Why girls stay away from STEM:
How the image of science clashes with teenagers’ identity

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The Interests as Identity Regulation Model (IIRM)

- Range of Subjects/Activities at School
- Image of a School Subject Prototype related to a School Subject
- Social Meaning Attached to Different Domains or Objects of Interest
- Acquisition of Social Meaning
- Student’s Self
- Differential Development of Interests

Kessels & Hannover (2007); Kessels, Heyder, Latsch, & Hannover (2014)
The Interests as Identity Regulation Model (IIRM): Focus on Girls and STEM

Kessels & Hannover (2007); Kessels, Heyder, Latsch, & Hannover (2014)
Masculine Stereotyping of STEM?

Studies using explicit measures (questionnaires):
- Clear-cut STEM-male stereotypes
  (e.g. Hannover & Kessels, 2002; Martinot, Bagès, & Désert 2012)

Studies using implicit measures (e.g. IAT):
- Clear-cut STEM-male stereotypes
  (e.g. Cvenecék, Meltzoff, & Greenwald 2011; Kessels, Rau, & Hannover 2006; Nosek, Banaji, & Greenwald 2002; Steffens, Jelenec, & Noack 2010)
Implicit Associations with Physics

Masculine stereotyping of the subject physics

Overall stronger implicit negative attitudes and less identification with physics in girls

Especially girls more easily associated negative words, words related to maleness (as compared to femaleness) and words referring to other people (instead of themselves), words related to heteronomy (as compared to self-realization), words related to difficulty (as compared to ease) with physics (compared to English).

Kessels, Rau, & Hannover (2006)
The Interests as Identity Regulation Model (IIRM)

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- Range of Subjects/Activities at School
- Acquisition of Social Meaning
- Image of a School Subject Prototype related to a School Subject
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Kessels & Hannover (2007); Kessels, Heyder, Latsch, & Hannover (2014)
The **typical girl favoring physics** was described as a girl possessing **less feminine traits** and **more masculine traits** than a girl liking the subject music.

![Diagram showing comparisons of masculinity and femininity between typical boys and girls favoring physics or music.](image-url)
Stereotyping of Typical Teachers of Different Subjects

Science teacher:

- less attractive
- less socially competent and integrated
- more intelligent and ambitious
- more self-centred
- less creative and emotional ...
- almost always male
- ...and less similar to students’ selves
  then...
  ...the language teacher

(Kessels & Taconis, 2012)
“Self-to Prototype Matching” 
(cf. Niedenthal, Cantor & Kihlstrom, 1985; Setterlund & Niedenthal, 1993)

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Liking for subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-to-Same-Gender-Prototype-Matching Score (Physics)</td>
<td>-.46 ***</td>
</tr>
</tbody>
</table>

The closer the self-description is to the physics prototype, the more students like physics.
Self-to-Prototype Matching

Similarity to prototypical peers predicts…

…liking of school subjects
(Hannover & Kessels, 2004; Kessels, 2005)

….choosing science as a major
The more similar students perceived themselves to the math/physics prototype, the more they were enrolled in the science-oriented profile in Dutch secondary school (Taconis & Kessels, 2009).
Self-to-Prototype Matching

Similarity to prototypical adults predicts...

...liking of school subjects
...choosing subjects as a major
  Self-to-teacher prototype matching: Kessels & Taconis (2012)

...the intention to pursue a career in that area
  e.g. Self-to-engineer prototype matching: Kessels & Hannover (2004)
Masculine connotation as a reason for girls not to engage in science?

Typical girl excelling in physics

Ascription: You have a talent for physics

Self-image of girls as being feminine

Threat to feminine self-image

Compensatory self-presentation

„But I am a real girl!“
Hypotheses in false feedback study

• Girls should react to highly positive feedback concerning their physics' abilities in a compensatory manner: instead of accepting the positive feedback, they should emphasize their femininity.

• Boys, confronted with the same highly positive feedback, should accept the feedback as is (instead of engaging in compensatory self-presentations).
Procedure

1. Short physics **test** (easy test items, open-ended format)
   (Example: „Why shouldn‘t you slide down a climbing pole too quickly?“)

2. Collection of test sheets (marked by a personal code number),
   randomized allocation to two experimental groups receiving different types of
   written feedback on their test results:
   **Group 1: highly positive feedback**
   **Group 2: average feedback**
Highly positive feedback vs. average feedback:

The test you completed at the beginning of the lesson does not test exactly the same as the usual class exam. Rather, this test can tell us whether generally someone has the right feeling for physics.

