning.

10.3.4. Correlations of believability in own math abilities and preference of afternoon math classes

10.3.4.1. Believability in own math abilities

Believability in own math abilities and valuing mathematics

Another unexpected result was the low correlation coefficients – though larger than .3 in 11 of the 13 sub-groups between believability in own math abilities and valuing mathematics. According to **Middleton, & Spanias (1999)**, "When students see themselves as capable of doing well in mathematics, they tend to value mathematics more than students who do not see themselves as capable of doing well" (**ibid, p. 67**). **Eccles et al, 1993), Meece et al, 1990), Midgley et al, 1989)**, and **Pokay, & Blumenfeld (1990)** have also pointed at the connection between these two psychological/emotional components. It should also be noted that not only that all observed correlation coefficients were weak, their maximal magnitude was .37 and thus the similarity among all sub-groups regarding this correlation was high. This low variance challenges studies done elsewhere, and call for further research both in Israel and elsewhere.

10.3.4.2. Correlations of preference of afternoon math classes

Preference of math afternoon classes was significantly correlated – with correlation coefficients higher than |.3| – only with stability of math abilities and valuing mathematics. Because the question of choosing afternoon math classes is almost irrelevant to most Israeli students who very rarely would choose afternoon math classes (e.g. **David, 1997, 1998a, 1999b, 2001b, Bredenstein, 23.12.2002**), it seems that this question is not particularly relevant to most of them.

10.3.5. The role of gender, religion, religiosity, class-type, and grade on the correlations

10.3.5.1. The role of gender

Gender played a minimal role regarding correlations. Among all correlations examined only in one – that between math helplessness and believability in own math ability – a difference larger than .1 was found between the two genders, namely, this correlation was -.60 for boys and -.70 for girls. Taking into account that believability in own math abilities is the components that predicts achievements more than any other single one, this information should be important for any future intervention programs for increasing girls' – as boys' – believability in their own abilities. However, until the influence of both these ingredients on achievements is not computed, it cannot be concluded to what extend does any of them – or both – play a role in mathematics learning.

10.3.5.2. The role of religion

Religion has played a role in some important correlations. Three of the correlations of valuing mathematics – those with believing in stability of intelligence, preference of afternoon math classes, and approach goals – were found to have coefficient differences larger than .1: I. Between Jews Muslims; II. While approach goals had a low correlation coefficient (smaller than .3) with believing in stability of intelligence among Jews, among Muslims this correlation coefficient was -.44; and III. While among Jews the correlation coefficient between approach and learning goals was .38, among Muslims it was .61.

10.3.5.3. The role of religiosity and class-type

Religiosity and class-type behave in the same way in six out of the seven cases where correlations among sub-groups of the same categories had a coefficient difference larger than .1. In all these correlations – whether positive or negative – the absolute value of the correlation was lower in the single-sex/religious class than in the mixed-sex/secular class. From the point of view of either intervention programs for helping students increase their math achievements, as well as from the theoretical aspect of belief in change, improvement, and development of the student in spite of psychological components that might influence her or his choice, the situation of the single-sex/religious student might be considered as more adaptive. However, unless each of these components in proven to influence achievement or participation in mathematics, no correlation – and might it be even very strong – should be perceived as significantly influencing the learning of mathematics.

10.3.5.4. The role of grade

Let us see some of the correlations where a difference larger than .1 was observed between at least two grades of the four examined:

1. Between approach goals and valuing mathematics – a difference larger than .15 between 8^{th} and 10^{th} graders;
2. Between approach goals and preference of afternoon math classes – a difference larger than .15 between 7^{th} and 9^{th} graders on the one hand and 8^{th} graders on the other;
3. Between learning goals and belief in rigidity of intelligence – a difference of .16 between 7^{th} and 9^{th} graders;
4. Between learning goals and preference of afternoon math classes – a difference larger than .23 between grade 8 and 9;
5. Between learning goals and mathematical helplessness – a difference larger than .22 between students in grade 8 and 9 and students in grade 10;
6. Between learning goals and valuing mathematics – a difference of .13 between 7^{th} and 9^{th} graders;
7. Between stability of math abilities and learning goals – a difference of .21 between 7^{th} and 9^{th} graders;
8. Between valuing mathematics and preference of afternoon math classes – a difference of .13 between 9^{th} and 10^{th} graders;
9. Between valuing mathematics and stability of math abilities – a difference of .17 between grade 7 and 8 students;
10. Between mathematics anxiety and avoidance motivation – a difference larger than .18 between 7^{th} and 8^{th} graders;

11. Between mathematics anxiety and believability in own math abilities – a difference of .13 between 9th and 10th graders;
12. Between stability of math abilities and preference of afternoon math classes – a difference of .12 between 7th and 10th graders;

We can see that the role grade plays in the differences of the correlation coefficients' magnitudes is substantial. A shallow look at the "list of differences" shows, that the "main player" regarding differences in the correlations between each two motivational, educational, and psychological measures are learning- and approach motivation orientations. However, since the influence of these correlations on either actual achievements or on other educational and psychological components has not studied yet, the findings exhibited here should be treated with caution and further research is needed in order to validate any conclusions.

10.3.6. Summary

The main finding of the correlations study of the 10 motivational, psychological, and educational measures influencing the learning of mathematics was, that each and every one of these components was distinguished from any other, namely, no two measures – even those perceived as similar to each other – "produced" similar correlations with any third components. The importance of this finding both to the present study and to any future one is that it validates the assumption, that a full picture of the findings can be presented only after carefully analyzing all components; all factors taken into account have been indispensable.

