How can we enhance girls’ interest in scientific topics?

Sylvie Kerger*, Romain Martin and Martin Brunner
Center for Educational Measurement and Applied Cognitive Science, University of Luxembourg, Luxembourg

Background. Girls are considerably less interested in scientific subjects than boys. One reason may be that scientific subjects are considered to be genuinely masculine. Thus, being interested in science may threaten the self-perception of girls as well as the femininity of their self-image.

Aims. If scientific topics that are considered to be stereotypically feminine were chosen, however, this potential threat might be overcome which, in turn, might lead to an increase in girls’ interest in science. This hypothesis was empirically tested by means of two studies.

Sample. Participants were 294 (Study 1) and 190 (Study 2) Grade 8 to Grade 9 students.

Method. Gender differences in students’ interest in masculine and feminine topics were investigated for a range of scientific concepts (Study 1) as well as for a given scientific concept (Study 2) for four scientific subjects (i.e., biology, physics, information technology, and statistics), respectively.

Results. Both studies indicated that the mean level of girls’ scientific interest was higher when scientific concepts were presented in the context of feminine topics and boys’ level of scientific interests was higher when scientific concepts were presented in the context of masculine topics.

Conclusion. Girls’ interest in science could be substantially increased by presenting scientific concepts in the context of feminine topics. Gender differences as well as individual differences in the level of interest in scientific topics may be taken into account by creating learning environments in which students could select the context in which a certain scientific concept is embedded.

The ‘swing away from science’ tendency is common in many countries. In Germany, for example, the percentage of students choosing natural sciences as a major subject has decreased by about 50% within the last 20 years (Zwick & Renn, 2000). The dwindling number of students in the UK engaging in scientific fields such as biology, physics,
statistics, or information technology\(^1\) has become a matter of great social concern (House of Lords, 2000) as it is well known that members of these scientific disciplines contribute strongly to a nation’s economic growth and well-being. Furthermore, the swing away from science may potentially cause more concern in the future as there is an ever-increasing need on the job market for individuals who are highly trained in scientific subjects: For example, whereas the overall rise in employment opportunities in the United States in the coming decade is assumed to be around 14\%, employment opportunities in science-related fields are expected to increase by over 50\% (Committee on Equal Opportunities in Science and Engineering, 2000, section 5).

It is important to note at this point that several empirical studies have shown that the choice of occupation and academic subjects is not directly influenced by a person’s subject-specific ability *per se* but rather is regulated by students’ attitudes and interests (Arnot, David, & Weiner, 2001; Harackiewicz, Barron, Tauer, & Elliot, 2002; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Köller, Baumert, & Schnabel, 2001). Thus, a lack of interest in science at the high school level may eventually pose a serious threat to economic prosperity. There is worrying evidence to support this theory: When students were asked to rank school subjects according to personal preference, typically, scientific subjects are at the lower end of the scale (Zwick & Renn, 2000). Moreover, compared to other subjects, students’ decrease in interest in scientific subjects is particularly marked (Todt, 1978; Todt & Schreiber, 1998) and this downward trend is most evident in subjects such as physics and chemistry (Löwe, 1987).

Crucially, there are also considerable gender differences in interest levels in scientific subjects: Boys are far more likely than girls to claim to like science (Osborne, Simon, & Collins, 2003), and the decrease in interest in science amongst girls is even more pronounced than amongst boys (Hoffmann, Häußler, & Peters-Haft, 1997). This is somewhat surprising, as nowadays girls on average perform as well as, if not better than, boys in many scientific subjects (Elwood & Comber, 1995; Spelke, 2005). Furthermore, even if girls have the same level of competence in science as boys, girls will engage considerably less often in scientific subjects (Baudelot & Establet, 1993). Consequently, it might be suggested that the gender gap in interest in science could lead, in turn, to an over-representation of boys in scientific fields and occupations, a trend that can already be observed (Faulstich-Wieland & Nyssen, 1998; Halpern, 2000; Kimura, 1999; National Science Foundation, 2002) and one that will most likely continue in the future.

In sum, the job markets of modern societies require more and more individuals with a good scientific education. Furthermore, although boys and girls have almost equal abilities in scientific subjects, girls are considerably less interested in these subjects and therefore less likely to choose scientific subjects to study at the university level or occupations in the scientific field. Thus, in order to make more use of the female talent pool to fill the ever-increasing number of job vacancies in the scientific field, it is essential to question how we can better cultivate girls’ interest in science.

This paper will suggest ideas about how this can be done. To this end, we combine theoretical assumptions on the interplay between self-development and gender stereotypes (Hannover & Kessels, 2004) with current models on interest development (Hidi & Renninger, 2006) in order to develop a measure of how girls’ interest in

\(^1\) In accordance with the yearly report ‘\textit{Education at a glance}’ of the Organisation for Economic Co-operation and Development (Organisation for Economic Co-operation and Development, 2005), we conceive science in the present study as a rather broad term covering subjects such as physics, biology, information technology, and statistics. Consequently, by using the term \textit{scientific interests} we refer to interest in any of these scientific subjects.
science may be enhanced. Our guiding hypothesis is that girls’ interest in science can be cultivated by introducing scientific subjects using topics that are considered to be stereotypically feminine. The use of such feminine topics has the potential to enhance the personal relevance of the scientific subjects to girls and thus increase their topic-specific interest for science. Two quasi-experimental studies empirically support our predictions.

**Theoretical framework**
The following sections provide an analysis of current theories on subject-specific interests and self-development. The focus is on those theoretical aspects that may help to develop a pedagogical concept in order to increase girls’ interest in science. The next section will first give an introductory account of the conception and development of subject-specific interests.

**Interest: Definition and development**
In educational and psychological research, students’ interest has received increasing attention as level of interest has been found to have a positive influence on student learning by increasing their attention, enabling goal-directed learning behaviour, and increasing the elaboration level of the learning material (Hidi & Renninger, 2006). Among the detailed theories on interest, two types are typically distinguished: situational interest and individual interest (Hidi, 2006; Hidi & Renninger, 2006; Krapp, 2002). Furthermore, and of particular importance for the present study, some researchers (Ainley, Hidi, & Berndorff, 2002) also add topic interest as a third type of interest. The three types of interest are described in the following.

**Individual interest** is a relatively stable individual motivational disposition towards specific objects of interest and is characterized by increased attention and (in most cases) positive affect and emotions (Hidi, 2006). The object of interests can be concrete things, a particular content, events, or ideas.

Individual disposition towards interest is characterized by the tendency of individuals to re-engage with an object of interest and thus represents a relatively stable person-object relationship (Krapp, 2002). Thus, in the educational context, interest in science represents a student’s enduring disposition to engage in scientific school subjects (which represent the objects of interest, e.g., physics).

