RESUMEN
EN INGLÉS

Gender differencesin attitudes toward new technologies in adolescents: a psychosocial approach

INTRODUCTION

According to sources of the Ministry of Science and Culture, during the academic year 2003-2004 (MEC, 2005a), the distribution of students in Spain in the different domains belonging to two courses immediately prior to university varies according to participants' gender. This way, the rate of female students is higher in those domains considered traditionally as feminine (*Humanities and Social Science*: 55% women), but on the contrary, the rate of men is higher both in the *Biology and Health Sciences* domain (where 36.3% of the students are women) and in the Technological domain (where 3.8% of the students are women).

In general terms, during the academic year 2004-2005, the rate of women in university studies is higher than men (55.1%). According to table 1, women are underrepresented in technological studies, such as engineering, physics or computer science and overrepresented in Health Science studies and Humanities (MEC, 2005c).

Tabla 1. Rate of women distributed by domain of university studies (Academic e 2004-2005)

Domain	Women
Social Science and Law	62.6%
Humanities	64.4%
Technical studies	27.1%
Experimental Sciences	59.3%
Health Sciences	73.5%

Self-elaborated from data extracted of MEC (2005 c)

Bearing in mind the data above mentioned, we can conclude that women are underrepresented in scientific and technological fields and that the election of university studies tends to open a gap between girls and boys. Meanwhile boys tend to choose studies which are more socially prestigious and that also entail easy access to the labor market; girls choose studies that lead to a more difficult professional path, basically in terms of entering into the labor setting and of achieving proper professional development. As an example, during the academic year 2002-2003- only about 17.9% of the students enrolled in Computer Science studies were women.

Eccles and her research group (Eccles, 2005; Zarrett and Malanchuk, 2005) have used the metaphor "the leak in the pipeline" to refer to the underrepresentation of women in technological studies, despite their excellent performance in technologically related domains, such as mathematics, science or IT.

The fact that many female students are enrolled in courses that properly match social stereotypes and the roles that women are supposed to play in our society, calls into question the supposed educational equality that parents, teachers and other social agents provide to both girls and boys.

We also have to take into consideration how, regardless of the relationship between the choice of university studies and better work opportunities, being competent in the use of information technologies is an important requirement in order to gain a good position in both private and public settings.

This study is an attempt to deal with certain psychosocial factors that can be involved in the different attitudes and interests that boys and girls may show regarding new technologies (NT) [2] and computer usage. All these psychosocial variables will contribute to predict the possible stereotyped attitudes toward technologies and computer science, along with the career choices that adolescents finally make in technological fields.

OBJECTIVES

Among the most outstanding aims to be fulfilled with this work we cite the following:

- To analyze the influence of certain psychological and social factors on the attitude that adolescents hold toward new technologies (NT), computers and computer science.
- To investigate stereotypes concerning technology and technological professional paths.
- To explore possible gender differences in attitudes toward computers and computer science.
- To study the moderating effect played by certain contextual variables in terms of gender differences in attitudes toward computers and computer science.
- To go beyond the existing relationship between some psychosocial variables and attitudes toward computers and computer science.

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2 We have used the term New Technologies (NT) to refer to all types of technologies and technological procedures (including also those related to the IT field) than incorporate new designs and improvements.

• To seek a model that contributes to predicting the intention of working in technological fields and the role played by attitudes toward computers and computer science in those future plans.

GLOBAL HYPOTHESES

The hypotheses herein mentioned were formulated to carry out this descriptive and correlational study:

The global hypothesis taken as the starting point of this research is that the process of socialization is different for boys and girls and therefore boys hold more positive attitudes toward new technologies than girls.

• Boys and girls' conception of new technologies and of professions and professionals in technological fields will be congruent with gender roles.

• Girls and boys' usage of the computers will be an extension of gender roles.

• Socialization agents will play an important role in shaping adolescent's computer use and stereotypes regarding new technologies and computer science.

• Boys will hold a more positive attitude toward computers and computer science than girls.

• Certain contextual variables, such as place of origin or social class, will moderate gender differences in attitudes toward computers and computer science.

• Psychosocial aspects (gender identity, academic and occupational motivations, self-concept of computer ability) will play a very important role in elucidating gender differences in attitudes to computer and computer science.

• Boys will show better self-concept of their computer ability than girls; therefore boys will have more intention than girls of enrolling in technological fields.

• Attitudes toward computers and computer science will predict the intention of working in technological fields.

DISTRIBUTION OF THIS DISSERTATION

This dissertation has been divided into eight chapters and a final chapter including the main conclusions of the work.

We would like to draw notice to the fact that this study constitutes a new approach to the study of attitudes toward technologies and computers in the Spanish context. In comparison to other European countries such as Germany, Sweden or the Netherlands, Spain, along with Portugal and France, has a high representation of women in technological studies (Elejiabeitia y López-Sáez, 2004).