A second aspect of the correlation analysis is the great differences in the correlation coefficients found among the different sub-groups. The division to 13 sub-groups for the correlations analysis has produced different results within many sub-groups, and thus it is clear that any further research should take into consideration at least the gender, religion, religiosity, class-type, and grade divisions.

A third is about the limitations of the correlations study. The fact that only 10 motivational, psychological, and educational measures were taken into account probably implies, that taking more motivational, psychological, and educational measures into account should "produce" many more interesting results. Unfortunately this limitation can have its remedy only in a future research. As for the other limitation, namely, that only 13 "demographic" divisions were taken into account, in the next part of the discussion, that measure the influence of each component on both the expected and actual math grade, 23 divisions – the maximal number possible within the statistical limitations – were already taken into account.

10.4. Motivational, educational, and psychological items that influence math grades

10.4.1. Introduction

One of the nicknames often used in Israel for high school is “a matriculation factory”. Indeed, high schools are evaluated by the success rates in the matriculation exams in general, and by the quality of the matriculation certificate their graduates hold in particular. Without passing a mathematics matriculation exam one cannot get a matriculation certificate; without high achievements in mathematics, chances for high prestige academic education are very limited.

It is during junior high school when the future academic advancement of the student is determined. Mathematics and English are the two subjects playing the major role in this decision. Thus, junior high school math achievements are most important for the future of the Israeli student.

In order to find out what influences mathematics achievements in the Israeli junior high school it is important to know the magnitude of each motivational, psychological, and educational factor that influences achievements, and to what extent this factor influences achievement. Regression in general helps us understand the contribution of each component taking part in a process to its final result. Here we need to calculate what is the contribution of the three motivational orientations measured – learning-, approach-, and avoidance goals, as well as the adaptive factors – believability in own math abilities, valuing mathematics, and preference of afternoon mathematics classes, and the maladaptive ones – math anxiety, stability of mathematical abilities, mathematical helplessness, and holding an entity theory of intelligence to math achievements.

Schiefele & Csikszentmihalyi (1995), **Aiken (1971**, and **McLeod (1990)** have stated, that cognitive traits are responsible for the larger part of achievement variance, while motivational and emotional factors, such as attitude, anxiety, interest, or task motivation are often found to be less important (**Aiken, 1970, 1972; Schneider & Bös, 1985; Steinkamp, & Maehr, 1983; Willson, 1983)**. The reasons why, according to **Schiefele & Csikszentmihalyi (1995**), neither cognitive nor motivational or emotional component should be neglected in studying their potential contribution to students' achievements are:

1. The magnitude of explained variance. In spite of the fact that the larger part – which can be as large as 50% of achievement – can be explained by cognitive characteristics, this variance can be reduced to as much as half under certain conditions (e.g. **Schneider & Bös, 1985**).
2. The influence of emotional components is not always direct, they might influence achievement indirectly – by mediator variables (e.g. **Meece et al, 1990)**;
3. Psychological and educational components are must when higher-level achievements are at stake. Problem solving, creativity, and profound understanding require positive attitude, intrinsic motivation, and commitment (**McLeod, 1990, Ziv, 1990)**;
4. The decline in the average math performance in many countries (e.g. **Mulis et al, 1998, December 2000)** implies that students lack interest in mathematics. The results should be that both motivational and emotional components influencing interest in mathematics should be studied, in order to help math achievement by increasing interest in mathematics.

10.4.2. Believability in own math abilities and its influence on math achievement

In 41 of the 46 examined sub-groups – 23 for the influence of the motivational, psychological, and educational components were measured on the expected grade and 23 – on the actual one – believability in own math abilities had a significant influence on the grade. Thus, believability in own math abilities proved to be influencing far more than any other measured components both the expected and actual grade of both genders, among all the populations participating in my study.

As we can see from the results, five different sub-groups of boys had "believability in own math abilities" as the only significant component influencing their expected math grades. As for the actual grade – for boys in grades 8 and 9, and for girls in grade 9 and secular girls it was the only of the 10 components measured significantly influencing it. The importance of believability in own math abilities has been discussed widely, and the inferiority of girls regarding it has been shown in many studies (e.g. **Brew et al, 1996, Malpass, 1996)**. Thus the fact that in spite of girls' higher achievements in school, and in spite of their being more adaptive than boys regarding avoidance motivation, as we have seen in the previous chapter, and being not substantially different in any other of the 8 components measured, the fact that in Israel girls choose the highest level mathematics track 50% less than boys MUST be connected to their lower level of believability in own math abilities, especially during the most critical stage – grade 8 and 9, when future choices of school track are being made.

10.4.3. The role of motivational orientations in math achievement

10.4.3.1. Learning goals

Learning goals proved to be significant for expected math achievements in only 5 of the 23 sub-groups and in none of the sub-groups for the actual grade. This finding is somewhat surprising when taking into account findings from elsewhere, especially from the US (e.g. **Barron & Harackiewicz, 2000, 2001; Dweck, 1999; Hidi, 2000; Lepper, 2000; Wolters et al, 1996)**. As was already explained, the Israeli education system does not encourage learning for the sake of learning, neither does it reward it; school is aimed to prepare students for the matriculation exams, rather than to like learning in general and mathematics in particular.