**Situational interest**, by contrast, is triggered by the environment, and is characterized by a state of actual attraction or curiosity as well as increased attention (Ainley et al., 2002; Hidi, 2006). Situational interest comprises two phases. In the first phase, situational interest is triggered and in the second phase, situational interest is sustained (Mitchell, 1993). For example, the physics teachers may trigger the students’ situational interest by presenting a surprising experiment on how electricity may cause their hair to stand on end. In order to maintain the students’ situational interest, the teacher then asks the students to further elaborate on the topic by engaging in co-operative group work to conduct further experiments on voltage.

**Topic interest** is closely associated with both situational interest and individual interest. It is characterized by an anticipatory response triggered by the presentation of topics and themes. Crucially, topic interest can result from the activation of individual interest as well as of situational interest, and it may be viewed as the degree of interest that is generated from the sum of these two types of interest. On the one hand, if students were presented with the topic, ‘functioning of a laser illustrated by its use in cosmetic
surgery’, for example, some students might find it interesting as it is closely related to their subject-specific individual interest in physics. On the other hand, some students may find the topic interesting because their situational interest is activated by the presentation of pictures of prominent actors or musicians who have undergone cosmetic surgery. For these latter students, we will use their individual interest in cosmetics and show business in order to create situational interest for the main scientific topic that would normally not activate their individual interest on its own.

Given the positive influence of interest on subsequent learning and behavioural outcomes, the question of how interest develops becomes central. Hidi and Renninger (2006) have summarized the existing literature on interest development and proposed a four-phase model of interest development, which can be briefly summarized as follows. In the first phase, situational interest is triggered, for example, by environmental conditions such as, group work, computers, puzzles, incongruous or surprising information, character identification, and – of immediate importance for the present study – personal relevance. In the second phase, situational interest is maintained through instructional methods, such as project-based learning, cooperative group work, or one-to-one tutoring, as well as by the meaningfulness of tasks and/or by personal involvement. In the third phase, individual interest emerges characterized by positive feelings, knowledge, and a deliberate choice to re-engage with and, indeed, to value the object of interest. However, an emerging individual interest, although self-generated to some extent, still needs some external support (e.g., from peers or teachers), particularly if the engagement with the object of interest requires substantial effort and confronts students with difficulties. In the fourth phase, a well-developed individual interest (as characterized above) has developed and will be cultivated by providing challenging opportunities that allow for further knowledge building.

This four-phase model of interest development allows some very significant conclusions to be drawn about how girls’ interest in science can be enhanced. Given that science teachers can only rarely expect a well-developed interest in their subject (Zwick & Renn, 2000) and, especially not amongst girls (Osborne et al., 2003), a promising educational tool could be developed if science teachers were to create and maintain girls’ situational interest in science through the introduction of non-scientific contexts and illustrations that are known to activate girls’ individual interests (Krapp, 1998; Mitchell, 1993). This could potentially evolve into individual interest for the targeted scientific subjects themselves. As outlined above, girls’ situational interest in scientific subjects can be assumed to be (a) triggered, and (b) maintained if scientific topics are made personally relevant to them and if they are personally involved. Moreover, given appropriate scientific content, teachers could also activate themes that are likely to tap into girls’ individual interests in order to trigger their situational interest for the scientific question under scrutiny. In this respect, girls’ topic interest in scientific subjects can be expected to substantially increase if scientific content is chosen that has personal meaning for girls. The next section will present some theoretical propositions that may sharpen our understanding of how this educational challenge can be met.

**Self-development and gender-specific attitudes towards science**

What makes scientific topics personally relevant and subsequently interesting to girls? An answer can be found in developmental theories of the self. Interest development during adolescence is an essential developmental stage as interests are of great importance to the self: Young people are, in the eyes of others, defined by their interests; interests have
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In this respect, it can be seen that the relationship between stereotypes and interest development has immediate relevance (Hannover & Kessels, 2004). Stereotypes concerning scientific subjects can be conceived of as socially shared beliefs about (a) the image of scientific subjects (i.e., mentally represented characteristics of scientific subjects), and (b) attributes of those individuals (i.e., prototypes) who are interested in these scientific subjects. Significantly, it can be expected that students develop more interest in a school subject if they perceive the subject’s image as good and if they see a great similarity between their own self-image and the prototypical representatives of this subject (Hannover & Kessels, 2004).

However, from the perspective of stereotype theory, scientific subjects seem to have gained a poor reputation. Most girls and many boys perceive prototypical representatives of scientific subjects as unattractive and not well liked (Kessels & Hannover, 2004). Moreover, scientific subjects themselves often have a negative image as well. Girls and boys share the opinion that these subjects offer fewer possibilities to express their own personality than, for example, languages (Kessels & Hannover, 2004). They also perceive the contemporary curriculum of scientific subjects as suffering from an overemphasis on cognitive activities (such as recall or copying) that lack intellectual challenge (Osborne & Collins, 2000).

Consequently, from the perspective of stereotype theory, those girls and boys who are interested in scientific subjects are threatening their self-image. If they are interested in science, they threaten their own self-perception as well as their self-symbolization in two ways: (a) They engage in a subject with a negative image and (b) they could be considered as a representative of a scientific subject and therefore considered as unattractive and not well-liked by their fellow students.

Crucially, in addition to this general effect, which may affect both boys and girls alike, the threat to the self from engaging in scientific subjects seems to be greater for girls than for boys: Generally speaking, scientific subjects can be described as masculine. Men are associated with math and science, whereas women are associated with the arts and humanities (Nosek, Banaji, & Greenwald, 2002). Moreover, male teachers are by far over-represented in scientific subjects (Faulstich-Wieland & Nyssen, 1998). Furthermore, as Hoffmann (2002) notes, the syllabus and the modes of behaviour of male and even female science teachers mainly reflect masculine interests, knowledge, and abilities. For example, in school textbooks scientific subjects are more often presented with a masculine topic than with a feminine topic (Faulstich-Wieland & Nyssen, 1998). Hence, masculine topics can be considered as the standard topics in scientific subjects. Taken together, science is associated with being male and not with being female.

Thus, if girls were interested in science and if they engaged in genuinely masculine subjects, they would threaten their own self-perception as well as their self-symbolization as feminine: prototypical representatives are primarily male, and - with an emphasis on masculine topics - scientific subjects have limited personal relevance for girls during adolescence when they develop their sense of being a woman. It then follows that the answer to the question, ‘How can we make scientific topics personally relevant and subsequently interesting?’ is to present scientific topics in a context that can be considered to be feminine.

**Gender-specific topic interest in science**

Feminine contexts are likely to increase girls’ situational interest in science as the related topics would be relevant to their gender identity per se and an engagement in those topics...
would not represent a threat to the femininity of their self-symbolization. Several studies in this area (Häußler & Hoffmann, 1995, 1998; Hoffmann & Häußler, 1993; Todt, 2000; Todt, Arbinge, Seitz, & Wildgrube, 1974; Todt & Götz, 1998; Todt & Hänel, 1988) are of particular relevance for the present paper as they have empirically identified feminine and masculine contexts for the presentation of scientific topics. In these studies, boys and girls were presented with detailed lists of scientific subjects presented in various contexts. Students were then asked to judge how interesting each subject was.