Chapter 1. Theoretical frame

In chapter one, we have described in detail the theoretical frame that has inspired both the design and interpretation of our findings. *The model of task achievement* developed by Eccles and collaborators in the early nineteen eighties (Eccles, 1984; 1985) posits how gender socialization interferes with the future choices that peo-

ple make and with the degree of importance they give to certain tasks. This model has been proved to be a good predictor of task choices (Dickhäuser, 2001; Dichhäuser and Stiensmeier-Pelster, 2002a; Eccles and Wigfield, 2000; Zarrett and Malanchuk, 2005; Zarrett, Malanchuk, Davis-Kean and Eccles, 2006).

For this author and her research team, expectancies for goals and task values are an explanation of the future decisions that students make. But these expectancies for goals and task values are under the influx of gender roles and of certain social and cultural pressures present in our society, aspects that contribute as a whole to the formation of our personal and social identity. (Eccles, 1984, 1994; Eccles, Frome, Suk Yoon, Freedman-Doan and Jacobs, 2000; Eccles, Wigfield and Harold, 1993).

This model can be split into two basic components: the one related to the influence of the process of socialization; and the other one related to certain psychosocial variables (such as self-concept of domain ability, success expectations, task value or personal identities). Both components are antecedents of the selection of tasks.

In accordance with this model, personal experiences and immediate social environment influence every individual into acquiring proper self-concept and a perception on what it is important and valuable in life. This also contributes to the selection of those tasks that are closer to the possible expectancies and to the perceived value associated with them.

In our work, we have discussed the main prerogatives and drawbacks of Eccles' model. Among other theoretical approaches that we have considered relevant during the different stages of interpretation of our results, we have to point out how the lack of role models is a handicap for girls who want to pursue a non-traditional, professional path. In line with Bandura (1997), modeling is a very important tool of influence in the process of professional development and promotion. Given the fact that women are normally reluctant to choose those scientific and technical professions –traditionally male domains –the lack of feminine roles in these professions that could be taken as models of reference in order to motivate them to select non-traditional professional paths.

Consistent with Volman and Van Eck (2001), it is crucial that women teachers become involved in computer education classes and that there exist female role models with sufficient skills, knowledge, and positive attitudes to stimulate female students' participation in the use of computer tools.

Finally, we shouldn't forget about the *stereotype threat* and its possible implications in this context. Along with Steele (1997), this threat refers to the potential risks taken by certain stereotyped groups confirming some negative expectations related with their performance in certain tasks. Some theorists (Keller and Dauenheimer, 2003) think that there is a self-regulating mechanism through which women –belonging to the stereotyped group, like those immersed in some non-traditional areas– could exert a degree of control over the negative effects of the mentioned stereotype threat and obtain optimal achievements, free from negative interference. The stereotype threat has been analyzed and studied with different population groups – apart from women –, for example with elderly people (Maas and Cardinu, 2003).

Chapter 2. Methodological aspects

In order to achieve the above objectives and hypotheses, we have used the following methodological intruments:

• *Self concept of computer ability* (Provided by Eccles and collaborators). This scale encompasses 5 five-point Likert items that measure how competent the participants are in using computers (Zarrett and Malanchuk, 2005).

• *Gender association of electronic appliances* (Self-elaborated). This scale consists of five point- Likert items that contain pictures of 12 electronic devices to be rated as masculine, feminine or neither masculine nor feminine.

• *Interests and opinions towards Mathematics, Spanish Language, Computing and English Language* (Harold and Eccles, 1991). Consisting of 4 items that analyze how competent or incompetent the participants think they are at Mathematics, Computing, Spanish and English language and how much they like or dislike the mentioned subjects.

• *Computer use scale*: comprising of 19 items (Self-elaborated and provided by Eccles and collaborators) that measure the real use that adolescents make of computers, along with their behavior on computers.

• *New Technologies Scale* (Provided by Eccles and collaborators). Encompassing 26 sub-scales, with open and closed questions, this scale tries to explore attitudes, experiences and expectations that the participants show toward NT and computer science.

The open questions study possible stereotypes regarding NT and technological occupations.

- Cognitive dimension of attitudes toward computers and computer science

This scale consists of 17 five-point Likert items. We carried out a factor analysis using principal component analysis and varimax rotation, obtaining the next three factors that explain 40.25% of the total variance: attitude toward a a computer science professional's social skills (Cronbach's alpha=.74), computer vision (Cronbach's alpha=.64) and attitude toward computer science professional's intellectual aptitudes (Cronbach's alpha=.49). Reliability of the global scale is good (Conbrach's alpha=.74).

In order to study gender differences in computer use and behavior on computers and in stereotypes regarding technology and technological occupations, along with group comparisons between those with favorable and unfavorable attitudes toward computers and computer science in the mentioned variables, we proceeded to dicotomize the cognitive dimension of attitudes by the median (Mdn=2.294). Those participants with scores above [3] the median were considered to have unfavorable attitudes, and those with scores below the median were considered to have favorable attitudes toward computers and computer science.

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3 The lower score, the more favorable attitudes toward computers and computer science.

- *Behavioral dimension:* This scale comprises two items that with a value from 1 to 3 evaluate how many hours per day and per week adolescents spend on computers. We have also used a global scale resulting of the sum of both components.

- *Affective dimension:* Encompassing of 2 four-point items, this scale measures how much the participants enjoy computers and how comfortable they are with them. We have extracted a global dimension resulting of the sum of the two items.

