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Talent Viewer: Evaluation of a Project Aimed at Breaking Down (Gender) Stereotypes about STEM and STEM-Talents in Primary Schools in the Netherlands

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ABSTRACT
Talent Viewer is VHTO's first large project in primary education. It was designed to break down gender stereotypes about science and technology (S&T) among primary-school pupils, their parents, and the teachers. In the project, pupils assigned (S&T) talents to each other and discussed them. They investigated S&T professions that combine these talents. A female professional who works in S&T visited each class participating in Talent Viewer. The program also included the involvement of parents, who were encouraged to discuss the talents with their child. The project was evaluated by teachers. Pupils' attitudes towards STEM were measured before and after the project. The pupils' attitude towards STEM has changed significantly in a few aspects throughout the project. Teachers were positive about the impact of Talent Viewer on breaking down gender-STEM-stereotypes.

KEYWORDS
Science; technology; primary education; teachers; parents; gender; stereotypes

Talent Viewer: Evaluation of a Project Aimed at Breaking Down (Gender) Stereotypes about STEM and STEM-Talents in Primary Schools in the Netherlands

Since the early 1980s, VHTO, the Dutch National Expert Organisation on Girls/Women and Science/Technology, has been building up knowledge and experience of the participation of girls and women in the world of science, technology, engineering, and mathematics (STEM) and deploying this expertise in areas such as education. In 2007, Associate Professor Helen Watt from Monash University, Australia was invited to be a keynote speaker at a VHTO conference. Our discussions centered on the very many research studies and findings concerning gender and STEM participation, but also considered the fact that different studies tend to focus on one or only a few aspects. We agreed that it would have extra value if relevant research results from the last few years could be interrelated, in order to provide a more coherent view concerning gender and STEM (Science/Technology/Engineering/Mathematics) from childhood to labor market. With this in mind, we have formed the Network on this subject with members who undertake related research. Turning research theory into a project that is workable and applicable to the Dutch context is not easy. VHTO would be very interested in obtaining more practical guidelines from researchers in the field. In this paper, VHTO's first large project in primary education is evaluated. The aim of the project was to break down stereotypical ideas about (gender and) science and technology in primary-school students and teachers, and, to a lesser degree, parents.

INTRODUCTION

Traditionally, the Netherlands have lagged behind other countries as regards the percentage of girls opting for science, technology, engineering, and mathematics (STEM) study programs (Eurostat, 2009; OECD, 2003). A more equal participation is desirable from both an economic and a gender-equity perspective (Booij et al., 2011; European Commission, 2004, 2006; Eurydice, 2011).

Since 1983, VHTO has developed approaches and instruments to attract more female students to STEM. VHTO works with international partners in EU projects, and has joined several (European) networks concerned (fully or partly) with gender and STEM/IT. VHTO has cooperated with partners in the Netherlands and abroad, designing and implementing intervention programs to increase the participation of girls and women in STEM/IT. This has taken place in the whole chain of education from primary school to higher education and the labor market. The design of the VHTO projects has always been based on the most recent research on gender and STEM. In this paper, we would like to share the preliminary results of the implementation of the first large primary-school project, which started in 2012.

Theoretical Background

In international research, a number of determinants have been identified for the under-representation of girls/women in STEM. These include: girls' lower self-concepts, non-stimulating learning environments, the lack of female role models, stereotyped associations in society about girls/women and STEM, fertility/lifestyle factors, and career preferences of girls and women (e.g., Bøe et al., 2011; Ceci & Williams, 2010; Eccles, 2007; Eccles et al., 1999; Watt, 2006).