Hence, feminine contexts are made up of topics in which girls were more interested on average than boys. In this respect, girls showed more interest in physics when the context involved topics covering social or close-to-reality settings (Häußler, 1987). In biology, other feminine contexts involved the descriptions of plants, harvesting, the decline of forests, as well as practical applications of biological knowledge, such as knowing which plants can be cultivated together (Todt & Hänel, 1988). A study by Hoffmann (2002) identified further feminine topics for contextualizing scientific questions, namely those relating to mankind and social involvement.

On the other hand, boys showed more scientific interest when the presentation context involved technology, mechanics, power, motors, energy saving, contamination, nervous system, organs, and the construction of ships or airplanes (Hoffmann, 2002). In the remainder, we refer to these masculine contextual topics as standard topics due to the strong association with science as being masculine (cf. Section 2.2).

In sum, several studies have demonstrated that boys and girls differ substantially in the degree of interest they show in certain topics that can be used as illustrations within scientific subjects. In the following, we consider those contextual topics where significant gender differences have been found as being either feminine or masculine contextual topics. These gender-specific topics represent, moreover, an excellent starting point for an explanation of the present investigation.

The present study
A rigorous investigation of the question: ‘How can we enhance girls’ interest in science?’ is reported in the present paper. To this end, we first conducted an analysis of current theories of interest and its development (Ainley et al., 2002; Hidi, 2006; Hidi & Renninger, 2006; Krapp, 2002; Mitchell, 1993) and integrated this analysis into recent thinking on the functional value of interests for self-symbolizing and self-perception (Hannover & Kessels, 2004). The key theoretical result was that presenting scientific subjects in the context of feminine topics could potentially enhance girls’ interest in science. Such topics are personally meaningful to girls, and moreover, an engagement with such topics (i.e., situational interest) does not threaten the self-perception of girls nor challenge their self-symbolization as female. Preliminary support for this guiding research hypothesis is provided by several studies (Häußler & Hoffmann, 1995, 1998; Hoffmann & Häußler, 1993; Todt, 2000; Todt et al., 1974; Todt & Götz, 1998; Todt & Hänel, 1988), which show that feminine as well as masculine topics have a varying impact on girls’ and boys’ interest in science.

However, since these studies were conducted, many socio-educational policies (e.g., gender equity policies, educational programmes that targeted girls’ scientific interests) may have taken effect. Thus, it is an open question whether girls now demonstrate a higher level of interest in scientific subjects; if this is the case, this may in turn also have caused the gender gap in the level of interest in scientific subjects to become significantly narrower. On the other hand, given that these interests might be at least partly under
genetic influence (Baron-Cohen, 2003), the gender gap in the level of interest in scientific subjects may have remained stable. In the present investigation, we therefore conducted two quasi-experimental studies that examine our research hypothesis. Study 1 analysed whether girls’ interest in the scientific subjects of physics, biology, information technology, and statistics can be fostered by using feminine contextual topics. This study will thus try to replicate some of the results obtained by the older studies mentioned above. This will permit us to verify whether the observed gender preferences for specific topics have not changed over time and whether they are still valid in a different sociocultural context (i.e., Luxembourg). But Study 1 does not only aim to replicate former results. It extends these former studies by the systematic inclusion of both masculine and feminine topics for the presentation of scientific phenomena and by the inclusion of further scientific subjects, such as information technology and statistics, two subjects, which have not yet been analysed. These additional data are needed to show the generalizability of the contextual embedding approach for enhancing interest in scientific subjects. Note that in Study 1, the underlying scientific concepts could vary for masculine and feminine topics. Study 2, therefore, goes one step further by showing that for a given scientific concept (e.g., the functioning of a laser), interest amongst girls can be enhanced by presenting it in the context of a feminine topic (e.g., the use of laser for cosmetic surgery). This is important as (to the best of our knowledge) it has never been shown that the contextual embedding works for exactly the same scientific concepts.

**STUDY 1**

**Method**

**Design**

Study 1 focused on the question of whether girls’ scientific interests can be enhanced with feminine topics *per se*. To this end, we applied a quasi-experimental design that manipulated the context (standard [masculine] vs. feminine) in which the scientific concepts were embedded. We also investigated boys’ interests in scientific subjects for two reasons: (1) To explore the extent to which boys’ level of interest in scientific topics is still higher than that of girls when these topics are embedded in standard (masculine) contexts. (2) To derive educational recommendations. The potential detrimental effect on boys’ interests in scientific subjects when using feminine contextual embeddings still needs to be explored.

**Sample**

The sample of Study 1 consisted of 134 (46%) boys and 160 (54%) girls (total \(N = 294\); average age = 14.1 years; \(SD = 0.87\) years). Data were collected in 2003/2004. To ensure the heterogeneity of the sample (particularly with respect to students’ achievement levels), we selected students who were in either the 8th (81.1%) or the 9th grade (19%) of the intermediate academic track (43.5%; the so-called ‘enseignement secondaire technique’) or the academic track (56.5%; the so-called ‘enseignement secondaire classique’). Note that we deliberately included only students in our sample that had not yet been taught in any scientific subjects (except biology) at the time when Study 1 was conducted. In so doing, we attempted to minimize the potential effects on students’ response processes due to gender stereotypes that are related to experience of science classes at school.
Procedure
To assess students’ interest in topics of various scientific subjects, students completed an interest instrument that comprised 80 items (see Appendix A for the complete list of items). Before students worked on this instrument they received the following instruction: ‘Imagine that you will visit a new school next year, where you can select your subjects. Now we will present different subjects to you, which you can select. Each subject has different topics. You can say for each topic how much you are interested in it’. Importantly, when students responded to the interest items they did not know the name of the respective scientific subject. The reason for this is that knowledge of whether a certain topic belongs to a particular scientific subject might activate corresponding gender stereotypes (e.g., physics = masculine subject), which in turn might decrease girls’ interest independently of the contextual topic (Kessels & Hannover, 2006). Consequently, the scientific subjects were masked by a letter of the alphabet (e.g., items covering a feminine topic interest in physics were presented as ‘subject C’ to the students).

The (masked) scientific subjects analysed were biology and physics as in former studies. In order to show the generalizability of the procedure, we extended the analyses to other scientific subjects, namely information technology (an area that is becoming increasingly important in our society) as well as statistics, which can be considered as applied mathematics. Within each of the four scientific subjects under investigation, 10 items assessed subject interest when presented with feminine contextual topics and 10 items assessed subject interest when presented with standard (masculine) contextual topics, respectively. The selection of feminine and standard (masculine) contextual topics in physics and biology was guided by the topics identified in several studies (Häußler, 1987; Häußler & Hoffmann, 1995, 1998; Hoffmann & Häußler, 1993; Todt, 2000; Todt et al., 1974; Todt & Götz, 1998; Todt & Händel, 1988). As previous studies treated only the subjects of biology and physics, we adapted gender stereotypes identified in these previous studies to the subjects of information technology and statistics. In accordance with the methodological approach of prior studies (Häußler & Hoffmann, 1995, 1998; Hoffmann & Häußler, 1993; Todt, 2000; Todt et al., 1974; Todt & Götz, 1998; Todt & Händel, 1988), students judged the interest value of each topic on a 5-point Likert scale. A higher value indicates higher interest (1 = not interesting at all; 2 = not interesting; 3 = quite interesting; 4 = interesting; 5 = very interesting).

