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## **The Influence of a Two-Day Recruitment Event on Female Upper Secondary Students' Motivation for Science and Technology Higher Education**

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### **ABSTRACT**

This paper reports on how female students' motivation for undertaking higher education in science, technology, engineering and mathematics (STEM) was influenced by a recruitment event (The Girls' Day) at the Norwegian University of Science and Technology. The findings indicate that the event influenced the participants' STEM motivations by affecting their expectation of success and subjective value of STEM tertiary education. Meeting university STEM students was emphasized as the most important factor. These students provided 'trustworthy' information, and served as achievable role models helping the participants to see themselves as future STEM students. The majority of the participants rated the costs (in terms of required effort) of studying STEM higher after the event than they did before, but this did not weaken their expectation of success. While learning about the difficulty and required effort, the participants were also introduced to strategies for coping with these costs: study groups, tutor support, and 'it is tough for everyone' attitudes.

### **KEYWORDS**

STEM participation; recruitment event; upper secondary school; gender; Girls' Day; Norway



## **The Influence of a Two-Day Recruitment Event on Female Upper Secondary Students' Motivation for Science and Technology Higher Education**

### **INTRODUCTION**

In Norway, as in most of the Western world, there is a widespread concern about insufficient participation of women in STEM (ERT, 2009; Ministry of education and research, 2010; Osborne et al., 2003; Osborne et al., 2009). However, the problem does not apply equally to all STEM disciplines. It is primarily physics, mathematics, engineering, and, to a lesser extent, chemistry that experience relatively low enrolment and underrepresentation of women (Bøe et al., 2011). Norway had 12 % female participation in higher education computer science programmes in the academic year 2009–2010. The corresponding figures were 38 % in mathematics, 44 % in chemistry, 28 % in physics, and 68 % in biology (Bøe & Henriksen, 2013b). In order to improve STEM participation, a large number of recruitment efforts have been developed and implemented. However, while there exists a growing body of science education research on STEM interests, attitudes and choices, there is not much available research on recruitment campaigns (Andrée & Hansson, 2013). The approach used in this paper is informed by Jensen and Sjaastad's (2013) investigation of a weekly after-school mathematics programme for secondary students in Norway, using focus groups and a questionnaire study, where results from the focus groups informed the development of the questionnaire. The purpose is to see how different concerns that have been linked to STEM participation problems in the literature can be addressed through a two-day recruitment event for girls.

### **Expectancy-Value Theory and STEM Choice**

As described, few research articles investigate specific STEM recruitment initiatives. Andrée and Hansson (2013) used the Eccles et al. (1983) expectancy-value model to study a recruitment campaign, and Jensen and Sjaastad (2013) used the same model to investigate a weekly after-school mathematics programme. The present study builds on these previous studies and uses the same theoretical model. The main question in this paper is how the STEM motivations of high-achieving female upper secondary students were influenced by their participation in a two-day recruitment event. Eccles and colleagues' expectancy-value model for achievement-related choices (Eccles et al., 1983; Eccles & Wigfield, 2002) is employed as an analytical tool for understanding this influence. Bøe et al. (2011) used this model as a lens when reviewing international research on young people's attitudes towards and participation in STEM, and claimed that this model is suitable for evaluating and designing initiatives. According to the model, choice motivation consists of two main aspects: expectation of success and the subjective value attributed to the education in question. Four components are included in the subjective value: Attainment, interest-enjoyment, utility and cost.

Expectation of success is the individual's beliefs about how well he or she will do in an upcoming study programme or education: 'Will I be able to go through with this?'

Is it likely that I will succeed in reaching the goals I set for myself?' Attainment value is related to identity: 'How well does this activity match my perceived identity? How important is it for me to be engaged and do well?' Interest-enjoyment value concerns intrinsic motivation: 'How enjoyable is the education? Am I interested?' Utility value is related to extrinsic motivation: 'How will this task help me reach other goals I have set for myself?' The greater the expectation of success, attainment value, interest-enjoyment value, and utility value, the greater probability of choosing the educational option in question. The fourth subjective task value, cost, has to do with negative aspects: 'How much time and effort will it take? What do I risk in terms of failure and anxiety?'