In light of these findings the question of differences in learning motivation among sub-populations becomes hardly relevant. By every criterion Israel scores very high in the educational level of its population: in 2001 there were in Israel 117,525 university students (http://www.cbs.gov.il/shnaton53, **table 8.32**), plus 34,762 students of the Open University (**ibid, table 8.44**), plus 62,363 students in non-university institutions of higher education (**ibid, table 8.46**). To this number at least a few thousands more have to be added – of Israelis learning abroad, either because they have not been accepted to their desired department in an Israeli university, or because of the high tuition in Israel. Taking into consideration that the size of Israeli population is only about 6.5 millions (**Greenstein, 16.4.2002)**, this is indeed a high percentage. The relative low number of degrees recipients: 26,678 recipients of degrees from the universities (**ibid, table 8.38**), plus 1,775 who received their degrees from the Open University (**ibid, table 8.44**) plus 11,477 recipients of first degree from non-university institutions (**ibid, table 8.47**), combined with the higher percentage of students receiving their degrees after 5 years of studying (**ibid, table 8.42**) demonstrates, that in the next coming years the percentage of Israelis with higher education degrees will grow rapidly. Thus, not only there is hardly any practical importance for learning for the sake of learning; even the aim of entitlement of a matriculation certificate has but a minimal relevance when the striving is towards a higher education degree. A matriculation certificate has become just the corridor to the palace.

10.4.3.2. Approach goals

In contrast to learning motivation, approach motivation proved to be more influencing on the expected grade – it had such influence on nine of the 23 sub-groups examined, but a very limited influence on the actual grade – just on one sub-group. The result according to which approach motivation influences almost half of the sub-groups regarding the expected grade has been expected (e.g. **Deci et al, 1999a, 1999b; Ryan & Deci, 2000a, 2000b, 2000c, 2000d; Dweck, 1999)**. The very limited influence of approach goals on the actual grade was not expected. A possible explanation for this finding can been, that as was found by **Lee (1998**), approach goal motivation has – among Israeli students as among Americans – an indirect influence on the actual achievement. However, because no other study has yet been conducted examining the connections between approach goal motivation to actual achievements among Israeli students, examining Lee's hypothesis can result in only limited consequences without repeat studies and further studies of all motivational orientations and their influence on Israeli students.

10.4.3.3. Avoidance goals

Six of the nine sub-groups among whom avoidance motivation influenced math grade were girls'; only two were boys – Muslims and 10th graders. This does not necessarily mean that girls were more vulnerable regarding being influenced by avoidance motivation. As was found in the first part of this chapter, there were no significant gender differences per se regarding avoidance motivation, in accordance to other findings (e.g. **Patrick et al, 1999**). While one boys' sub-group (Muslims) had their expected grade influenced by avoidance motivation, the other – 10th grade boys – was the only one found to have their actual grade influenced by it. We shall hereby see if these boys' sub-groups will be proved vulnerable regarding other motivational and psychological-educational components as well.

As we have already seen in many other measures, Muslim boys are not only a minority among Muslim students because of the high rate of dropout, but because of their lowest achievements – in comparison to all other sectors examined – in mathematics as in all other subjects. Thus it has not been a surprise that the grades of Muslim boys were influenced negatively by math avoidance. As for boys in grade 10 – since a double percentage of boys than girls in this grade take the highest possible level of math instruction (e.g. **Mevarech, 2000; Statistics, Israel, 2002a**), while girls' grades are not lower than boys', it is quite understandable that boys in general would be more vulnerable than girls to negative influences of competitiveness and feelings of inadequate abilities.

This hypothesis will be re-checked after examining the influence of helplessness, IPT, and stability of math abilities on 10th grade boys.

10.4.4. Belief in rigidity of intelligence – IPT – and its influence on math actual and expected grades

Belief in rigidity of intelligence was equally influencing the expected and the actual grades: it influenced the expected grade of five sub-groups and the actual grade of five sub-groups. The fact that three out of these sub-groups had both their expected and actual grades be influenced implies, that unlike in the motivational orientations examined, the connections between the expected and the actual grade were stronger regarding believing in rigidity of intelligence, but this assumption requires further research.

The sub-groups among whom IPT significantly influenced their expected or actual grade can be divided into three groups: 1. The general population, girls, and girls in single-sex classes. Among them both the actual and the expected grade was influenced by belief in rigidity of intelligence. 2. Boys in grade 10 and Muslim girls. Among them only the actual grade was influenced by belief in rigidity of intelligence. 3. Secular girls and Muslim boys. Only their expected grade was influenced by their belief in rigidity of intelligence. This division shows, that not only was there no gender-dependent pattern for belief in rigidity of intelligence (e.g. **Dweck, 1999**), but the gender component was but marginal regarding its influence either on the expected or the actual grade. The "minorities pattern" becomes more and more obvious with the analysis of the findings. Here, again, we can see that the expectations of more vulnerable sub-groups, in our case – secular girls and Muslim boys, were significantly influenced by their belief in rigidity of intelligence. 10th grade boys can be grouped together with Muslim girls: in both groups the actual grade is influenced by belief in rigidity of intelligence. Boys in grade 10 were vulnerable because of social high expectations aimed towards them; Muslim girls, as have already been shown (e.g. **Mittelberg & Lev-Ari, 1999**), are the dominant educational group regarding low dropout, participation in high-level tracks, and high actual achievements. Thus both these groups become more vulnerable to beliefs in changeability of intelligence regarding their actual math grades.

10.4.5. Stability of math abilities: How much does it influence math achievements?

Like what was found when analyzing the significant influence of belief in rigidity of intelligence both on the expected and actual grades, such influence of stability of math abilities clearly points at an advantage to girls: only one group of girls – girls in grade 10 – had their actual grade influenced by their belief in stability of math abilities. Among boys, on the other hand, four such sub-groups were found, and thus expended the circle of vulnerability regarding this measure to all majority groups of boys: those learning in mixed-sex classes, boys in grade 9 and 10, secular boys, and Jewish boys. We can conclude, that belonging to any male majority group means being vulnerable to the negative influence that might stem from the belief that math abilities are not prone to change.