• *Gender identity scale* (Provided by Eccles and collaborators). This scale is comprised of 5 items that attempt to analyze different attributes associated with gender identity.

After recoding the items in order to formulate them in accordance with the gender of our participants, we proceeded to develop a factor analysis that resulted in two components: gender identity congruent with biological sex (Cronbach's alpha=.79) and gender identity incongruent with biological sex (Cronbach's alpha=.76).

• *Occupational Motivations and Interest* Scale (Eccles and Harold, 1991). This scale consists of 22 seven-point Likert items that test the adolescents' future occupational interests.

The factor analysis resulted in four components that accounted for 47.9% of the total variance: a future occupation compatible with personal life (Cronbach's alpha=.76), a social oriented occupation (Cronbach's alpha=.74), a decision-making occupation (Cronbach's alpha=.71) and task motivating occupation (Cronbach's alpha=.40).

Chapter 3. Stereotypes regarding new technologies, technological professions and professionals

In this chapter, we have tried to explore stereotypical beliefs regarding technology and technological occupations. To do so, we have developed Friedman analyses to investigate which of the 12 technological devices are considered more masculine, more feminine or neither masculine nor feminine. X^2 analyses were developed to analyze possible gender similarities and differences concerning stereotypical beliefs regarding new technologies and technological occupations.

In order to study differences in stereotypical beliefs about new technologies and technological occupations between those adolescents with positive and negative attitudes toward computers and computer science, we have carried out analyses of difference of proportions.

We have found that certain electronic appliances, such as the vacuum cleaner, the hairdresser and the washing machine are considered as the most feminine; meanwhile the computer, the videogame console and the modem are considered the most masculine appliances. Boys consider that the computer is more masculine than feminine.

Generally speaking, our participants associate new technologies with technological advances, along with future prospects, telecommunication and the Internet and other technological appliances, such as MP3, Minidiscs or USB's. Girls, contrary to boys, do not mention improvements in software, products and appliances. Girls with a negative attitude toward computers and computer science mention difficulties in using technologies.

Furthermore, although boys and girls think about technological occupations, such as computer science professionals, engineering or telecommunications, girls associate new technologies with all types of professions and with medicine; meanwhile boys do it with professions that are related to construction and agriculture.

The *multi-component approach* developed by Deaux and Lewis (1984) has been very useful for analyzing those physical, personality and occupational traits normally associated with the person involved in technological occupations and in computer science. Adolescents mention more masculine than feminine examples of people who have had a successful professional path in technological fields, such as Bill Gates or Einstein. They also cite people belonging to their immediate social context, which could be a sign of the lack of feminine role models in this context. The most positive characteristics of personality associated with people working in technological fields are related to intellectual attributes, such as brightness or creativeness; on the contrary, the most negative characteristics of personality related to these people are attributes such as freaks, geeks or lacking a social life.

Among the physical features associated with people involved in technological fields, we can mention some allusions to bald people and people wearing glasses. Some adolescents relate high socioeconomic status to this group of professionals.

We have found no gender difference in the advice received by adolescents in order to pursue technological studies, although they differ in the type of study recommended by their immediate social environment. Meanwhile boys mention having been encouraged to pursue technological studies; girls cite having been encouraged to enroll in Social Science studies. More boys than girls declare to have received the advice of their friends to enlist in technological studies. Among boys, those who hold a more positive attitude toward computers and computer science state having received their father's advice.

Regarding professional expectations in the technological environment, more boys than girls have considered the intention of working in technological fields, which is also related to holding a positive attitude toward computers and computer science. We have observed gender some differences in the type of occupation related to new technologies that our adolescents have considered pursuing in the future, occupations that are congruent with existing role stereotypes. Boys mention occupations such as engineering, programming or web-design; but girls allude to occupations that are linked with health sciences, cinema, marketing and publicity or company management.

Among the low rate of adolescents (60 boys and 47 girls) who cite having tried to get information about the requirements to be fulfilled in order to enlist in technological studies on their own, more boys than girls state having searched for information on internet. Among adolescents who mention not having adopted an active role in informing themselves about those qualifications, they explain their lack of interest in technological studies or the fact that they had been informed by other, significant people.

There are few adolescents (13.1% boys and 15.1% girls) who mention explicitly having avoided taking a Computing class and explaining that computers can become contaminated by viruses, or that their teachers were not good enough or that they do not like computers at all, or that technologies isolate people from their social environment.

Chapter 4. Computer usage and behavior

In chapter four, we have used X^2 analyses to study gender differences in computer use, along with the behavior displayed by adolescents on the computer and how this is related to attitudes toward computers and computer science. We have developed analysis of difference of proportions in order to study differences in computer usage and behavior on the computer between those adolescents with favorable and unfavorable attitudes toward computers and computer science.

Most of our adolescents confirm having at least one computer in their house. Boys and girls use the computer in different places, but boys specifically declare more frequently than girls to use the computer in their friends' home. This finding confirms the recreational use that boys make of the computers.

Contrary to other authors' findings (Nelson and Cooper, 1997; Ruiz-Ben, 2001; Shashaani and Khalili, 2001), we have not found gender differences in computer use at school. Among the few adolescents who state not having computer at home, boys reveal wanting to have a computer as a way of accessing information.