Recent research by Miller et al. (2014) shows again that while the Netherlands score high on overall gender-equity measures, such as the Gender Gap Index (GGI) and the Gender Empowerment Measure (GEM), pervasive stereotypes associating men with science still exist. The under-representation of women in STEM in the Netherlands predicts the strength of gender stereotype associations (Miller et al., 2014, Nosek et al., 2009), influencing girls' interest in S&T and hence their career choices. Stereotypes are formed and changed partly by repeatedly observing members of different social groups in role-linked activities. Multiple associations of counter female stereotype across diverse contexts, either directly in science courses or indirectly in television shows, are critical to changing stereotypes (Eagly & Wood, 2012; Wood & Eagly, 2012). Exposure to successful women scientists and mathematicians weakens gender-related STEM stereotypes (e.g., Galdi et al., 2014). People need multiple and mutually reinforcing examples to see counter stereotype individuals as evidence of trends (Miller et al., 2014).

The stereotypical image of a male researcher or technician in STEM has a negative impact on attitudes, the development of interest in STEM-related subjects and professions, the way in which girls are motivated to participate in STEM, and young women's attitudes towards STEM-related subjects and self-concept (Blickenstaff, 2005; Brotman & Moore, 2008; OECD, 2006). Moreover, girls and young women often (implicitly) learn from parents, teachers, and the media that STEM is for boys (Blickenstaff, 2005; Brotman & Moore, 2008; Hartung, Porfeli & Vondracek, 2005; OECD, 2006; Osborne & Dillon, 2008). Young women are less encouraged to opt for STEM (Brotman & Moore, 2008; VHTO, 2008) and to develop their skills in that direction. Also, girls tend to be more interested in health, the human body, and medical studies (Bøe et al., 2011; Krapp & Prenzel, 2011; Schoon & Eccles, 2014). Previous research indicates that education about stereotypes weakens STEM–gender associations for both young women and men (Bøe et al., 2011; Miyake et al., 2010).

VHTO involves role models (i.e., female STEM professionals) in many of its activities. Among other things, these women deliver (guest) lectures in primary schools, take part in 'speed-networking' at secondary schools, and engage in work-shadowing activities (see Jansen & Joukes, 2013, for an overview of VHTO involvement in high school and higher education). Talent Viewer has also been founded on the idea that role models are critical in efforts to break down (gender) STEM stereotypes, to strengthen self-concepts, and to gain a feeling of belonging in STEM (Leaper, 2015,).

Furthermore, Talent Viewer aims to emphasize talent development and the role of teachers and parents. In an early stage of their life, girls are less stimulated (i.e., by parents, teachers, and peers) to develop talents explicitly related to the abilities needed for STEM education and professions. In Talent Viewer, they learn that STEM professionals need non-specific-STEM skills and talents, such as the ability to work in a team, helping people, and design and creativity. It is stressed that STEM professionals work not only in industry, but also in hospitals, schools, and (local) government, etc. These efforts may help to reframe pupils' (teachers' and parents') perception of the goal affordances associated with STEM. As many girls do not view STEM subjects as adequate means of achieving their communal goals, learning to see such subjects as compatible with these goals may make girls and women more supportive of one another when it comes to STEM achievement (Leaper, 2015).

TALENT VIEWER

VHTO and Amsterdam-based Science Center NEMO, have developed and implemented a primary-school project that aims to: 1) provide a broader and more complete picture of professions in the S&T domain; 2) motivate pupils to develop their *individual* skills rather than those that fit gender stereotypes; 3) make pupils, parents, and teachers aware of their (gender) stereotypes about S&T education and professions; and 4) offer role models.

Talent Viewer has been designed for primary schools, grade 5 and 6 (9–12 years of age). The project consists of eight separate lessons, which can be taught independently. Participating schools receive a ready-made curriculum in a project folder containing descriptions of the lessons, worksheets, and materials.