Among Jewish and Muslim boys belief in stability in math abilities influenced actual grades. However, while among Jewish boys this influence was accompanied by influence on actual grade, and thus might act as a prophecy becoming materialized (**Rosenthal, 1966)**, for Muslim boys the actual math grade was not found to be influenced by as many outer ingredients as has been the case for Jewish boys.

10.4.6. The Myth of the importance of valuing mathematics: Why does it not work for the Israeli student?

In many studies valuing mathematics has been proved as predictor of success in this subject (e.g. **Eccles & Wigfield, 1995; Eccles et al, 1993; Seegers & Boekaerts, 1993; Wigfield, & Eccles, 1992)**. In Israel it was found that Muslim students tended to value mathematics more than Jews **(Mittelberg & Lev-Ari, 1999)**.

In light of these findings, it should be surprising why only in five sub-groups (the general population, three girls' sub-groups and one boys') valuing mathematics has had a significant influence on the expected grade, and only in four (the general population, one of girls' and two boys') – on the actual grade. But first – let us look at the division between more and less vulnerable sub-groups. In addition to the general population, whose expected and actual grades were significantly influenced, the more "masculine" sub-groups – boys, 10th grade boys, and girls in single-sex classes, had all a significant influence on their actual grade. The pattern according to which "feminine" groups – majority girls (i.e. learning in secular classes), as well as Muslim boys who are the minority of students as well as the less achieving ones, are not so much influenced regarding their actual grades has again proven to be correct.

Let us look again at the questions consisting the "value" part of the questionnaire:

- Math classes are very useful.
- I like math classes.
- Math class is important.
- Being able to do math is important.
- I like to be able to do math.
- Math is something very useful.

Knowing what we have already explored about the aims of the Israeli student we can assume, that these questions reflect more the student's feelings towards math than what is perceived by her or him as valuing mathematics. Thus, the student who aims towards higher education does not usually think that classroom mathematics is useful or important; neither does he of she think that mathematics in general is useful per se, but rather – as means for a high grade that will enable her or him to be excepted to a desirable department. As for liking mathematics – mathematics is considered in Israel as the most hated subject not only by bad students, but also by the general body of students. Thus, I would recommend a repeat study where the questions dealing with valuing mathematics will focus on the value for getting good grades and thus being able to choose any track in high school, as well as on future advantages resulting from learning high-level mathematics successfully.

10.4.7. The fall of the anxiety theory: The minimal influence of anxiety on math achievements

Math anxiety has been described in the psychological-educational literature of mathematics teaching and learning as one of the main components influencing math achievements (e.g. **Osborne, 2001**). It is true that in many studies significant gender differences favoring males were found in math anxiety (e.g. **Ben-Zur & Zeidner, 1988; Carr, 1996; Cramer, 1989; Hyde, 1993**; **Lupkowski & Schumaker, 1991**;

Zeidner, 1996). However, these studies did not examine to what extent these differences influenced math achievements. In the previous part of this chapter, the one discussing significant interactions in means of the psychological, educational, and motivational components measured, I have already presented the findings about gender differences – or rather – their existence only when religion or grade and religiosity were taken into account. Here we shall see what is the influence of math anxiety on both the expected and actual math grades.

The grades of six sub-groups of boys were significantly influenced by their mathematical anxiety. Of these groups, three were ”typical masculine” groups: boys, boys in grade 7, and Jewish boys, and two were somewhat “androgynous”, namely, they had both male and female characteristics. These two subgroups – highly overlapping – were religious boys and boys learning in single-sex classes. From the picture drawn until now it looks as if belonging to an “androgynous” group has moderated negative behaviors rather than supporting maladaptive characteristics of both genders. This has been the case regarding the influence of math anxiety on the female sub-groups: it did influence “masculine” girls, namely, girls in single-sex classes who do not usually have to confirm to social standards requiring girls to behave in a calm, submissive way in the present of members of the opposite gender, as well as the minority group of Muslims – male students. However, not even in one case did it influence the actual grade, and in the bottom line what really counts in the Israeli school is not the expected grade but only the actual one.

Math avoidance and math anxiety have proved in my study to influence in quite a similar way. As was already mentioned, avoidance motivation was the only component found to have a main-effect favoring females. Anxiety, though not having a gender main effect, was proven to influence boys much more than girls. We can thus conclude, that because of the socially accepted possibility for girls much more than for boys to choose themselves out of mathematics, namely, to prefer learning lower level mathematics, they gain less avoiding classroom assignments as well as less risking that their grade would be influenced by their math anxiety.

10.4.8. How come helplessness has but a minimal influence on math achievements?

In my study mathematical helplessness has been, regarding the influence on the actual grade, very similar to mathematical anxiety. While the sub-groups where math anxiety influenced the actual grade were either boys' or "masculine" girls', four of the sub-groups where the actual grade was influenced by mathematical helplessness were girls', and the fifth the vulnerable 10th grade boys' sub-group.

In spite of the fact that no gender main-effect was found for mathematical helplessness, girls in my study were found to be inferior to boys regarding math helplessness. First, an almost significant gender-difference favoring boys was observed when taking class-type into consideration. In addition, the level of helplessness was significantly higher among 8th and 10th grade girls than among boys. While in 10th grade mathematical helplessness might influence academic learning of mathematics-dependent professions, in grade 8 it has a strong influence on the decision not to take high-track high school mathematics.