Boys use the computer for fun and girls use it for a range of different purposes and for instrumental reasons, such as to do their homework, to download programs and music from the Internet, to watch films or to chat with friends. These results support other findings in the literature (Busch, 1993; Colley, 2003; Harris, 1999; Joinson, 2003).

Computer games that boys and girls use emphasize gender roles (Martin, 1999). Boys play games that entail competition and aggression, meanwhile girls play games where they have to interact with other people and that stimulate their social skills. These findings support other studies found in the literature (Kamala-Morris, 2004, Pinkard, 2005).

We have also observed that social influence, exerted by significant others, plays a crucial role in reinforcing the mentioned gender differences in the behavior on the computer which our adolescents manifest. A father's encouragement to use computers seems to be fundamental for girls, in general, and for boys who hold a positive attitude toward computers and computer science in particular. Specifically, the arguments given by others to encourage adolescents' computer usage reflect girls' instrumental computer use (arguments such as computer utility for obtaining information, learning new things and achieving improved future opportunities) and the more *recreational* use that boys make of computers (boys mention more frequently using computers for playing games).

Finally, we have found that boys, especially those who hold a positive attitude toward computers and computer science, use computers more frequently than girls. Girls on the contrary, make a more moderate usage of computers than boys. Parental discouragement from using the computer supports boys' immoderate computer usage because excessive computer use could result in less time being spent on doing their academic duties and other leisure activities.

Chapter 5. Attitudes toward computers and computer science

The main aim of this part of the study consists of analyzing gender differences in attitudes toward computers and computer science and how these gender diffe-

rences are moderated by the influence of the next contextual variables: computer possession, social class, occupation of the mother, domain of Bachillerato chosen and to be chosen.

Following McGuire's dimensional perspective of attitudes (McGuire, 1985), we have distinguished three dimensions of attitudes toward computers and computerscience: *a cognitive dimension*, referred to beliefs about computers and computer science; *an affective dimension*, related to how much our adolescents enjoy the computer and how comfortable they are with it; and *a behavioral dimension*, associated with the daily and weekly hours of adolescents' expenditure on computers.

In order to proceed with the data analyses, we have used every sub-component of the three dimensions of attitudes toward computers and computer science, along with the global scales.

Correlations between the three dimensions of attitudes toward computers and computer science and their respective sub-components reveal that girls obtain lower correlations than boys when all the components of the affective dimension and the number of hours spent weekly on the computer are taken. In girls, lack of correlations between computer science professional's social skills and a computer science professional's intellectual aptitudes could indicate that both constructs measure different things. For girls, both components of the behavioral dimension of attitudes toward computers and computer science correlate lower than for boys with all components of cognitive dimension of attitudes toward computers and computer science.

5.1. Gender differences in attitudes toward computers and computer science

Regarding the cognitive dimension of attitudes toward computers and computer science, one-way ANOVAs show that boys tend to hold a more positive attitude toward the intellectual aptitudes that computer science professionals are supposed to have and girls tend to hold a more positive attitude toward the supposed social skills that these professionals are thought to have. No gender differences have been extracted in computer vision and global beliefs about computers and computer science. These findings partially confirm our predictions: we expected boys to hold more positive global beliefs about computers and computer science and a more favorable computer vision than girls.

Considering the affective dimension of attitudes toward computers and computer science, one-way ANOVA illustrates that boys enjoy using computers more than girls and that they feel more comfortable with them. These findings provide support to our predictions and confirm the emotional tie that boys seem to have with computers.

With regards to the behavioral dimension of attitudes toward computers and computer science, one-way ANOVA demonstrates that boys spend more hours daily and weekly on computers than girls, which confirms our predictions and other authors' findings (Dickhäuser, 2001; Dickhäuser and Stiensmeier-Pelster, 2002a; Nelson and Cooper, 1997; Shashaani, 1994; Volman and van Eck, 2001).

5.2. Moderating role played by contextual variables

Multiple-factor ANOVA's have been developed to test the moderating role played by the following variables: adolescents' place of origin, computer possession, social class, occupation of the mother, and domain of *Bachillerato* chosen or to be chosen.

5.2.1. Place of origin

a) Cognitive dimension of attitudes toward computers and computer science

2x2 ANOVA shows a main effect of sex on computer science professionals' social skills and intellectual aptitudes and a significant main effect of place of origin on computer science professionals' intellectual aptitudes. Adolescents from rural areas hold a more positive attitude toward computer professional's intellectual aptitudes than those from urban areas.