Talent Viewer Objectives

Discover your talent

Talent in Talent Viewer is defined as "a package of personal characteristics or skills that accelerate the acquisition of expertise and enhance performance". Talents are explicitly described as non-fixed, developing features or skills. Talents are explicitly related to one's own skills and characteristics, and *not* to those of others; this serves to create a safe environment for all pupils. The project folder contains a list of 42 various talents. Some are related to socio-psychological skills (e.g., the ability to cooperate, to take initiative); others are related to the so-called "S&T-talents" (e.g., spatial thinking, analytical skills, or the ability to fix broken objects). Pupils are required to make talent cards for a few other pupils: for each member of their group, they choose a talent from the talent list. They then write an explanation of their chosen talent on a card. Next, they hand out the cards to each other and, for each group member, they discuss the talents on those cards. The teacher also makes a talent card for each pupil in her/his class, and parents are asked to do the same for their child(ren).

Meet S&T professions and professionals

Pupils and teachers are introduced to professions in the S&T domain. In the Talent Viewer card game, pupils try to collect the four cards that characterize one profession. The four types of card are: 1) a description of the work; 2) an object needed for that work; 3) a talent needed for that work; and 4) a professional aim. The project folder contains two times two different packages of cards, each containing four cards for eight S&T professions.

Example: The cards for "Water Manager" contain:
1) Description: A water manager prevents the land from being flooded by ensuring that water levels in the polder are kept low. A water manager knows how pumping stations operate.
2) Object: A picture of a water pumping station with a short description.
3) Talent: an ideograph of the talent "decision making" is displayed with a description "The ability to decide well and quickly". A water manager likes to look at space as "land and water".
4) Aim: An image of an Amsterdam canal with high water levels and the description "Water levels should be constantly monitored and adapted in order to keep the land and the houses dry".

Pupils are encouraged to use the Internet and other sources to find out more about various S&T professions. To facilitate the research, VHTO developed an online database (i.e., "This is what I do in S&T", www.ditdoeik.nl) with images (photos and videos) of S&T (female and male) professionals and their professional backgrounds.

An additional feature of Talent Viewer is the guest lecture delivered by a female S&T professional, who shares her personal and professional experiences with the pupils. Pupils have to prepare for her visit by finding out about her profession and preparing questions for her. The professional is briefed by VHTO: she is prepared for this very young target group, and also asked to (a) pick a talent from the talent list, and (b) to bring (pictures of) objects she uses for her work (e.g., a map, a camera, a measurement system).

In addition, participating pupils are given the opportunity to visit a company in the S&T domain. For the girls, this is arranged in the context of Girls' Day, an annual national event arranged by VHTO; the aim is to show girls aged 9 to 14 what happens in S&T companies and for them to meet female S&T professionals.

Create awareness of gender-stereotyped ideas about S&T
Talent Viewer attempts to create awareness of gender stereotypes associated with S&T among children, teachers, and parents. At the start of the project, pupils sketch an architect and discuss the drawings. (Of interest is that most children draw a middle-aged man with glasses in a lab coat.) Instructions for the teachers on how to start and lead the discussions are provided in the project folder. The guest lecture delivered by a female S&T professional also contributes to the breakdown of (gender) stereotypes about S&T professions. Furthermore, teachers can subscribe to a training program on gender awareness in the context of S&T education and talent development.

Parental involvement
The parents are also asked to make talent cards for their child(ren). This is designed to promote dialogue. Parents with an S&T profession are invited to prepare a (second) guest lecture about their career. Furthermore, Talent Viewer offers an option for teachers to invite parents to both the first and the final presentation of the project.

RESULTS

Phase one of the Talent Viewer project took place from September 2011 to August 2014. More than 1700 primary schools and more than 3500 classes started working with Talent Viewer in that period. It is now being applied in more than 20% of Dutch primary schools. The evaluation period discussed in this paper ran from March to June 2014. At that moment approximately 2000 classes participated (i.e., approximately 46,000 girls and boys between the ages of 9 and 12).

Since not enough parents' questionnaires were returned only teachers' and parents' evaluations were included. Teachers were asked to fill out a questionnaire after their participation in the project. Pupils were asked to fill out an online questionnaire both before *and* after participation. Participation in the evaluation was not a compulsory part of the project.