Statistical analysis
Some students had missing values for some of the interest measures (197 students had complete data for all items; for each item data from at least 285 students were available). Thus, in accordance with Schafer and Graham (2002), statistical parameters were estimated using the full information maximum likelihood estimator as implemented in Mplus 4.2 (Muthén & Muthén, 1998–2006).

Our primary research hypothesis was that girls’ interest in scientific topics might be enhanced by using feminine topics to present scientific subjects. We evaluated this hypothesis with respect to scale scores to represent the mean level of interest in standard (masculine) or feminine contextual topics in each of the four scientific subjects under investigation, respectively. Of immediate significance to our research hypothesis were gender-specific mean differences between standard masculine contextual topics (ST) and feminine contextual topics (FT) within a certain scientific subject. We computed these mean differences such that positive values indicate a stronger interest for the scientific
subject when used with feminine topics compared to the use of standard masculine topics. A corresponding effect size $d_{FT-ST}$ was calculated as suggested by Dunlap, Cortina, Vaslow, and Burke (1996, Equation 3). Further, we examined gender differences in the level of interest in scientific topics. To do this, we computed mean differences between boys and girls for standard topics as well as feminine topics for each of the four scientific subjects, respectively. Positive values of these mean differences indicate that boys were more interested than girls. These mean differences were expressed in terms of Cohen’s $d$ (1992). We used Cohen (1992) for interpretive guidelines for all effect sizes and considered mean differences of 0.20, 0.50, and 0.80 to be small, medium, and large effects, respectively.

**Results**

Scale reliability was evaluated in terms of Cronbach’s alpha ($\alpha$). All scale scores showed satisfactory reliabilities for both boys and girls (Table 1), with values ranging from $\alpha = .83$ (boys’ interest in feminine topics in information technology) to $\alpha = .95$ (boys’ interest in standard topics in physics). Thus, the reliabilities of our interest measures support further investigation of students’ scientific interests.

Figure 1 displays the key results of Study 1, that is, the gender-specific mean levels of interest in scientific topics (Table 1 contains information on corresponding effect sizes and statistical significance).

Our results strongly supported our research hypothesis (cf. right-hand sections of Figure 1). The presentation of feminine topics enhanced girls’ scientific interest in

| Table 1. Study 1: Level of scientific interest in standard (masculine) topics and feminine topics |
|---------------------------------|-----------------|-----------------|-----------------|
|                                  | **Boys**        | **Girls**       | **Gender**      |
|                                  | $M$   | $SD$ | $\alpha$ | $r_{ST,FT}$ | $d_{FT-ST}$ | $M$   | $SD$ | $\alpha$ | $r_{ST,FT}$ | $d_{FT-ST}$ | $d_{B-G}$ |
| Biology                         |       |      |          |             |            |       |      |          |             |            |           |
| Standard topics                 | 2.60  | 1.02 | .92      | .72*         | −.15*       | 2.53  | 1.05 | .93      | .70*         | .55*        | .06       |
| Feminine topics                 | 2.45  | 0.91 | .88      |              |             | 3.11  | 0.95 | .86      |              |             | −.72*     |
| Physics                         |       |      |          | .70*         | −.71*       |       |      | .70*     | .53*         |             |           |
| Standard topics                 | 3.31  | 1.17 | .95      |              |             | 2.09  | 0.99 | .94      | .70*         | .56*        | 1.12*     |
| Feminine topics                 | 2.50  | 0.95 | .90      |              |             | 2.62  | 0.94 | .88      |              | .73*        | −.12      |
| Information technology          |       |      |          | .60*         | −.58*       |       |      | .56*     | .73*         |             |           |
| Standard topics                 | 3.86  | 1.05 | .94      |              |             | 2.23  | 1.06 | .94      | .56*         | .73*        | 1.55*     |
| Feminine topics                 | 3.23  | 1.00 | .83      |              |             | 3.01  | 1.00 | .90      |              | .22         |           |
| Statistics                      |       |      |          | .53*         | −.24*       |       |      | .44*     | .19*         |             | .79*      |
| Standard topics                 | 2.71  | 1.03 | .89      |              |             | 1.99  | 0.76 | .87      | .44*         | .19*        |           |
| Feminine topics                 | 2.46  | 0.93 | .90      |              |             | 3.13  | 1.00 | .92      |              | .79*        | −.70*     |

**Note.** $\alpha =$ Cronbach’s alpha; $r_{ST,FT}$ = correlation between the level of scientific interest in standard topics and feminine topics; $d_{FT-ST}$ = gender-specific effect size (computed in accordance with Dunlap et al., 1996) for the difference in the level of scientific interest between feminine and standard topics. Positive values indicate that the level of scientific interest was higher in feminine than in standard topics; $d_{B-G}$ = effect size (Cohen’s $d$, see Cohen, 1992) for the difference in the level of scientific interest between boys and girls. Positive values indicate that boys had a higher level of interest than girls. $^*p < .05$. 
Figure 1. Study 1: Gender-specific mean level of interest in standard (masculine) topics (ST) and feminine topics (FT) for (a) biology; (b) physics; (c) information technology; and (d) statistics. Error bars show corresponding 95% confidence intervals. Note that within each of the four parts of Figure 1, the left section shows the results for standard topics, the middle section shows the results for feminine topics, and the right section shows gender-specific mean differences between feminine and standard topics. Positive values of the difference indicate higher interest in feminine topics.

biology, physics, information technology, and statistics, respectively. The (statistically significant) differences in the level of interest between feminine and standard topics could be regarded as medium for biology and physics, and as large for information technology and statistics.

However, the presentation of scientific subjects in the context of feminine topics had a (statistically significant) detrimental effect on boys' levels of scientific interest. Boys' levels of scientific interest decreased to a small extent in biology and statistics, and to a medium and large extent in physics and information technology, respectively.

Consequently, the differential impact of standard and feminine topics on boys' and girls' levels of scientific interest also affected gender differences in scientific interests (see left and middle sections of Figure 1). In line with stereotypical thinking and except for biology, boys had (statistically significant) stronger interest in standard scientific topics across subjects. These gender differences can be considered to be large. However, given the enhancing effect of feminine topics on girls' levels of scientific interest, girls were now (statistically significantly) much more interested in biology, physics, and statistics when concepts in these subjects were presented in the context of feminine topics. Corresponding effect sizes were small in physics and medium to large in biology and statistics, respectively. It should be noted that, although the concepts were presented in the context of feminine topics, boys' level of interest in information technology was still somewhat higher than that of girls' (the statistically significant effect was small).
Summary and discussion

Study 1 focused on the question of whether girls’ scientific interests can be enhanced by using feminine topics per se. To this end, we applied a quasi-experimental design that embedded scientific concepts of four scientific subjects (i.e., biology, physics, information technology, and statistics) in the context of standard (masculine) or feminine topics, respectively. The key results of Study 1 are summarized in the following.