Interaction between sex and place of origin on a computer science professional's social skills and intellectual aptitudes is a sign of how the effect of sex is moderated by place of origin. Boys from urban areas and girls from rural areas hold a more positive attitude toward computer science professional's social skills. At the same time, girls from urban areas and boys from rural areas hold a more positive attitude about computer science professional's intellectual aptitudes than girls from rural areas and boys from urban areas. These findings could be explained by the salience of social skills in rural areas and of intellectual aptitudes in urban ones.

b) Affective dimension of attitudes toward computers and computer science

2x2 ANOVA shows a main effect of sex on the two components and the global affective dimension toward computers and computer science, which supports the above findings. The lack of interaction between sex and place of origin does not support the predicted moderating role played by place of origin with regard to this dimension.

c) Behavioral dimension of attitudes toward computers and computer science

2x2 ANOVA demonstrates that boys use computers more frequently than girls and that adolescents from urban areas use computers more frequently than those from rural ones. Interaction of sex and place of origin reveals that boys and girls from urban areas use computers more hours per week and in general than boys and girls from rural contexts. These findings could be a result of the salient role played by computers in urban areas compared with the fact that people from rural areas have more opportunities to spend their free time on activities that have nothing to do with computers.

5.2.2. Computer Possession

a) Cognitive dimension of attitudes toward computers and computer science

2x2 ANOVA shows a main significant effect of sex on computer vision, a a computer science professional's social skills and global beliefs about computers and computer science. Girls hold a more positive vision of computers than boys, a more positive attitude toward computer science professional's social skills and more positive global beliefs about computers and computer science than boys.

A main significant effect of possession of computers at home illustrates that, in accordance with our predictions, adolescents who have a computer at home hold more positive attitudes toward computer science professional's social skills and more favorable global beliefs about computers and computer science than adolescents who do not have computer at home.

The interaction of sex and computer possession at home confirms the moderating role played by computer possession. Boys who have computer access at home hold a more positive vision of computers and more positive global beliefs about computers and computer science than boys who do not have one. Girls without computer access at home hold a positive vision of computers and more positive global beliefs about computers and computer science. Boys and girls with computer access at home hold a more positive attitude toward a computer science professional's social skills than those who do not have computer at home.

b) Affective dimension of attitudes toward computers and computer science

2x2 ANOVA illustrates a main effect of computer possession on how comfortable adolescents are using the computer. This demonstrates that those adolescents who have at least one computer at home feel more comfortable using computers than those who do not have a computer at home.

Interaction between computer possession at home and sex exhibits that boys who have computer at home enjoy computers more than those who do not have computer at home. Girls who do not have computer at home enjoy using computers more than girls who have computer at home. These findings seem to be paradoxical, but they corroborate that for girls having computer access at home does not guarantee that they feel more affection for computers and computer science.

c) Behavioral dimension of attitudes toward computers and computer science

2x2 ANOVA reveals that boys spend more hours daily, weekly and in general than girls using computers. This finding supports previous ones and reinforces the more proactive attitude that boys seem to have on the computer.

5.2.3. Social class

a) Cognitive dimension of attitudes toward computers and computer science

2x3 ANOVA illustrates a main effect of sex and social class on the computer science professional's social skills, which means that girls and adolescents from the middle class hold a more positive attitude toward computer science professional's social skills than boys and adolescents from other social groups.

Social class interacts with sex, which proves that social class moderates the effect of sex on some components of the cognitive dimension of attitudes. Boys belonging to the middle class hold a more positive vision of computers, a more positive attitude toward computer science professional's social skills and more positive global beliefs about computers and computer science than boys belonging to high and low social classes. On the contrary, lower social class girls have a more positive vision of computers, a more favorable attitude toward computer professional's social skills and more favorable global beliefs about computers and computer science than girls from other socioeconomic status groups.

Girls from lower classes have these favorable cognitive attitudes toward computers and computer science because they possibly consider computers as being a way to ascend the labor and social ladder.

b) Affective dimension of attitudes toward computers and computer science

2x3 ANOVA illustrates a main effect of sex on the two components of the affective dimension and on the global dimension, which emphasizes the affection that boys state feeling for computers. No significant effects were found when social class was considered separately and together with sex, which does not support our predictions regarding the moderating role played by social class.

c) Behavioral dimension of attitudes toward computers and computer science

2x3 ANOVA demonstrates a main effect of sex on daily and weekly usage of computers and on global usage of computers, which confirms that boys spend more time using computers than girls. The lack of interaction between sex and social class on computer usage does not support the predicted moderating role played by social class in the relationship between sex and behavioral attitude toward computers and computer science.

5.2.4. Occupation of the mother

a) Cognitive dimension of attitutdes toward computers and computer science

2x2 ANOVA reveals a main effect of sex on a computer science professional's social skills, so reinforcing previous results in this sense. The interaction of sex and occupation of the mother demonstrates the moderating role of the occupation of the mother. Boys whose mother has an occupation outside the home hold a more positive vision of computers and more positive beliefs about computers and computer science. On the contrary, girls whose mother has no occupation outside the home hold a positive vision of computers and more favorable beliefs about computers and computer science.

Contrary to mothers with an occupation outside their home, those mothers who are only home-keepers can exert more control over the time that their children –more specifically their sons– spend on computers.

b) Affective dimension of attitudes toward computers and computer science

2x2 ANOVA evidences a main effect of sex on the two components and the global affective dimension of attitudes, which supports the fact that boys are more emotionally tied to computers than girls. No significant effects were found when the occupation of the mother is taken separately and together with sex, which does not support the prediction of the moderating role played by occupation of the mother.

c) Behavioral dimension of attitudes toward computers and computer science

2x2 ANOVA illustrates that boys use computers more hours per week than girls. Interaction between sex and occupation of the mother reveals that boys whose mother has a profession outside their home use computers more hours per week. On the contrary, and supporting previous results, girls whose mother has no occupation outside the home use computers more frequently than girls whose mother does have an occupation outside.