Teachers

In April and May 2014, 384 (107 men and 278 women) teachers returned the questionnaire. Most teachers ran the project in grade 6 (64%) or 5 (33%). The other 3% was run in grade 4, a combined group (4, 5, 6 or 5, 6) or a special class (e.g., for gifted children). A quarter (25%) of the teachers conducted all lessons (i.e., lessons 1 to 8), an additional 72% conducted lesson 1 (discussion about S&T and "Draw an architect"), 71% did lesson 2 (talent cards and discussion), 70% prepared their class for the guest lecture (lesson 3), in 72% of participating classes female S&T professionals gave a guest lecture (lesson 4), 41% prepared for a second guest lecture by a parent or an acquaintance (lesson 5), 24% worked on the integration of S&T professions and talents in a rap song, play or magazine (lesson 6), 14% worked on a presentation about the pupils' favorite talents (lesson 7), and 4% worked on a final presentation in which pupils could show/perform the project to their parents. Most teachers did not conduct all the lessons because that would have taken too much of their time.
On a scale ranging from 1 (very poor) to 10 (very good), 72% (M=7.9, SD=1.3) of the teachers rated the extent to which Talent Viewer contributed to breaking down (gender) stereotypes about S&T as 7 or higher. Both the drawing exercise and the visit of the female professional were eye-openers for both the teachers and the children.

The various elements of the project were rated on a scale from 1 (insufficient) to 4 (excellent) (see Figure 1 for an overview of the ratings). The exercise with the talent cards was valued positively, as were the guest lecture and the card game. The drawing assignment (i.e., "Draw an architect"), the other assignments (i.e., integration of talents and professions in a play, magazine or rap song, favorite talents in a presentation format, and the final presentation were rated lower. Still, more than 60% rated these elements as excellent or good.

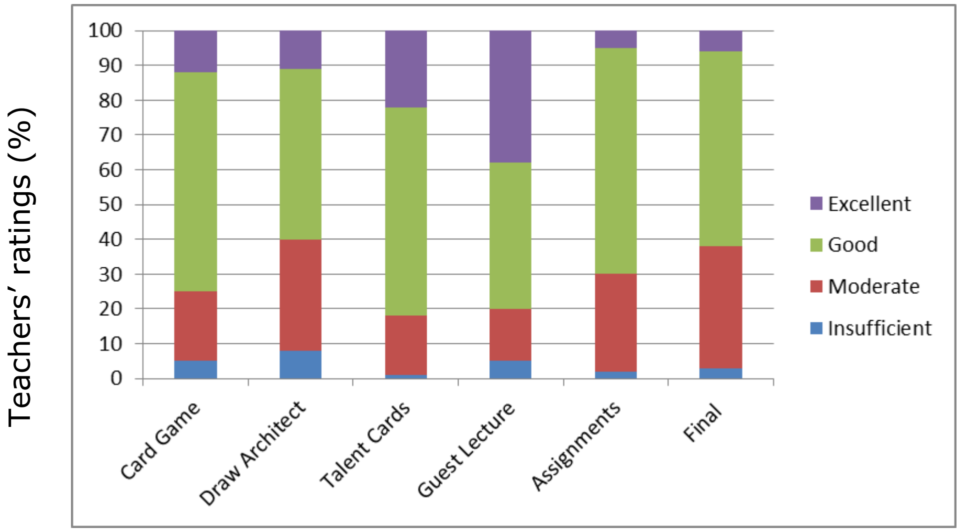

Figure 1: Percentage of Teachers rating 1 (insufficient) to 5 (excellent)

Card game = Professions Card Game. Draw Architect = Exercise to draw an architect. Talent Cards = Cards with talents that pupils, teachers and parents made for each other. Guest Lecture = lecture by female S&T professional. Assignments = Make picture frame for favorite talents, integrate favorite professions. Final = Final presentation for parents and peers.