First, and most importantly, our research hypothesis received strong empirical support. We observed medium (biology and physics) to large effect sizes (information technology and statistics) on girls’ levels of scientific interest when subject-specific scientific concepts were presented within the context of feminine topics. Thus, girls’ level of scientific topic interest can be seen to be substantially increased when scientific subjects are presented using feminine topics.

Second, the ‘negative side’ of our quasi-experimental manipulation was that we substantially decreased boys’ scientific interests when concepts in biology (small negative effect), physics (large negative effect), information technology (medium negative effect), and statistics (small negative effect) were presented in the context of feminine topics.

Third, the differential impact of standard (masculine) or feminine topics on boys’ and girls’ scientific interests also affected the gender gap. Whereas boys (in line with stereotypical thinking) showed stronger scientific interest in standard (masculine) topics in physics, information technology, and statistics, girls were even more interested in biology and statistics than boys when corresponding concepts were embedded in the context of feminine topics. Interestingly, the gender gap was almost closed in physics and information technology when feminine topics were presented in these scientific subjects.

Despite the encouraging results obtained in Study 1 concerning our guiding research hypothesis, one particular limitation should be discussed. Our interest instrument covered 10 feminine and 10 masculine topics for each scientific subject, respectively. However, within the subjects, most of the feminine and the masculine topics that were presented to the students referred to different underlying scientific concepts. Hence, one could speculate that it was not the feminine topic per se that increased girls’ interest. Rather, it is possible that certain scientific concepts were more interesting to girls. In order to address this potential limitation, we conducted Study 2, which presented female and masculine topics for the same scientific concepts within each subject. This allowed us to scrutinize simultaneously the generalization of the results of Study 1 using an independent student sample.

STUDY 2

Method

Design

Study 2 tested our refined research hypothesis that girls’ interest in science can be enhanced when a certain scientific concept is presented in the context of a feminine topic. To this end, we again applied a quasi-experimental design that manipulated the context (standard vs. feminine) in which a certain scientific concept was embedded. Specifically, students completed an interest instrument where the same scientific concept (selected from one of the four scientific subjects, physics, biology, information technology, and statistics) was presented in the context of a standard (masculine) and
a feminine topic, respectively. For example, for a given physics concept (e.g., the functioning of a laser) the feminine topic was ‘the use of laser for cosmetic surgery’, whereas the masculine topic was ‘reflect on how a laser can read CDs’.

**Sample**

The sample of Study 2 consisted of 109 (57.4%) boys and 81 (42.6%) girls (total $N = 190$; average age $= 14.4$ years; $SD = 0.89$ years) attending either the 8th grade (49.5%) or 9th grade (50.5%) of the intermediate academic track (47.4%) or the academic track (52.6%) at state schools in Luxembourg. Data were collected in 2003/2004. Analogous to Study 1, the students in our sample were thus (a) heterogeneous (particularly with respect to students’ achievement levels), and (b) had not yet been taught in any scientific subjects (except biology) under investigation at the time when Study 2 was conducted.

**Procedure**

The instructions given to the participants as well as the masked presentation of scientific subjects (denoted with letters A, B, etc.) were identical to those in Study 1. In doing so, we attempted to circumvent the potential influence of science-related gender stereotypes on students’ response processes. Further, within each of the four scientific subjects (physics, biology, information technology, and statistics), five scientific concepts were presented with either a feminine or a masculine topic, yielding 40 items altogether (Appendix B contains the complete interest instrument that was applied in Study 2). The selection of feminine and masculine scientific topics was again guided by the topics identified in several studies (Häußler, 1987; Häußler & Hoffmann, 1995, 1998; Hoffmann & Häußler, 1993; Todt, 2000; Todt et al., 1974; Todt & Götz, 1998; Todt & Händel, 1988). Students judged the interest value of each topic on a 5-point Likert scale with anchors ranging from 1 to 5 ($1 = \text{not interesting at all}; 2 = \text{not interesting}; 3 = \text{quite interesting}; 4 = \text{interesting}; 5 = \text{very interesting}$).

To guarantee that items address the same scientific concept, 10 external judges were asked to identify items dealing with the same science topic, despite the difference in contextual embedding. These judges, who were teachers in science, were presented with two-column tables containing randomized lists of the different topics. Topics presented in masculine contexts were presented in one column and those using feminine contexts in the other. The experts then had to link items dealing with the same scientific concept. The results of these judgments showed that all teachers were able to make the correct relation between the items (masculine topic and feminine topic) dealing with the same science concept.

**Statistical analysis**

The statistical analyses of Study 2 were analogous to Study 1. Thus, we again evaluated our research hypothesis with respect to mean scale scores for interest in each of the four scientific subjects under investigation depending on the presentation with standard (masculine) topics or with feminine topics. As some students had missing values for some of the interest measures (158 students had complete data; for each item data for at least 185 students were available), model parameters were freely estimated using the full information maximum likelihood estimator as implemented in Mplus 4.2 (Muthén & Muthén, 1998–2006).
Table 2. Study 2: Level of scientific interest in standard (masculine) topics and feminine topics

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th></th>
<th>Girls</th>
<th></th>
<th>Gender differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>α</td>
<td>r_{ST,FT}</td>
<td>d_{FT-ST}</td>
</tr>
<tr>
<td>Biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard topics</td>
<td>2.72</td>
<td>1.01</td>
<td>.80</td>
<td>.70*</td>
<td>-.08</td>
</tr>
<tr>
<td>Feminine topics</td>
<td>2.64</td>
<td>0.82</td>
<td>.75</td>
<td>.47*</td>
<td>-.55*</td>
</tr>
<tr>
<td>Physics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard topics</td>
<td>3.34</td>
<td>0.92</td>
<td>.79</td>
<td>.78*</td>
<td>-.41*</td>
</tr>
<tr>
<td>Feminine topics</td>
<td>2.69</td>
<td>0.98</td>
<td>.83</td>
<td>.35*</td>
<td>-.26*</td>
</tr>
<tr>
<td>Information technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard topics</td>
<td>3.90</td>
<td>1.04</td>
<td>.86</td>
<td>.70*</td>
<td>-.41*</td>
</tr>
<tr>
<td>Feminine topics</td>
<td>3.40</td>
<td>0.95</td>
<td>.75</td>
<td>.35*</td>
<td>-.26*</td>
</tr>
<tr>
<td>Statistics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard topics</td>
<td>2.99</td>
<td>0.91</td>
<td>.74</td>
<td>.35*</td>
<td>-.26*</td>
</tr>
<tr>
<td>Feminine topics</td>
<td>2.68</td>
<td>0.99</td>
<td>.81</td>
<td>2.17</td>
<td>.84*</td>
</tr>
</tbody>
</table>