We can thus see, that the debate about "are there gender differences in mathematical helplessness" should be changed to: "are there gender differences in the influence of math helplessness on math achievements". If girls and other at-risk groups are more vulnerable to the influence of mathematical helplessness, an intervention program aimed to lower the level of helplessness might be valuable, as well as a program minimizing the destructive influence of math helplessness, even when its level is not particularly high. That should be the case when trying to help talented girls who suffer from mathematical helplessness (e.g. **Dweck, 1999; Greulich, Pomerantz, & Gochberg, 1993; Licht & Dweck, 1984; Pomerantz & Ruble; 1998)**. Even when the level of helplessness among these girls in not higher than that of regular girls or boys, its influence on their achievements has proved to be substantial and thus might damage their future professional advancement. In this case it is quiet obvious that reducing their level of helplessness should be recommended (**Zorman & David, 2000**).

10.4.9. Preference of math afternoon classes: Not a predictor of achievement for the Israeli student

Preference of math afternoon classes had in my study no influence on math grades. In Israel a student takes afternoon classes either as private classes, given by a tutor and paid by the students' parents, or in one of the gifted groups (e.g. **David, 1996, 1997, 1998a, 1998b, 2001b)**. In the first case private tutoring in mainly a function of the financial ability of the parents, thus a student taking such sessions is not necessarily doing worse than a peer whose parents cannot afford such a luxury. In the second case it is understandable that a gifted student will both expect and achieve highly in mathematics. Unfortunately, Israeli students belonging to this category are but a negligible minority.

Dr. Eliezer Feldman, the manager of *City College*, an Israeli extension of a Russian university that administrates the Israeli Mathematics Olympiad, has summarized the comparison between Israeli and ex-Russian high school students regarding participating in extra-curricular mathematics classes:

> We do not approach the Hebrew speaking population, because both mathematics and participating in [mathematics] Olympiads are closer to the culture of immigrant children […]. The new comers to Israel are starving for competitions of the kind they were used to have in the ex-USSR; in the Russian street there is a wish to take part in it: it is rooted in our culture **(Bredenstein, 23.12.2002)**.

10.5. Summary: The sub-populations most influenced

10.5.1. Boys versus girls

Let us examine the differences in numbers of sub-groups of boys versus girls that the motivational, psychological, and educational examined measures significantly influenced their math grade: examined

The expected grades of all male subgroups have been influenced by 15 predictors and the females' – by 28;

The actual grades of all male sub-groups have been influenced by 28 predictors and the females' – only by 17.

Conclusion: Because what really "makes the difference" is the actual grade, boys were found to be much more vulnerable to non-academic variables than girls.

Let us examine a partial group – that of motivational orientations – regarding their influence on both the expected and the actual grades of boys and girls:

Expected: **Boys: 1.** In grade 8 (learning)

1. In grade 10, **2.** Muslim (avoidance)

Girls: 1. Girls-general, **2**. In mixed classes **3.** In grade 9, **4.** Secular girls (approach),

1. Girls-general, **2.** In mixed-classes, **3.** In grade 7, **4.** In grade 8, **5**. In grade 9, **6.** Secular girls, **7.** Jewish (avoidance);

1. In single-sex classes, **2.** In grade 10, **3.** Muslim (learning)

Actual: **Boys: 1**. In single-sex classes, **2**. Religious, (approach)

In grade 10 (avoidance)

Conclusion:

1. The inversion between actual and expected grades exposes the roots of male vulnerability – As we have already seen, groups that are considered more vulnerable, their grades are influenced by more predictors than groups who are less vulnerable.
2. No Girls' sub-group was influenced by any of the motivational orientations examined regarding their actual math grades!

In contradiction of what should have been expected (e.g. **Middleton, & Spanias, 1999)**, that motivational factors would predict academic factors more for girls than for boys, it was shown in my study that this was true only for expected grades. In reality not even one of the three motivational orientations studied – learning-, approach-, or avoidance motivation had an influence on girls' grades. This result proves once again that in Israel girls are not a vulnerable group regarding education; females achieve higher grades in all subjects in all educational levels, and participate in higher education more than males.

Within the more vulnerable sub-groups – boys – the most vulnerable male sub-group were 10th grade boys. We can thus conclude, that high participation level in mathematics is double-edged: 10th grade boys, who are the majority of those taking the highest level mathematics instruction pay a price for their prize: their actual math grade has been influenced by many psychological and motivational ingredients.

10.5.2. Boys and girls in single-sex versus mixed-sex classes

The expected grade of boys in both mixed- and single-sex classes was significantly influenced only by believability in own math abilities; girls in mixed-sex classes were influences by two more "Grand 10" items, and girls in single-sex classes – by four more such items.

As for the actual grade – boys and girls in mixed-sex classes were influenced by two significant items, and in single-sex classes – by tree.

Conclusion: The division of single- versus mixed-sex classes did not prove fertile regarding differences in the vulnerability of either male or female students. The debate of single-versus mixed-sex education (chapter 5) does not get any closer to its end by examining the results of the influence of the class-type on the significant influence of any of the measured components either on the expected or on the actual level. The most that can be said about this issue is, that since adaptivity of both boys and girls in single-sex classes is higher than that of students in mixed classes, and since there are no obvious differences between students learning in these two class-types regarding the influence of the "Grand 10" ingredients on achiements, single-sex classes have won in the "adaptivity battle"

10.5.3. Grade level and its connection to the motivational, educational, and psychological items influencing math achievement

In grade 8 two predictors were found to influence the expected grades significantly; in grade 10 – just one item of the "Grand 10"; in grades 7 and 9 no such predictors were found.

In grade 7 there were two predictors significantly influencing the actual grades; in grade 8 – only one that was almost significant, in grade 9 – one significant and one almost significant, and in grade 10 – four significant and one almost significant.

In grade 8 there was one almost significant item influencing the expected grade; in grade 9 – three such items, and in grade 10 – only one almost significant item.