These results could demonstrate, on one hand, the immoderate usage carried out by boys when their mothers do not control the time they spend on computers and on the other hand, the lack of interest that girls whose mother has an occupation outside have in using computers.

5.2. 5. Domain of Bachillerato chosen

a) Cognitive dimension of attitudes toward computers and computer science

2x3 ANOVA illustrates an interaction effect between sex and dimension of *Bachillerato* chosen, which at the same time evidences the moderating role played by the Domain of *Bachillerato* chosen. Positive beliefs about computers and computer science are more salient in technological than in other domains. Therefore, adolescents who have chosen the domain of Technology in secondary education hold more positive beliefs about computers and computer science and more favo-

rable attitudes toward a a computer science professional's social skills than adolescents who have chosen other domains.

b) Affective dimension of attitudes toward computers and computer science

2x3 ANOVA shows a main effect of sex on the two components of the affective dimension of attitudes toward computers and computer science and on the global affective dimension. This result supports the idea that boys are more emotionally tied to computers than girls.

No significant effects were found when taken domain of *Bachillerato* chosen separately and together with sex, which doesn't confirm the predicted moderating role played by domain of *Bachillerato* chosen.

c) Behavioral dimension of attitudes toward computers and computer science

2x3 ANOVA reveals that boys spend more time on computers and that, at Bachillerato level, adolescents who have chosen the technological domain spend more time using computers than those who have chosen the domain of Biology and Health Science and of Humanities and Social Sciences. A lack of interaction between sex and domain of *Bachillerato* chosen does not confirm the predicted moderating role of domain of *Bachillerato* chosen.

5.2.6. Domain of Bachillerato to be chosen

a) Cognitive dimension of attitudes toward computers and computer science

ANOVA 2x5 exhibits only a main effect of domain to be chosen on computer vision. Therefore, adolescents who have chosen Arts, those who mention the possibility of not continuing to study and those who have selected Technology hold a more favorable vision of computers.

b) Affective dimension of attitudes toward computers and computer science

2x5 ANOVA reveals no significant effects of domain to be chosen on any affective component of attitudes toward computers and computer science when taken alone or together with sex.

c) Behavioral Dimension of attitudes toward computers and computer science

2x5 ANOVA displays that those adolescents who plan not to continue studying and those who plan to choose the technological domain spend more hours

daily and weekly using computers. Interaction between sex and domain to be chosen shows that boys who plan to choose the domain of Humanities and Social Science or to discontinue studying, spend more hours using computers. On the contrary, girls who plan to choose the technological domain confirm spending more time using computers. The technological dimension to be chosen seems to be more salient for girls than for boys.

Chapter 6. Gender identity, self-concept of computer ability and utility of Computing classes for the future academic and professional paths

The main purposes of this chapter are the following: to test gender differences in gender identity, self-concept of computer ability and perceived utility of Computing classes for future academic and professional paths, along with the moderating role played by some contextual variables in explaining the possible gender differences; and at the same time, to test the degree of association of these variables with all dimensions of attitudes toward computers and computer science.

One-way ANOVAs were carried out in order to analyze gender differences in all psychosocial variables. Multiple ANOVAs were developed to verify the moderating role of certain contextual variables in the mentioned gender differences in those psychosocial aspects.

Correlation analyses to corroborate the relationship between these psychosocial variables and all dimensions of attitudes toward computers and computer science.

6.1. Gender identity

We have observed that boys find behavior incongruent with biological sex more disruptive than girls. Correlations between the two components of gender identity and the cognitive dimension of attitude toward computer and computer science reveal that holding favorable beliefs about computers and computer science correlates both in boys and girls with having a high gender identity congruent with biological sex and with a low gender identity incongruent with biological sex only in boys.

Regarding the correlation between gender identity and the affective dimension of attitudes toward computers and computer science, for girls, having an emotional tie with computers correlates with having a gender identity congruent with biological sex. Gender identity does not correlate with the usage that adolescents make of computers.

6.2. Self-concept of computer ability

One way ANOVA reveals that boys have a higher self-concept of computer ability than girls. This finding confirms our expectations and other findings (Eccles, 1984; Eccles, Frome, Suk Yoon, Freedman-Doan and Jacobs, 2000; Hannover and Kessels, 2004).

2x2 ANOVA also shows that adolescents who have at least one computer at home have a better self-concept of computer ability than those who do not have a

computer at home, which confirms our predictions (Zarrett, Malanchuk, Davis-Kean and Eccles, 2006). Age moderates the relationship between sex and self-concept of computer ability and reveals that younger adolescents have a higher self-concept of computer ability than remaining age groups. This finding provides support to Eccles' assumptions (Eccles, 1987, 2001), because as girls get older they have a lower self-concept of computer ability than boys.

The self-concept of computer ability correlates positively with all the dimensions of attitudes toward computers and computer science, which anticipates the important role that self-concept of computer ability plays in holding favorable or unfavorable attitudes toward computers and computer science.