Note. $\alpha = $ Cronbach's alpha; $r_{ST,FT} = $ correlation between the level of scientific interest in standard topics and feminine topics; $d_{FT-ST} = $ gender-specific effect size (computed in accordance with Dunlap et al., 1996) for the difference in the level of scientific interest between feminine and standard topics. Positive values indicate that the level of scientific interest was higher in feminine than in standard topics; $d_{B-G} = $ effect size (Cohen’s $d$, see Cohen, 1992) for the difference in the level of scientific interest between boys and girls. Positive values indicate that boys had a stronger interest than girls. $^*p < .05.$

Results

All scale scores showed adequate to satisfactory reliabilities for boys and girls, respectively (Table 2), with values ranging from $\alpha = .62$ (girls’ interest in feminine topics in information technology) to $\alpha = .88$ (girls’ interest in standard topics in information technology). Thus, the reliabilities of our interest measures support further investigation of students’ scientific interests.

Figure 2 gives the key results of Study 2, that is, gender-specific mean levels of interest in scientific topics (Table 2 contains information on corresponding effect sizes and statistical significance).

Crucially, the results of Study 2 mainly replicated the results obtained for Study 1, and thus empirically supported our research hypothesis (cf. right-hand sections in Figure 2). Except for biology, the use of feminine topics enhanced girls’ scientific interests in physics, information technology, and statistics, respectively. The (statistically significant) differences in the level of interest between feminine and standard topics could be regarded as medium for information technology, and as large for physics and statistics. In contrast to Study 1, girls’ interest in biology was barely affected by embedding corresponding concepts in the context of feminine topics.

As in Study 1, the presentation of scientific topics in the context of feminine topics had a (statistically significant) disadvantageous effect on boys’ levels of scientific interest in physics, information technology, and statistics (the effect on the level of interest in biology was negligible). The decrease in levels of scientific interests can be considered to be small in statistics, and medium in physics and information technology.
Figure 2. Study 2: Gender-specific mean level of interest in standard (masculine) topics (ST) and feminine topics (FT) for (a) biology; (b) physics; (c) information technology; and (d) statistics. Error bars show corresponding 95% confidence intervals. Note that within each of the four parts of Figure 2, the left section shows the results for standard topics, the middle section shows the results for feminine topics, and the right section shows gender-specific mean differences between feminine and standard topics. Positive values of the difference indicate higher interest in feminine topics.

The differential impact of standard and feminine topics on boys' and girls' levels of scientific interests also affected gender differences in scientific interests (see left and middle sections of Figure 1). Except for biology, boys had (statistically significant) higher levels of interest in standard scientific topics across the subjects. These gender differences were large. On the other hand, given the enhancing effect of feminine topics on girls' levels of scientific interests, girls again were much more interested in biology, physics, and information technology when concepts in these subjects were presented in the context of feminine topics. Corresponding effect sizes were small in biology (the gender difference was not statistically significant), medium in physics and information technology, and large in statistics (gender differences in these latter three subjects were also statistically significant). Analogous to Study 1, boys' level of interest in information technology was still somewhat greater than that of girls' (the effect was medium and statistically significant) when information technology concepts were presented in the context of feminine topics.

Summary and discussion

Study 2 provided strong empirical support for our research hypothesis that girls' interest in science can be enhanced when scientific concepts are presented in the context of a feminine topic. Note that in Study 1, the scientific concepts could vary for female
and masculine topics within a certain scientific subject. This, in turn, left room for the interpretation that it is not the feminine topic per se that increased girls' interest in science but rather the fact that some of the scientific concepts that were used in Study 1 were more interesting to girls. Study 2 comprehensively addressed this potential limitation by applying an instrument to measure interest that presented the same scientific concept in the context of both a feminine topic and a masculine topic, respectively. The key results were as follows.

Firstly, and most importantly, our research hypothesis was again lent strong empirical support. We observed positive effects on girls’ levels of scientific interests when subject-specific scientific concepts were presented in the context of feminine topics in information technology (medium effect), physics (large effect), and statistics (large effect). Thus, girls’ level of scientific topic interest can be substantially increased by presenting scientific subjects with feminine topics.

Secondly, and unfortunately, we again observed the ‘down side’ of contextualizing scientific concepts within feminine topics. Boys’ scientific interests decreased when concepts in physics (medium negative effect), information technology (medium negative effect), and statistics (small negative effect) were presented in the context of feminine topics.

Thirdly, the differential impact of standard (masculine) or feminine topics on boys’ and girls’ scientific interests also affected the gender gap. Whereas boys showed greater scientific interest in standard (masculine) topics in physics, information technology, and statistics, girls were more interested in physics and statistics than boys when corresponding concepts were embedded in the context of feminine topics.

Finally, it should be noted that neither girls’ nor boys’ interest in biology was significantly affected by presenting corresponding concepts in the context of standard (masculine) or feminine topics (corresponding gender differences were small). This suggests that these topics in biology are only marginally loaded with gender stereotypes which, in turn, made these topics almost equally interesting to boys and girls.

GENERAL DISCUSSION

In this paper, an empirically supported answer to the question ‘How can we enhance girls’ scientific interests?’ is provided. Two quasi-experimental studies with data from several hundred Luxembourgian students attending public secondary schools empirically demonstrated that girls’ scientific interests can be substantively enhanced by presenting scientific subjects with topics, which are stereotypically considered to be feminine. In the following, we discuss theoretical and educational implications of our findings as well as some limitations of the present paper.

Theoretical implications

Our research hypothesis is based on an integration of theoretical concepts and models that deal with students’ interests as well as with the interplay between interests and students’ image of the self (Hannover & Kessels, 2004; Hidi & Renninger, 2006). In our endeavour, we relied on a concept of topic interest that is characterized by an anticipatory response triggered by the presentation of topics and themes and that can result from activated individual interest as well as from situational interest. By applying the four-phase model of interest development (Hidi & Renninger, 2006), we identified scientific topics as interesting if these topics are personally relevant to students and if
they are personally involved. Relevance and personal involvement were discussed in
the context of the theoretical approach developed by Hannover and Kessels (2004),
an approach that emphasizes the link between stereotypes and interest development.
Specifically, interests are of central importance to the self as they have a self-symbolizing
function. Thus, in the present study, girls were expected to be interested in scientific
topics when they are presented in a context that is stereotypically considered to
be feminine as these contextual topics are relevant for their gender identity per se,
and an engagement with those topics did not represent a threat to the femininity
of their self-symbolization. One critical element of science-related stereotypes is the
shared beliefs about central characteristics of scientific subjects. Information on shared
characteristics was obtained from several empirical studies (Häußler & Hoffmann, 1995,
1998; Hoffmann & Häußler, 1993; Todt, 2000; Todt et al., 1974; Todt & Götz, 1998; Todt & Händel, 1988) that identified feminine and masculine contextual topics for science by
aggregating students’ responses on the interestingness of these topics.