In grade 8 no predictor was significant for the actual grade; in grade 9 – there was one significant predictor, and in grade 10 – two significant predictors.

Conclusion: Once again 10^{th} grade boys were found to be more vulnerable than any other male sub-group to non-academic ingredients that influence their actual grades

10.5.4. The influence of religion on boys and girls regarding predictors of math achievement

Jewish boys resembled Jewish girls and Muslim girls had all but two measures influencing their expected grade. Among Muslim boys the number of these significant components was five.

Regarding the actual grade, the picture was quite different: 2-3 of the "Grand 10" ingredients significantly influenced each of these 4 sub-groups.

Conclusions:

1. Muslim boys have not proved to be more vulnerable than any other sub-group regarding having their actual grade significantly influenced by more measures than other sub-groups. Thus, the expectations regarding "motivation of underrepresented populations" (**Middleton, & Spanias, 1999)** were not confirmed. As we have already shown, Israeli Muslims are an underrepresented minority regarding higher education. **Rohrkemper & Bershon (1984**) have found that some minority children may feel lack of efficacy as early as in third grade, and as a result they would damage their learning mathematics abilities. Thus it should have been expected that Muslim 7th-10th graders would be more vulnerable than Jews regarding the influence of motivational, emotional, and psychological components on their mathematics grades. That was not the case either for Muslim boys or girls. In fact the actual grades of Muslim girls were not influenced by more ingredients than those of Jewish girls or Muslim boys.

2. We can summarize that Muslim girls have won – as expected (e.g. **Mittelberg & Lev-Ari, 1999**) in the "adaptivity fight": they have been proved to score higher in adaptive measures and lower in maladaptive ones both in comparison to Jewish girls and to Muslim boys. As has been shown, girls participate in math and sciences more than Muslim boys and more than Jewish girls, according to the results of my study they do not suffer any visible damage from excelling in learning mathematics.

10.5.5. The influence of religiosity on boys and girls

For the expected grade secular girls were substantially different from the other three groups – secular boys, and religious boys and girls, regarding the number of items (of the "Grand 10") significantly influencing it. While among these three groups only believability in own math abilities significantly predicted the grade, for secular girls there were four more such items: valuing mathematics, approach motivation, avoidance motivation, and belief in rigidity of intelligence.

Regarding actual grades differences among theses sub-groups were not so dramatic. While secular boys' actual grades were significantly influenced by two of the "Grand 10" items, among religious boys their number was three items, among secular girls – just one, and for religious girls – one that was only almost significant.

10.5.6. Final conclusion

Because

> Mathematics is a major key necessary in unlocking a majority of important career opportunities available for our most intelligent ad academically able students" (**Rekdal, 1984,** p. 11),

it should be taken into consideration that

> Gender differences in math scores generally begin in the point at which girls stop taking advance math and science courses" **(Kerr, 1991, p. 405)**.

In a study examining girls' participation in math and science courses in mixed- and single-sex classes it was found that:

> […] female responses […] represent only a small percentage of girls in co-ed schools, whereas they represent the majority of girls at all-girls schools (**Campbell & Evans, 1994,** p. 294).

By no means is single-sex tutoring the only solution to the low participation of girls in math and science. The main measure studied in the present research was believability in own math abilities, or self-efficacy:

> Student' task-specific self-efficacy was the only motivation variable to predict performance […] (**Pajares & Graham, 1999,** p. 124) ::

However, while mathematics self-efficacy proved to predict achievements when realistic. Thus, high believability in own abilities per se does not predict success, as was shown in the 1999 TIMS study (**Mullis et al., December 2000**).

As for the study of motivational orientations and their influence of mathematics achievements – all three orientations, learning-, approach, and avoidance motivation did not result in new insights either in the study of math gender differences or in finding new ways that would connect motivation and achievement. However, this study is just the beginning of the way. Much more research is needed in order to explore the wild land of motivation and its influence on the learning of mathematics.

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Zuckerman, H., Cole, J.R., & Bruer, J.T. (Eds.), (1992). *The outer circle. Women in the scientific community*. New Haven & London: Yale UP.

Curriculum Vitae

Name: Hanna David
Birth date: 11.8.1952
Birthplace: Tel Aviv, Israel
Address: 3/8 Kashani St.
Tel Aviv 69499, Israel
Home Telefax No.: 972-3-6412773
Office Fax No.: 972-3-6407031
e-mail: hannadav@post.tau.ac.il

Education

1971-1974	Physics, Mathematics, and Hebrew Literature, The Hebrew University, Jerusalem
1974-1975	Jewish Literature, The Jewish Theological Seminary, New York (M.A.)
1999-2003	Ph.D. Student (Psychology), Ludwig Maximilians Universität, München.

Positions Held

1975-1976	Style Editor, *HaSifrut – Quarterly for the Study of Literature*, Tel Aviv University
1977-1978	Scientific Editor, The Open University, Tel Aviv
1979-	Research Worker and Editor, The Katz Research Institute for Hebrew Literature, Tel Aviv University
1995-1996	Instruction coordinator, the 1995 Israeli census, The Prime-Minister Office, Jerusalem
2000-2001	Counselor, The Excellence Project, Ort – Colleges and schools for Advanced Technology and Science.

Teaching

1973-1974	Physics Teacher, The Evelina de-Rotschild High-school for Girls, Jerusalem
1976-1977	Literature Teacher, "Gimnasia Realit" High-school, Tel Aviv
1995	Training Coordinator, The 1995 Census, The Prime-Minister Office, Jerusalem
1995-1997	Lecturer of Giftedness, The Talpiot Teachers College, Tel Aviv
1997-1999	Lecturer of Literature and Education, The Giv'at Washington College.