The Expectancy-value model is highly suitable for our investigation because it comprises several factors that are described in the literature as important for educational choices: Bandura's (1997) self-efficacy, interests (Krapp, 2002), identity (Hazari, Sonnert, Sadler, & Shanahan, 2010; Taconis & Kessels, 2009) and utility value (Harackiewicz, Rozek, Hulleman, & Hyde, 2012). The model links expectations and subjective values directly to performance and choice, while factors like perception of the difficulty of different tasks, personal and collective identities, socializers' behaviour and beliefs, cultural milieu, and interpretation of previous achievement outcomes affect choices indirectly, through their influence on expectations and values.

### **Science Education Literature on Interests, Identity, Attitudes and Recruitment Initiatives**

A review of science education literature on relevant issues provides helpful information for the present study. Young students are generally interested in science, however, science interest tends to decline with age. Biology is less affected by this decline (Krapp & Prenzel, 2011; Osborne et al., 2003). In the Relevance of Science Education (ROSE) study of 15 year old students' interests in science and technology, Sjøberg and Schreiner (2010) found that students in less industrialized countries expressed higher interest for science and technology than students in highly developed countries. Norway is an example of a country where students' science interests are comparably lower, and the need for recruitment interventions is likely to be higher.

Identity is seen as an important factor in educational choices by the Eccles et al. model, as argued by Eccles (2009). Several studies concerning students' relationships with science have focused on identity. For instance, Schreiner (2006) related student interest in science in Norway to identities in late-modern societies. Hazari et al. (2010) examined responses of US tertiary students ( $N=3,829$ ) and found that these students' high school physics identities were predictors of physics career. The stereotypical image of physicists and scientists in general has been found to fit poorly with many young people's identity (e.g. Taconis & Kessels, 2009), and they tend to have trouble picturing themselves as scientists (Archer et al., 2010; DeWitt et al., 2011; Lyons & Quinn, 2010). Researchers have also pointed to identity as an important issue for understanding female under-representation in some STEM disciplines (Buck, Clark, Leslie-Pelecky, Lu, & Cerda-Lizarraga, 2008; Eccles, 2009; Lyons & Quinn, 2010).

Prospects for further education and jobs are important aspects of the utility value that students associate with STEM. The career opportunities provided by STEM education are unknown to many young people (e.g. Cleaves, 2005), and several investigations point to providing information about possible STEM careers as a way of increasing participation in these disciplines (Bøe & Henriksen, 2013a; Lyons & Quinn, 2010).

### **Gender**

Several studies have found girls to be more likely than boys to express low expectation of success in science and mathematics (Bøe & Henriksen, 2013a; Häussler & Hoffmann, 2002; Lindstrøm & Sharma, 2011; Lyons, 2006; Murphy & Whitelegg, 2006). In actual performance, however, differences tend to be much smaller, if present at all. Among Norwegian students in secondary school, the performance of girls and boys in STEM tests are on average very similar (Kjærnsli & Roe, 2010), and sometimes girls' performance is slightly better (Bjørkeng, 2011), indicating that performance or aptitude alone are not very powerful explanatory factors for the gender differences in STEM choices. Ceci et al. (2009) discussed socio-cultural and biological explanations for why girls are underrepresented in STEM, and argued that preferences and priorities were the most powerful explanatory factors for why fewer girls than boys choose these subjects. Sjøberg and Schreiner (2010) found that girls were more interested in health topics and environmental issues, while boys were more interested in technology, mechanics, and electronics.