Our guiding research hypothesis that feminine as well as standard (masculine) topics
have differential impact on girls’ and boys’ scientific interests was empirically supported
by two quasi-experimental studies. Both studies of the present paper elucidated a very
similar pattern of gender differences. Crucially, and this is the most important result of
the present paper, girls had a higher level of scientific interest in information technology,
statistics, and physics when corresponding concepts were presented in the context of
feminine topics. As feminine topics are obviously personally relevant to girls, this key
result suggests that feminine topics have the promising potential to trigger and maintain
girls’ situational interest across scientific subjects. Further, scientific topics that are
presented in a context that is stereotypically considered to be feminine are relevant for
girls’ gender identity per se and an engagement in these topics does not represent a
threat to their self-perception and self-symbolization as being feminine. So one answer
to the question of how girls’ scientific interest can be enhanced is to embed scientific
concepts in topics that are stereotypically considered to be feminine.

Regrettably, the contextualization of scientific concepts within feminine topics is not
a universal educational method. Both studies of the present paper revealed the ‘negative
side’ of this approach that led to significant decreases in boys’ levels of scientific interest.
Thus, these results suggest that being interested in scientific concepts in the context
of feminine topics may threaten boys’ self-perception and self-symbolization as being
masculine. This, in turn, may have caused the detrimental effects on their scientific
interest.

Educational implications
Given that two independent, quasi-experimental studies showed rather similar patterns
of results, we believe that some further investigation of the educational implications is
warranted. Specifically, we might consider how our empirical results on the positive
impact of feminine topics on girls’ scientific interests could be included in educational
practice. We propose a two-step procedure. In the first step, it is essential to empirically
identify feminine topics. Generally speaking, feminine topics can be conceived of as
those topics that can be empirically shown to be more interesting to females. Such
feminine topics can be found in several previous studies (Häußler & Hoffmann, 1995,
1998; Hoffmann & Häußler, 1993; Todt, 2000; Todt et al., 1974; Todt & Götz, 1998;
Todt & Händel, 1988) as well as in the interest instruments, which we applied in the
present paper (see Appendices A and B).
In a second step, it is important to include feminine topics in the school context. However, as boys’ scientific interest has been found to decrease when concepts were presented in the context of feminine topics, this poses an obvious dilemma. Thus, one solution might be to establish gender-specific science classes. This solution might seem logical because the results of the present paper show that the mean level of girls’ scientific interest was higher when scientific concepts were presented in the context of feminine topics and boys’ level of scientific interests was higher when scientific concepts were presented in the context of masculine topics. However, this solution might not work for every student. Imagine a girl whose interest does not match that of other girls and a boy who is more interested in female topics than in male topics. Hence, the solution to the dilemma might not be the simple division of students into gender-specific groups, but to find a solution that takes into account the individual differences among students. The development of individual interest can indeed be fostered by frequent experiences of self-determined learning motivation or situational interest (Krapp & Lewalter, 2001). Also goal clarity and coherence led to more self-determined learning motivation in physics instruction and thus, showed short-term motivational effects (Seidel, Rimmle, & Prenzel, 2005). So teachers and/or schools could offer a certain number of science modules or groups dealing with the same scientific concepts but presenting them in the context of different topics. Each student could then choose the science modules/groups using the contextual topics that seem the most interesting for himself/herself.

Another possibility could be the creation of multimedia learning environments on the computer. Within these environments, students could select the context in which a certain scientific concept is embedded. Thus, boys and girls could work simultaneously on lessons that present the same scientific concepts in the context of either standard masculine or feminine topics.

Limitations

Despite its conceptual and methodological strengths, our study has certain limitations. First, the findings of both studies were based on cross-sectional data from students attending 8th and 9th grades in just one country (i.e., Luxembourg). Thus, future research might profit from the use of longitudinal study designs to test the degree of generalization of our findings across other cultures, grades, and age levels.

Second, both studies described in the present paper empirically demonstrated that presenting scientific concepts in the context of feminine topics could enhance girls’ interest in science. However, in examining topic interests we only investigated one particular facet of interest. As girls are rarely expected to have a well-developed individual interest in science (Osborne et al., 2003), feminine topics can be assumed to be the primary trigger and reason for maintaining girls’ situational interest in scientific subjects. Thus, an important educational goal is to transform this situational interest into individual interest to preserve girls’ increased interest in science as a sustainable effect. In this respect, the four-phase model of interest development (Hidi & Renninger, 2006) allows for explicit predictions as to how girls’ situational interest (which concerns the first two phases) in scientific subjects may be transformed into individual interest in science (which concerns the last two phases). In the third phase, girls need some external support (e.g., from their science teachers), as engagement with scientific subjects clearly confronts female students with difficulties. Moreover, given that girls have successfully developed individual interest in the third phase, these interests can be enhanced by providing cognitively challenging learning contexts (Greeno, Collins, & Resnick, 1996;
Mayer, 2004; Seidel et al., 2005) that allow further knowledge and skill building in the fourth phase.

As individual interests have been shown to be mostly stable over a person’s lifetime (Low, Yoon, Roberts, & Rounds, 2005) and also predictive of future career paths (Arnot et al., 2001; Harackiewicz et al., 2002; Harackiewicz et al., 2000; Köller et al., 2001), the suppositions made by the four-phase model definitely merit future research attention. Interests seem indeed to be more relevant than ability for the choice of an educational or professional career in science, as has been shown in the study of Arnot et al. (2001). Despite a high ability of girls in science, they prefer typically feminine subjects for their educational choices. So using feminine topics to cultivate girls’ interest in science can be considered an important means to better exploit the female talent pool in order to: (a) close the gender gap and (b) fill the ever-increasing number of job vacancies in the field of science.

References


Girls’ interest in science


Received 21 April 2009; revised version received 1 December 2010
Appendix A

Interest instrument applied in Study 1

Biology

Feminine topics. 1. ‘Examine which areas of the human tongue are sensitive to particular tastes (sweet, sour).’; 2. ‘Learn how to best take care of your skin.’; 3. ‘Learn how to produce a skin cream.’; 4. ‘Discuss the dangers of smoking.’; 5. ‘Measure your pulse on your wrist.’; 6. ‘Learn how solar radiation is imitated in solariums.’; 7. ‘Observe animals in the forest through binoculars.’; 8. ‘Observe how animals behave.’; 9. ‘Learn why some animals (e.g., dolphins, horses) are more intelligent than others.’; 10. ‘Reflect on how skin tanning comes about in the summer.’