Most of the positive comments made by the teachers focused on the guest lecture. It offered new insights for both pupils and teachers. Children were often surprised when they realized that the professional they had prepared for was a woman. Although teachers were explicitly informed that the project did not contain a technological assignment, many thought it was a missed opportunity that one was not included (i.e., pupils did not perform an experiment or make something for which they needed to use technical skills). Despite the efforts invested in training the professionals, some teachers commented that the professional was incapable of giving a proper guest lesson. In particular, she could not relate to the imagination of the children, used words they could not understand, or was simply not engaging.

Pupils
1395 (703 girls, 692 boys) pupil questionnaires were returned prior to participation in the project (T1). 1124 (541 girls, 583 boys) were returned after participation in the project (T2). Individuals in the samples at T1 and T2 could not be related to each other.

Pupils' attitudes towards S&T
Chi-square tests of independence were performed to examine the relationship between gender and (a) pupils' attitudes and (b) the effect of Talent Viewer on pupils' attitudes (T1 vs T2). In Figure 2, the percentages of pupils that agreed with the questions are depicted for T1 and T2. In general, the percentage of boys (86%) that agreed with the statement "S&T is interesting" is significantly higher than that

for girls (69%, $X^2(1, 2517)=148.4$, $p<0.001$). No difference was found for T1 and T2 ($p>0.05$). Girls (43%) agreed significantly more often with the statement that S&T is difficult compared to the boys (26%), $X^2(1, 2517)=79.26$, $p<0.001$); no difference was found between T1 and T2 ($p>0.05$). Boys (86%) agreed significantly more often than girls (35%) that they had talent in S&T, $X^2(1, 2517)=247$, $p<0.001$ with no significant difference between T1 and T2 ($p>0.05$). Girls and boys were in agreement that working in S&T requires the ability to cooperate (92%), with no difference between T1 and T2 ($p>0.05$). An equal percentage of boys and girls agreed that creativity is needed for S&T ($M=93\%$); no difference was found at T1 and T2 ($p>0.05$).