6.3. Perceived utility of Computing classes for the future academic and professional paths

Contrary to our predictions and to Eccles' (Eccles, 1984; Eccles, Barber, Jozefowicz, 1999; Wigfield and Eccles, 2000), we have not found gender differences in the perceived utility of Computing classes for future academic and professional paths. But adolescents who come from rural areas perceive more utility of Computing classes than those from urban contexts. This finding could be associated with the fact that adolescents from rural areas perceive that computers could mean a way of attaining certain social mobility.

That early adolescents perceive more utility of Computing classes than the other age groups could be explained by the idealistic view of computers that these adolescents have or to the lack of utility of Computing classes perceived by the older adolescents who have experienced this type of class. Maybe these classes are not well designed to capture the interest of these students or to meet their needs.

2X3 ANOVA reveals a main effect of domain of *Bachillerato* chosen on the perceived utility of Computing classes. Adolescents who have chosen the technological field consider Computing classes to be more useful. Perceived utility of Computing classes correlates with most of the components of the cognitive dimension of attitudes. In girls, it also correlates with all affective components of attitudes, which emphasizes how girls seek an emotional attribute in their use of computers.

Chapter 7. Academic and Occupational motivations and interests

In this chapter, we have tried to investigate possible gender differences regarding academic and occupational motivations and interests, and their association with all dimensions of attitudes toward computers and computer science.

7.1. Academic motivations

X2 analyses show that boys feel more competent at Computing and, on the contrary, girls feel more competent at English language. More girls (48.1%) than boys (34.5%) feel less competent in Mathematics than in the other subjects.

2x4 ANOVAs show that adolescents who feel competent in English and Computing hold a positive vision of computers and of a computer science professional's social skills, along with favorable beliefs about computers and computer science. Boys state feeling more comfortable using computers and enjoy them more than their female counterparts. Those adolescents who feel competent in English and Computing spend more daily and weekly hours on computers. These results could be explained by the close link between English literacy and using certain computer tools such as the Internet to do effective searches on the web.

Congruently with our predictions and as expected, feeling competent in Computing correlates with all dimensions of attitudes toward computers and computer science.

7.2. Occupational motivations and interests

Girls value a more socially oriented occupation, which is also compatible with their personal life, more favorably than boys. This finding supports Eccles' and other authors' results (Eccles, Barber and Jozefowicz, 1999; Gonzalez and Zarco, 2004), which is consonant with gender stereotypes.

2x2 ANOVA evidences that place of origin moderates gender differences in occupational motivations and interests. Adolescents from urban areas would like to have an occupation through which to manage people and make important decisions. That people in rural areas are more likely to run their own business could explain the greater interest that boys from rural areas have in developing a job where they can manage people and make important decisions. At the same time, the finding that boys from urban areas and girls from rural areas would like to have a job compatible with their personal life could be explained by the perception of both groups of future interference between their jobs and their personal life.

2x3 ANOVA reveals that according to our predictions, adolescents who have chosen Technology in the pre-university years are interested in entering a profession which is task motivating and an occupation where they can manage people and make important decisions. The domain chosen moderates the effect of sex on occupational motivations and interests: boys who have chosen Humanities and Social Sciences and girls who have chosen Technology show interest in achieving an occupation compatible with their personal life (Sáinz, López-Sáez and Lisbona, 2004). Those adolescents who plan to choose Technology and Humanities and Social Sciences are more interested in a task motivating occupation.

Correlations among the dimensions of occupational motivations and interests emphasize the importance that boys and girls give to an occupation compatible with personal life, a socially-oriented occupation and a decision-making, people managing occupation. Feeling comfortable with computers and enjoyment of them entail, for both boys and girls, being interested in a profession compatible with personal life.

Chapter 8. Predicting model for the intention of working in technological fields

In order to find a predictive model for the intention of working in technological fields and due to the qualitative nature of the variable intention of working in technological fields, we proceeded to carry out logistic regression analyses.

To do so, we carried out the following steps:

Firstly, we carried out a regression analysis that reveals that sex, age, advice on enrolling in technological studies, self-concept of computer ability and being motivated for a task-demanding profession are the best predictors of the intention to work in technological fields. These results illustrate that the older the adolescent and the higher their self-concept of computer ability, the more likely they are to have the intention of working in technological fields. Boys and adolescents who have received advice on studying technological paths and who are interested in a task motivating occupation will be more likely to intend to work in technological settings.

Secondly, as self-concept of computer ability was the best predictor of the intention of working on technological fields, we decided to carry out a multiple linear regression analysis to investigate which of the variables best predicted self-concept of computer ability. This analysis demonstrated that the three dimensions of attitudes toward computers and computer science, as well as the perceived utility of Computing classes, were the best predictors of the self-concept of computer ability. All these variables explained 42.5% of the variance of self-concept of computer ability.