### **Recruitment Initiatives**

Hands-on activities and a personal meeting between participants and university students or professionals are referred to as important factors in several studies on recruitment initiatives. Swimmer and Jarratt-Ziemski (2007) investigated a one-week US engineering residential camp for 9<sup>th</sup> to 12<sup>th</sup> grade young women, and claimed that the participants were more engaged with and learned more from interaction with professionals and from hands-on activities, than the lecture-style modules. Woolston et al. (1997) found that more participants in University of Wisconsin-Madison's day-long campus visit programme ranked interaction with students and hands-on activities as more favourable activities than printed material and general introduction to the college. Cantrell and Ewing-Taylor (2009) investigated a programme where 130 US high school students attended eight weekly sessions where they received presentations from STEM professionals. They found that the social hour after the formal programme where participants met presenters and could ask questions was the most powerful experience contributing to the participants' knowledge about STEM careers. Harackiewicz et al. (2012) investigated a three-step US recruitment intervention, where parents of high school students received two brochures and were introduced to a web site encouraging them to talk to their children about the utility value of science and mathematics. The adolescents in the experiment group took nearly one more semester of science and mathematics in the last two years of high school, compared to the control group.

### **The Girls' Day at the Norwegian University of Science and Technology**

This paper investigates a recruitment event called The Girls' Day (TGD), which is a two-day event at the Norwegian University of Science and Technology (NTNU) aimed at girls who have chosen specialization in mathematics and physics in their last years of upper secondary school. The explicit aim of TGD is to get more female applicants to the university's STEM programmes, which include Master of Science degrees in a range of technological disciplines as well as general science degrees. Admission to the STEM programmes at NTNU requires a high grade point average from secondary school, and the university has a good reputation and is considered as prestigious. Most higher education institutions in Norway, including NTNU, have public funding of tuition fees.

During the 2011 TGD event studied here, 251 participants attended a science show, a lecture about privacy and data security, a 'motivational' lecture, and a lecture where they received information about the study programmes and everyday life as a student at NTNU. Furthermore, they were divided into five groups based on what study programmes they had expressed interest in. These groups took part in a guided tour around the campus where they visited different departments and laboratories. Participants also visited exposition stands where they met university students and could ask questions about study programmes and everyday life at NTNU. Some students participated in a hands-on activity where they soldered an electronic name tag. Students also took part in a social dinner and enjoyed some entertainment. Participants were accepted for the event based on written applications, and their mathematics mark had to be average or better. The university covered all expenses for participants who travelled from all parts of Norway. TGD in its present form was first arranged in 2010, but NTNU has carried out similar events annually, with slightly different target groups and aims, for more than ten years before 2010.

### **Research Questions**

The purpose of the present paper is to see how different concerns that have been linked to STEM participation problems in the literature – students' stereotypical perceptions of science identities, their (particularly girls') perception of a high cost associated with STEM studies, and lack of knowledge of possible STEM careers etc. – can be addressed through a two-day recruitment event.

Our research questions are:

1. What were TGD participants' actual choices of higher education?
2. How did TGD influence participants' decision processes concerning what and where to study in higher education?
3. How did experiences from TGD influence the participants' expectation of success and subjective values related to tertiary education options in STEM?
4. How was the participants' motivation for working with school mathematics and science influenced by TGD?

### **METHODS**

Data from three surveys, three focus group interviews, and registration data from the university were utilised in a triangulation approach.

## Data Collection and Analysis

### *Respondents*

The target population in this study were the 251 participants in the 2011 event of The Girls' Day. Moreover, questionnaire responses from 273 participants in the 2010 event were used to inform the development of the 2011 event study. All participants were girls in their last year of upper secondary school (18 years old, with few exceptions) that had chosen specialisation in mathematics and physics. The 2010 event data collection consisted of an electronic survey which was administered to the participants six months after the event, in May 2011. 182 of the 273 participants responded (Table 1).

A few weeks prior to the 2011 event, an invitation to participate in focus group interviews was published on The Girls' Day Facebook site. 24 students volunteered to participate, however 7 students had to withdraw, some on the day of the event due to late changes in travel plans. Consequently, three separate focus group discussions with a total of 17 participants were carried out immediately following the conclusion of the event. These 17 respondents, therefore, form a convenience sample and we do not know to what extent they were representative for the whole target group.

An electronic questionnaire survey was administered to all participants approximately ten days after the event. 189 of the 251 participants responded. The questionnaire was administered again six months later, with additional questions about the participants' plans for tertiary education. This survey received 156 responses, 144 of these had also responded to the first survey. The participants reported a grade point average of 5.0 (on a 1–6 scale) in their year 13 mathematics course (n=154). This average shows that this was a group of high-achieving students. The national average for girls on exams in the same school year was 3.6 for the year 13 mathematics course (The Norwegian Directorate for Education and Training, 2013).