Conference Papers and Invited lectures

1980	Yiddish: Linguistic history and interrelations between language and culture – A research made on the computerized Responsa Project. The University of Barcelona, The international conference of computers in the humanities and in social sciences, June.

1987	On the verb ‘haya’ [=to be] in modern Hebrew literature. The annual international conference of Hebrew literature, Haifa University, April.
1995	The withdrawing mother in literature and reality. The conference on literature and feminism, Tel Aviv University, March 14-15.
1996	Feminist interpretation to Haim Be’er’s *Et HaZamir* (*The Time of Trimming*). Tel Aviv University, The inter-disciplinary Israeli feminist conference, May.
1998	Salzburg Seminar Session 354, The Contemporary Novel, March 22-29.
1998	Three short stories. Salzburg Seminar Session 354, The Contemporary Novel, March 27.
1998	The gifted girl. The inter-disciplinary Israeli feminist conference, Tel Aviv University, April 26-28.
1999	The gifted religious girl (with Zorman, R.). To be a Jewish woman: The first international conference in Israel. Jerusalem, July 14-15.
1999	The poet as a prophet: *The Seventh Column* by Nathan Alterman. Ben Gurion University of the Negev, December 21.
2000	Self-objectification of women (with Ziegler, A.). Universitaets Konstanz, Fachbereich Psychologie, Sozialpsychologie und Motivation, January 26.
2000	Was ist eine Koryphaee? Auswirkungen des maenlich gepraegten Stereotyps einer akademisch erfolgreichen Person (with Ziegler, A.). Dortmunder Symposion fuer paedagogishe Psychologie, February 11-12.
2000	Young women in science and technology. Haifa, The National Science Museum, March 3.
2000	Gender-dependent perception of vocational occupation (with Ziegler, A.). Tel Aviv University, The Inter-disciplinary Israeli Feminist Conference, March 14-15.
2000	Salzburg Seminar Session 379: Alternate systems and structures for higher education – Public needs and institutional response for the 21st century. Salzburg, July 1-8 .
2000	Women in the academia. Salzburg Seminar Session 379: Alternate systems and structures for higher education – Public needs and institutional response for the 21st century. Salzburg, July 6 .
2000	To be Jewish and Mediterranean, 999-1492: *From Voyage to the End of the Millennium* by Abraham B. Yehoshua to 1492 – *The Life and Time of Juan Cabezon of Castile* by Homero Aridjis. The Malta Festival of Mediterranean Literature. St. James Cavalier Centre for Creativity, Valletta: November 9-11.
2000	Three Holocaust Stories. The Malta Festival of Mediterranean Literature. St. James Cavalier Centre for Creativity, Valletta: November 9-11.
2000	Social, familial, and educational problems of the talented girl. Conference on Girls and Women in Science and Engineering,

	The Ministry of Science and the Ministry of Education, Tel Aviv University, Novbember 29.
2000	'Die Lorelei' by Heinrich Heine, 'The Lorelei' and 'The liberation of The Lorelei' by Nathan Alterman: Five poems and one Yiddish translation. The Nathan Alterman Conference, Tel Aviv University, December 19-21.
2001	Women in the Israeli Ashkenazi (Orthodox), Sephardi, Yemenite, Conservative, and Reform Synagogue. Tel Aviv University, The Inter-disciplinary Israeli Feminist Conference, April 1-3.
2001	Mathematics and gender. A conference for headmasters and superintendents, Nazareth, April 17.
2001	Head of the workshop session: "Body images". The Embodiment of American Literature Conference, The Austrian Association for American Studies, Klagenfurt, October 26-28.
2001	Gender differences in mathematics and science: The Israeli case. The Gender and Science Conference, The European Commission, Brussels, November 8-9.
2001	Mathematical giftedness: The mathematics acceleration program at the Tel Aviv University. 8. Internationale Konferenz ueber Schulmathematik, Vienna, December 17-20.
2002	Geometry in the Israeli kindergarten. 36. Tagung fuer Didaktik der Mathematik. Klagenfurt, February 25 – March 1.
2001	Anorexia Nervosa: The Israeli case. The Third Wave Feminism Conference, Exeter, July 23-25.
2002	Chairperson of "Panel of information technology". Women in the global community – a Fulbright-sponsored conference bridging academia and public policy. Bogazici University – Istanbul, September 18-21.

PUBLICATIONS

Short stories

1967-1970	*Ma'ariv Lano'ar* [an Israeli youth magazine. A youth-writer].
1973-1979	*La'isha [=Woman]; At [= (female) You]; Yedior Achronot [=Latest News]*

Books

<u>I. Published</u>

1994	*Dear Joe – A novel*. Tel Aviv: Yaron Golan Publishing House.
1995	*The divorcing woman: Prejudices, truths and half-truths*. Tel Aviv: Yaron Golan Publishing House.
1998	*Index to Keshet [Rainbow]: A Literary Periodical + Introduction*. Tel Aviv University.
2000	*There is another way: Girls and women - Achievements and challenges* (with Rachel Zorman). Jerusalem: The Henrietta Szold Institute and The Ministry of Education.

<u>II. In Press</u>

The gifted girl: Case-studies.

Alimony and child-support in the Israeli court.

III. In Preparation

Anorexia nervosa: The Israeli case.

Articles

I. Published

1981 Yiddish: Linguistic history and interrelations between language and culture. Research made on the computerized Responsa Project. *Proceedings of the International Conference on Literary and Linguistic Computing*, Barcelona.

1989 On the verb "haya" [to be] in modern Hebrew Literature. *Dappim – Research in Literature*, 5-6, 345-360.

1990 Ha'Sifrut 1968-1986: The development of a literary journal. *Criticism and Interpretation, Journal for Literature, Linguistics, History and Aesthetics*, 26, 125-135.