Evaluation of the completed items resulted in a score that according to our evaluation scheme signifies the following:

Your handling of the test items has shown that you do have a “real talent” for physics and related domains!
You might want to consider making more out of your talent for science and technology – like aspire to a career in these domains.

OR:

Your handling of the test items has shown that you could solve them as well as most other students your age. Therefore, no recommendation to what kind of career would be most appropriate for you could be derived from our results.

Recent notices from the economy and the job centre document the emergence of many new and interesting jobs in the area of science and technology! For example, there is a high demand for experts for information and communication technology, for medical technology, or for biotechnology.

Kessels, Warner, Holle, & Hannover, 2008
Procedure

1. Short physics test (easy test items, open-ended format) 
(Example: „Why shouldn‘t you slide down a climbing pole too quickly?“)

2. Collection of test sheets (marked by a personal code number), randomized allocation to two experimental groups receiving different types of written feedback on their test results:
Group 1: highly positive feedback
Group 2: average feedback

Written feedback attached to a questionnaire asking about students‘ general interest in sex-typed teenager topics and in science related topics.
→ Questionnaire version for girls: girls topics PLUS science topics
→ Questionnaire version for boys: boys topics PLUS science topics

3. Students read their feedback and immediately afterwards rate how much would they like to read magazine articles with the following headings:
Dependent variable: Wanting to read sex-typed or science related magazine articles

„How much would you like to read the following articles?“

Magazine articles on typical „girls topics“ (examples):
• Are you ready for true love?
• All natural beauty secrets
• All you have to know about boys
• Fashion lexicon – Styling from A to Z

Magazine articles on typical „boys topics“ (examples):
• Chatting up girls – what comes next?
• Cinema – what’s on? Action movies at a glance.
• US- Rappers: Who are the real gangstas?
• What kind of mobile type are you?

Science related magazine articles (examples):
• Exploring the latest trends – how engineers are working!
• A summer in the U.S. … join the international science lab for students!
• Still no apprenticeship? They want you in the technical industry!
• Curiosity as a life style- natural sciences hit it big

Items used had been pretested on adolescents - wanting to read these articles had been rated as stressin being a “real girl”, a “real boy” or a “person interested in a career in science”.

Kessels, Warner, Holle, & Hannover, 2008
Results

Relative interest to read science-related or sex-typed teenager articles as a function of gender and feedback

-0.63

0.43

Boys
Girls

highly positive feedback on talent for physics

average feedback on talent for physics

Negative value: relatively more interest for articles related to science
Positive value: relatively more interest for sex-typed articles

Kessels, Warner, Holle, & Hannover, 2008
What have we found?

Image of Science/Prototype of Science

Self-Image of Female Adolescents
Interventions Based on the Interests as Identity Regulation Model (IIRM)

Altering the image of science (e.g. by providing female role models) is one way to make girls engage in science (Kessels & Hannover, 2007)

Reducing the salience of gender (e.g. by single-sex learning groups) is one way to make girls engage in science (Kessels, 2002; Kessels & Hannover, 2008)
Interests as Identity Regulation Model (IIRM) Focus on Boys‘ Underachievement

Differential Development of Interests

Student‘s Self

Acquisition of Social Meaning

Academic or Nonacademic or Anti-academic Activities

Social Meaning Attached to Different Activities

Boys‘ (Gender-Related) Self-Concept

Academic Engagement

Kessels, Heyder, Latsch, & Hannover (2014); Heyder & Kessels, 2013
Summary I

1. Students use their academic interests and specialization as a means to regulate and demonstrate their identity.

2. Not only girls, but also many teenage boys are not interested in science, for motives and reasons that are true for both sexes.

3. Girls’ gender identity clashes with the image of the typical person representing science.

4. The larger they consider the difference between their self-image and the prototype, the less they like the subject, the less often they choose a science-related profile at school, and the less often they want to pursue a science-related career.
Summary II

5. Interventions aiming at enhancing the ability-related self-concept of girls might be less successful when neglecting the consequences for girls’ gender-related identity.

6. Enhancing the compatibility of girls’ identity and STEM can use different starting points:
   
   a. Altering the image of science (e.g. by providing female role models) is one way to make girls engage more in STEM.
   
   b. Reducing the salience of gender (e.g. by single-sex learning groups) is one way to make girls engage more in STEM.
References/ Related Publications