Then and as a third step, we developed a logistic regression analysis to study the modular effect of sex in the relationship between the three dimensions of attitudes toward computers and computer science, along with perceived utility of Computing classes, and the intention of working in technological fields. We found that sex only moderated the relationship between the cognitive dimension of attitudes toward computers and computer science. In this way, girls and boys who hold positive beliefs about computers and computer science are more likely to have the intention of working in technological fields than girls and boys who do not hold such positive beliefs about computers and computer science. This effect was stronger in boys than in girls.

Fourthly and in order to investigate the mediational role of self-concept of computer ability, we developed other logistic regression analyses. We observed that self-concept of computer ability played a partial mediational role between sex and the intention of working in technological fields and a total mediational role between all dimensions of attitudes toward computers and computer science and perceived utility of Computing classes for the future academic and professional path and the intention of working in technological fields.

Chapter 9. Conclusions

Although we have taken Eccles' model of achievement as a reference for the design and interpretation of the main findings, we have used some of its contructs and have included some variations to it in order to be congruent with our objectives

and hypotheses. As we have observed, not all our findings provide support for Eccles' model of achievement.

Boys and girls show certain stereotypical beliefs about technologies and technological occupations, which are consonant with gender roles. Adolescents plan to enroll in those studies congruent with social roles and tend to think that technological jobs are a masculine activity. More boys than girls cite their intention of working in technological fields.

Adolescents' usage and vision of computers are constant with stereotyped roles, which is reinforced by influence of significant others. Contrary to the recreational usage that boys make of computers, girls make an instrumental usage of them. Computer games, for instance, contribute to promoting the distribution of gender roles: boys play competitive and violent computer games.

The three dimensional perspective of attitudes toward computers and computer science is a contribution of our research into the study of gender differences in attitudes toward computers and computer science. As we have observed, boys and girls do not show differences in the global cognitive component of attitudes attitude toward computers than girls, but they differ in some its componets. On one hand, girls hold positive attitudes toward a computer science professional's social skills, while boys hold positive attitudes toward computer science professional's intellectual aptitudes. These findings are congruent with gender roles: girls attach more value than boys to social skills because for them being able to communicate with others and having social relationships is crucial. On the other hand, boys use computers for more hours and show more affection for computers than girls.

Certain gender differences concerning attitudes toward computers and computer science are more salient in certain contexts such as in rural areas, in technological domains, in girls belonging to low class groups or in boys whose mother has an occupation outside the home.

In comparison to girls, boys find having a gender identity incongruent with biological sex (acting and behaving contrary to stereotypes) more disruptive than girls. Contrary to our expectations, gender identity does not play an important role in the prediction of the intention of working in technological fields.

It is not surprising that boys declare having a higher self-concept of computer ability than girls. Early adolescents have higher self-concept of computer ability than adolescents from other age groups. Self-concept of computer ability correlates with all dimensions of attitudes toward computers and computer science.

Contrary to our predictions, we have not found gender differences in the utility of Computing classes for the future, which could be a result of the poor quality of these classes with regard to meeting students' needs and reaching their level of computer competence.

Occupational motivations regarding future profession are in the line of gender roles. More girls than boys prefer a future profession compatible with their personal life and a socially demanding future profession. These gender differences are moderated by the effect of place of origin and of domain of *Bachillerato* chosen.

Attitudes toward computers and computer science and utility of Computing classes for future academic and occupational trajectories have an indirect effect, through self-concept of computer ability, on the intention of working in technological fields. This finding highlights the crucial role played by attitudes and the value

attached to Computing classes in predicting - in an indirect way - the intention of working in technological fields. This result is also a contribution of our work to the study of attitudes toward computers and computer science under a task achievement perspective. Although having the intention of working in technological fields does not reveal whether the person will finally choose technological fields or not, this is an important finding that reinforces the proximity of attitudes to the self (Swanson, Rudman and Greenwald, 2001).

Sex moderates the relationship between cognitive dimension of attitudes toward computers and computer science and the intention of working in technological fields. This finding reveals the important role played by cognition when trying to explain gender differences in the intention of working in technological fields.

9.1. Suggestions for future reseach

Among the suggestions for future research, we should mention the following:

• To include contextual variables in the study of attitudes toward computers and computer science as a complement to gender perspective.

• To carry out a comparative study between co-educational and single sex schools in order to investigate whether gender differences are more salient in one context than in the other.

• To develop an investigation in the European context with the same characteristics as this, in order to further understand the higher presence of women in technological studies in Spain compared to other European countries.

• To investigate the role played by teachers and mass media in fostering or otherwise the adolescents' stereotypical image of technological fields.

• To design a longitudinal study that analyzes the final academic and professional trajectories pursued by boys and girls.

9.2. Proposals for intervention

Regarding proposals for intervention addressed to reduce gender gaps in technology and technological fields, we could cite:

• To foster from very early years girls' interest and contact with technology and computer programming.

• To design training and interventional programs whose main goal is the improvement of girls' self-concept of computer ability.

• To make women's presence in thecnological occupations more salient, thereby acting as role models for younger women interested in enrolling in these professional paths.

• To plan educational programs in schools that attempt to reduce the masculine image that technology and computer science have in different mass media.

• To encourage women's contribution and participation in the design of technological devices and computer software.

To adjust Computing classes to the students' level of competence and to improve its instrumental image relating to their academic and professional future needs.