1991 Literature and the mathematical sciences. *Hebrew Linguistics – A Journal for Hebrew Descriptive and Applied Linguistics*, 31-32, 53-69.

1995 Haim Be'er's *Et Ha'Zamir [The Time of Trimming]*: Reception and interpretation. In R. Tsur, T. Rosen, & H. David (eds.), Israel Levine Jubilee Book, Vol. 2 (pp. 65-103). Tel Aviv University.

1997 Mathematical giftedness. *The Talpiot College Annual*, 9, 147-169.

1997 Educating gifted children in regular or special classes? *Dappim, A Journal for Research In Education*, 25, 126-149. Re-published in A. Ziv (ed.) (1998). *Giftedness and special talents: A text book* (pp. 331-353), Tel Aviv: The Open University.

1998 The woman who gives up her children's custody. *Giv'at Washington College Annual*, 7, 91-101.

2000 Consequences of the male stereotype of an academically successful person for thinking (with Ziegler, A., & Stoeger, H.). In H. Metz-Goeckel, B. Hannover & S. Leffelsend (Hrsg.), *Selbst, Motivation, und Emotion* (S. 169-178). Berlin: Logos.

2000 Intervention program for minimizing gaps in mathematics among elementary school children. Paper submitted to the Ministry of Education, the Philippines.

2001 Gender gaps in Mathematics in Israel: An international comparison. *Aleh, The Journal for Mathematics Teachers*, 27, 55-69.

2002 A minority within a minority: Mathematics, science and echnology studies among Israeli and Arabic female students. *Proceedings of The Gender and Science Conference, Brussels, 8-9 November*, 2001 (pp. 248-255) Brussels: The European Commission.

2002 Mathematics gender gaps in the matriculation exams and in the psychometrics in Israel. Aleh, The Journal for Mathematics Teachers, 28, 1-17.

2002 Geometry in the Israeli kindergarten. In W. Peschek (Hrsg.). *Beiträge zum Mathematikunterricht. Vorträge auf der 36. Tagung für Didaktik der Mathematik vom 25. Februar bis 1. März 2002 in Klagenfurt* (S. 143-146). Hildesheim und Berlin: Verlag Franzbecker.

II. In press

Five Gifted Children in one Classroom: A case-study.

What is a specialist? Effects of the male stereotype of a successful person on the performance in a thinking task (part II) (with Ziegler, A., and Stoeger, H.).

III. Unpublished interviews

1998 The mathematics acceleration program at the Tel Aviv University. Interview with Dr. B. Arbel, head of the program.

1999a. Mathematics in the gifted programs for 3rd-6th graders in Tel Aviv. Interview with Y. Breuer, the mathematics teacher.

1999b. The gifted program for 3rd-6th graders in Tel Aviv. Interview with Y. Gedanken, the head of the program.

2000. The Beit Berl gifted program for 4th-8th graders. Interview with P. Zeltzer, head of the program.

2001 The Hadige Arabic high school for girls in Um El-Fachm. Interview with S. Samir, the school's headmaster.

Editing

I. Published

1980 *Proceedings of the International Conference in Literary and Linguistic Computing*. Editors: Zvi Malachi, and Hanna Ehrenstein-David.

1981 *Professor Israel Efros – Poet and Philosopher*. Editor: Hanna David.

1981 *Studies on A. Shlonsky and his Literary Work* (vol. 1). Editors: Uzi Shavit, and Hanna David.

1982 *The Other Meaning: From Allegorical Parable to Pararealistic Story*. By Uri Shoham. Editor: Hanna David.

1983 *Igeret Hai Ben Mekitz by Abraham ibn Ezra*. Editor: Israel Levin, Style-editor: Hanna David.

1985 *Studies in the work of Shlomo ibn-Gabirol*. Editors: Zvi Malachi, and Hanna David.

1985 *Cunning Innocence: On S.Y. Agnon's Irony*. By Esther Fuchs. Editor: Hanna David.

1986 *“Ani Ha’Sar”: Studies in Hebrew secular poetry in Spain*. By Masha Itzhaki. Editor: Hanna David.

1986 *The hero of our generation in Israel*. By Uri Shoham. Editor: Hanna David.

1986 *From King Messiah to King of Flesh and Blood*. By Ruth Shenfeld. Editor: Hanna David.

1987 *Author and public: Four chapters in applied reception theory*. By Gershon Shaked. Editor: Hanna David.

1988 *Studies on A. Shlonsky and his literary work* (vol. 2). Editors: Uzi Shavit, and Hanna David.

1988 *Metamorphosis of a story: The formation of Ch. N. Bialik’s stories*. By Ruth Shenfeld. Editor: Hanna David.

1989 *Sh. Tschernichovsky’s Idyls and the tradition of the genre*. By Haim Shoham. Editor: Hanna David.

1995 *The embroidered coat: The genres of Hebrew secular poetry in Spain* (3 vols.). By Israel Levin. Editor: Hanna David.

1995 *Israel Levin jubilee volume: Studies in Hebrew literature* (2 vols.). Editors: Reuven Tsur, Tova Rosen, and Hanna David.

1996 *Sadan: Studies in Hebrew literature. Selected chapters in the history of Hebrew women’s poetry*. Editors: Ziva Shamir, and Hanna David.

<u>II. In press</u>

Nathan Alterman’s letters. Editors: Hanna David, Haya Hoffman, Shmuel Trattner, and Ziva Shamir.

Ch. N. Bialik. Collected Stories (2 Vols.). Editors: Hanna David, Shmuel Trattner, and Ruth Shenfeld.