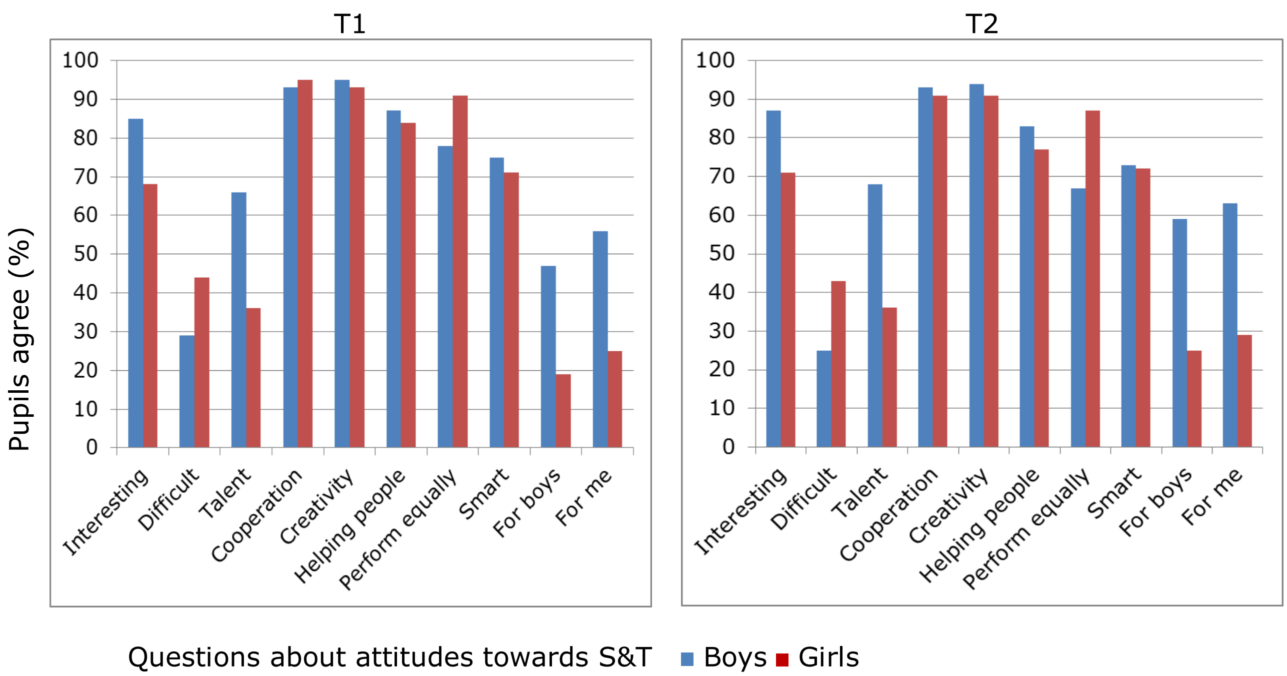

Figure 2: Percentage of pupils who agreed with the questions

Notes: % of pupils that agreed on T1 and T2: 1) I think S&T is interesting (Interesting); 2) I think S&T is difficult (Difficult); 3) I think I have the skills for S&T (Talent); 4) I think you have to be cooperative to work in S&T (Cooperation); 5) I think you need to be creative to work in S&T (Creative); 6) I think those who work in S&T are helping people (Helping people); 7) I think boys and girls could perform equally well in S&T (Perform equally); 8) I think one has to be very smart to work in S&T (Smart); 9) I think S&T is something for boys (For boys); 10) I think S&T is something for me (For me).

Boys (84%) agreed significantly more often than girls (80%) that S&T involves helping people ($X^2(1, 2517)=9.71$, $p<0.005$). The percentage of girls that agreed with this significantly increased at T2 (T1=77% vs T2=84%, $X^2(1, 1243)= 8.56$, $p< 0.005$. Girls (87%) agreed significantly more often than boys (67%) that boys and girls perform equally well in S&T at T1 ($X^2(1,1393)=79.32$, $p<0.001$) and T2 (91% vs. 78%, $X^2(1,1124)=33.46$, $p<0.001$). The percentage of pupils that agreed that girls and boys perform equally well increases significantly at T2

(X^2(1,2517)=19.8213, p<0.001). On average, 72% of pupils agreed that one has to be smart to be an S&T professional. No difference was revealed for T1 and T2 (p>0.05). Boys (53%) agreed more often than girls (22%) that S&T is for boys (X^2(1, 2517)=261.0838, p< 0.001). The percentage of pupils that agreed decreased at T2 (X^2(1, 2517)=19.82, p< 0.001). Boys (62%) more than girls (25%) agreed that S&T is for them (X^2(1, 2517)=265.64). No significant difference was found at T1 and T2 (p>0.05).

DISCUSSION

The Netherlands lag behind other countries in terms of the percentage of girls opting for S&T (Eurostat, 2009; OECD, 2006). The main reasons (e.g., Bøe et al., 2011; Ceci & Williams, 2010; Eccles, 2007; Eccles et al., 1999; Watt, 2006; Schoon & Eccles, 2014) for the under-representation of girls and women in S&T are: 1) Girls have no or only a few role models – that is, women who are educated and work in S&T; 2) Girls, even at a very young age, show less confidence in their ability in S&T; and 3) Girls are less encouraged and motivated by their teachers and parents to make non-traditional education choices for a career in S&T (e.g., Schoon & Eccles, 2014). Talent Viewer is designed to address these factors in primary school and to be supportive in – as Lynn Liben states (2015) – ensuring that all individuals, irrespective of specifically gender, but also ethnicity, nationality, economic status, or any other dimensions along which people vary, have access to the full range of opportunities and support they need to engage and succeed in STEM.