Masculine topics. 1. ‘Watch blood coagulate from a small wound.’; 2. ‘Examine the blood’s composition.’; 3. ‘Learn which parts make up the human nervous system.’; 4. ‘Examine which poisons have an effect on the nervous system.’; 5. ‘Discuss which insects can be valuable or detrimental to people.’; 6. ‘Learn how plants produce pure air.’; 7. ‘Learn something from photosynthesis that can be used for ship construction.’; 8. ‘Observe and describe the movements of fish.’; 9. ‘Learn something from the structure and composition of plants that can be used for the construction of houses and towers.’; 10. ‘Learn something from fish movements that can be used for ship construction.’

Physics

Feminine topics. 1. ‘Learn how a laser is used in cosmetic surgery.’; 2. ‘Explain why a hair dryer has different settings.’; 3. ‘Learn how to save energy in everyday life.’; 4. ‘Learn more about the origins of azure and afterglow.’; 5. ‘Reflect on how a sky diver can fly.’; 6. ‘Go to a swimming pool and try out how heavy your own body is under water.’; 7. ‘Reflect on why a show jumper has to stoop when he jumps with his horse.’; 8. ‘Learn more about why you can dry your hair faster with a blowdryer.’; 9. ‘Explain how the different figures originate in fountains.’; 10. ‘Reflect on why some rides at the fairgrounds propels you outward.’

Masculine topics. 1. ‘Reflect on why a laser is so powerful.’; 2. ‘Learn how much force a rocket needs to take off.’; 3. ‘Reflect on why red light has more energy than blue light.’; 4. ‘Reflect on the various possibilities to break light.’; 5. ‘Learn more about how to explore the earth using satellites.’; 6. ‘Learn more about how to pump crude oil from great depths (3,000 m).’; 7. ‘Reflect on why the engine is located very low in fast cars.’; 8. ‘Describe which appliances use the heating effect of electric current.’; 9. ‘Explain how taps can provide water on the upper floors of a house, even though the water pipes lead to the basement.’; 10. ‘Explain why, in a lighthouse, lenses help transport the light.’

Information technology

Feminine topics. 1. ‘Reflect on how to communicate with friends over the Internet.’; 2. ‘Reflect on how the computer can be useful in everyday life.’; 3. ‘Learn how to order clothes on the Internet.’; 4. ‘Learn how to develop a commercial.’; 5. ‘Find out how beautiful magazine cover pictures are created.’; 6. ‘Learn how to design clothes using a
Masculine topics. 1. ‘Learn how to write computer software.’; 2. ‘Reflect on how to design realistic graphics for computer games.’; 3. ‘Learn how the inside of a computer is structured.’; 4. ‘Reflect on how information technology software works.’; 5. ‘Reflect on how to improve computer graphics.’; 6. ‘Reflect on the creation of computer games.’; 7. ‘Learn which computers are more powerful and why.’; 8. ‘Reflect on how you can design a high-rise using graphics software.’; 9. ‘Learn how the mechanics in a computer work.’; 10. ‘Learn how to order computer games on the Internet.’

Statistics

Feminine topics. 1. ‘Calculate the differences in intelligence between boys and girls.’; 2. ‘Calculate the connection between the father’s education and his child’s.’; 3. ‘Calculate the relation between the water supply and poverty.’; 4. ‘Analyse what kind of connections there are between poverty and birth rate.’; 5. ‘Calculate to what extent academic success and aggressiveness are related.’; 6. ‘Calculate which illnesses increase with increasing age.’; 7. ‘Calculate the probability of a miscarriage.’; 8. ‘Analyse what kind of connections there are between age and intelligence.’; 9. ‘Calculate in which countries medical care is more successful.’; 10. ‘Calculate the relation between the birth of handicapped children and the mothers’ age.’

Masculine topics. 1. ‘Calculate the probability of a car accident.’; 2. ‘Analyse how often mistakes happen during automobile production.’; 3. ‘Calculate the annual interest of a savings account.’; 4. ‘Calculate a firm’s annual profit.’; 5. ‘Calculate the probability of an earthquake.’; 6. ‘Analyse which car companies have faster production.’; 7. ‘Calculate how stock prices change.’; 8. ‘Predict the probability of a plane crash.’; 9. ‘Analyse which factors had an influence on gas prices.’; 10. ‘Predict stock prices.’

Appendix B

Interest instrument applied in Study 2

Note that corresponding gender-specific items measuring topic interest for a certain scientific concept are presented in the same order. Thus, the first item covering feminine topics of the subject biology corresponds to the first item covering masculine topics, and so forth.

Biology

Feminine topics. 1. ‘Learn how to produce a beauty cream.’; 2. ‘Reflect on why the heart beats faster while dancing.’; 3. ‘Observe how pets behave.’; 4. ‘Learn about the effects of vitamins on the body.’; 5. ‘Analyse the impact of air pollution on lung diseases in humans.’
Masculine topics. 1. ‘Learn how to produce a medical ointment.’; 2. ‘Reflect on why the pulse quickens while playing soccer.’; 3. ‘Observe and describe fish movements.’; 4. ‘Learn about the effects of alcohol on the body.’; 5. ‘Analyse the impact of air pollution on forest dieback.’

Physics

Feminine topics. 1. ‘Reflect on why lasers are used in cosmetic surgery.’; 2. ‘Learn more about why you can dry your hair quicker with a hair dryer.’; 3. ‘Learn more about how an artificial heart pump works.’; 4. ‘Reflect on why your own body becomes lighter under water.’; 5. ‘Reflect on the origins of azure and afterglow.’

Masculine topics. 1. ‘Reflect on how a laser can read CDs.’; 2. ‘Learn which appliances use the heating effect of electric current.’; 3. ‘Learn more about how to pump crude oil from great depths (3,000 m).’; 4. ‘Reflect on why a submarine can float in the water.’; 5. ‘Reflect on the various possibilities to break light.’

Information technology

Feminine topics. 1. ‘Learn how to create computer software for photographic design.’; 2. ‘Reflect on how to design realistic graphics for drawing software.’; 3. ‘Reflect on how to map out swimming pools and garden areas using graphic software.’; 4. ‘Learn how to order books and movies on the Internet.’; 5. ‘Learn how to design clothes using a computer.’

Masculine topics. 1. ‘Learn how to create software for navigation systems.’; 2. ‘Reflect on how to design realistic graphics for computer games.’; 3. ‘Reflect on how to design gigantic bridges using graphic software.’; 4. ‘Learn how to order computer games on the Internet.’; 5. ‘Learn how to design cars using a computer.’

Statistics

Feminine topics. 1. ‘Calculate the probability of a miscarriage.’; 2. ‘Calculate the relation between the birth of handicapped children and the mothers’ age.’; 3. ‘Calculate the differences in intelligence between boys and girls.’; 4. ‘Calculate the probability of illnesses with increasing age.’; 5. ‘Calculate the relation between the father’s education and his son’s.’

Masculine topics. 1. ‘Calculate the probability of a car accident.’; 2. ‘Calculate the difference between annual profits of different firms.’; 3. ‘Calculate the relation between the good design of a car and its gas consumption.’; 4. ‘Calculate the probability of a plane crash.’; 5. ‘Calculate the relation between soccer training and good performances.’