The Talent Viewer Evaluation

Discover your talent

The teachers regarded this part of Talent Viewer favourably. They found it useful to consider the talents of each individual in their class. They also found that talent was a good starting point for a discussion on S&T occupations and what talents are required to become a STEM professional. Defining talents contributed to the awareness of stereotypical ideas about professions in the S&T domain. Also, working with individual talents and skills fits well with one of the official core objectives defined for primary education: "Orientation on the self and the future". S&T in primary education is incorporated in this objective in the Netherlands.

Less specific talents, that is those that girls often find attractive for future professions and which have not been correlated to a lower self-concept, were linked to S&T occupations. The aim: to engage more girls in S&T, and to weaken its associations with "difficulty" and "excellence". This might be related to the findings of Leslie et al. (2015), who found that women are under-represented in fields whose practitioners believe that innate talent is the main requirement for success because women are stereotyped as not possessing such skills. After participation in Talent Viewer both girls and boys were much less convinced that S&T is specifically for boys; the non-specific-talent–S&T associations might have contributed to that.

Meet S&T professions and professionals

For this part of Talent Viewer, considerable effort was put into creating a more feminine perspective. The professions in the card game were carefully selected. The card game contained non-obvious S&T occupations that appeal to girls as well. Additionally, VHTO arranged a guest lecture by a female S&T professional for each participating class. The aim: to offer role models/counter stereotypes. Teachers also rated this part of Talent Viewer as very positive. It allowed them to make the acquaintance of less-obvious S&T professions. The fact that the guest lecturer was a woman was met with surprise and resulted in more gender awareness among both teachers and pupils, according to the teachers. This in turn contributed to the general aim of breaking down stereotypes. The meeting with female S&T professionals has not resulted directly in more girls considering S&T as a future direction. However, the meeting with the STEM professional did contribute to the fact that both girls and boys were less convinced that S&T is only for boys.

Create awareness of gender-stereotyped ideas about S&T
In different parts of Talent Viewer there was a focus on creating awareness of (gender) stereotypical ideas about professions in S&T. At the end of the first Talent Viewer season, we can conclude that the project served well as an initial eye-opener for the participating teachers, parents, and pupils. The key point is that S&T is a domain for both men *and* women. Talent Viewer shows pupils that women also have S&T professions, they are good at their jobs, and they enjoy their work. Furthermore, Talent Viewer showed the target group that there is a wide variety of S&T professions, which is not limited to car mechanics, plumbers, and carpenters, but extends to water managers, bio-medical engineers, medical instrument makers, etc. Furthermore, the talents needed for S&T are not restricted to the traditional S&T skills (e.g., calculating, making or repairing things, and spatial awareness), but also involve cooperating, helping people, taking initiatives, and presenting. Also, after participating in Talent Viewer, girls still thought of themselves as less talented at S&T than boys. Even though a real change in attitude among pupils towards S&T could not be expected after only one event, the boys' attitude changed: after participating in Talent Viewer they more often agreed that girls and boys could perform equally well in S&T, which could indicate weakened (gender) stereotypical ideas towards S&T.

Parental involvement
Parents and teachers should also be actively involved in creating awareness of their gender stereotype. They are the primary influences on children as long as they are at school (e.g., Lazarides & Ittel, 2013; Schoon & Eccles, 2014). The talent cards seem to be a good tool for involving parents, creating awareness among them, and giving them a clue about discussing talents and future opportunities.

FUTURE DIRECTIONS

The broader aim is to deploy Talent Viewer in all primary schools in the Netherlands. In the new series, even more attention will be paid to the selection and training of role models, whose support is indispensable. More attention has also been paid to the possibility of using each of the project lessons separately, thereby making Talent Viewer more flexible and less time-consuming. Furthermore, to make the project more appealing to teachers, it should include a technological assignment. Based on this feedback, VHTO now includes a coding assignment, which uses the object-based coding language Scratch.

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