Table 1 *Number of Respondents in the Different surveys, and in the Focus Groups. Note. The last row shows the number of students that answered both questionnaires related to the 2011 event.*

| 2010 event (Target population: N = 273)    |        |               |
|--|--------|---------------|
|  | Sample | Response rate |
| Questionnaire, 6 months after event        | 182    | 67 %          |
| 2011 event (Target population: N = 251)    |        |               |
|  | Sample | Response rate |
| Focus groups, 2 <sup>nd</sup> day of event | 17     |               |
| Questionnaire, 10 days after event         | 189    | 75 %          |
| Questionnaire, 6 months after event        | 156    | 62 %          |
| Responded to both questionnaires           | 144    | 57 %          |

*Pilot study with 2010 event participants*

The questionnaire administered to the 2010 event participants was very brief, and asked the open-ended question 'How did your attendance at The Girls' Day 2010 influence your choice of study programme?'

*Focus groups with 2011 event participants*

Data from the 2010 event pilot study, alongside the Eccles et al. Expectancy-value model, provided a base when developing the interview guide for focus groups with 2011 participants. The authors were moderators for the focus groups. The first main question in the interviews was: 'Could you tell us about how you have experienced participating in The Girls' Day?' This question was chosen to get the participants' views without leading them on to a particular topic. After the topics that emerged from this question were discussed, we continued with more specific questions from the semi-structured interview guide. These questions asked in more detail about how TGD had influenced the girls' STEM motivations, and some of the questions were related to the Eccles et al. model. The conversations were held in Norwegian, audio recorded for later interpretation, and all quotes in this paper were translated into English by the authors.

Responses from the focus group interviews and open-ended survey questions were analysed qualitatively using the NVivo 9 software to code and retrieve quotations. A thematic analysis was performed, informed by the recommended approach of Braun and Clarke (2006), with the aim of finding repeated patterns of meaning. The coding process was guided by the Eccles et al. model. Responses were reviewed in several cycles and informed by discussions with colleagues, until we had an account that was considered as a valid representation of the students' responses. The categories that responses were coded into included: 'STEM Motivation', 'Expectation of success and cost', 'Utility value for future job', 'Meeting students and role models', 'Experiencing NTNU', 'Trustworthy information' and 'Student environment'.

*Questionnaire study with 2011 event participants*

A draft version of the 2011 event questionnaire was developed based on the interview guide as well as the data from the focus groups. The draft questionnaire was scrutinised by event organisers, focus group participants, and fellow researchers in several steps until a final version was made. The focus group participants who commented on the draft version participated in the survey when it was administered, thus these respondents were already familiar with the themes in the questionnaire. The steps mentioned above were important in securing the validity of the instrument and its use (Wilson, 2005, pp. 54-55). The questionnaire consisted of single item questions. The phrasing of items was informed by how respondents had talked about the themes in focus groups and open-ended questions. Furthermore, we chose to use response categories that were easily interpretable and easy to discern, and that fitted well with how focus group participants had described the event. As a result, most items had three response categories (e.g. 'Smaller than before', 'Same as before' and 'Larger than before'). The questionnaire design for the items that are included in this paper, is presented in Table 3, along with students' responses to these items.

The first survey was administered 10 days after the event, the second approximately 6 months after the event. The two surveys will from now on be referred to as survey #1 and survey #2, respectively.

*Registration Data on Study Programme Applications and Enrolment*

Registration data on how many of The Girls' Day participants that applied for and then later enrolled in STEM study programmes at NTNU, were provided by the university.

**RESULTS**

***What Were TGD Participants' Actual Choices of Higher Education?***

The main deadline for applications for higher education in Norway is 15 April each year. Applicants can apply for admission to up to ten different study programmes, and rank these according to their priorities. Drawing on questionnaire and registration data, the choices of the participants in connection with this decision point are described below.

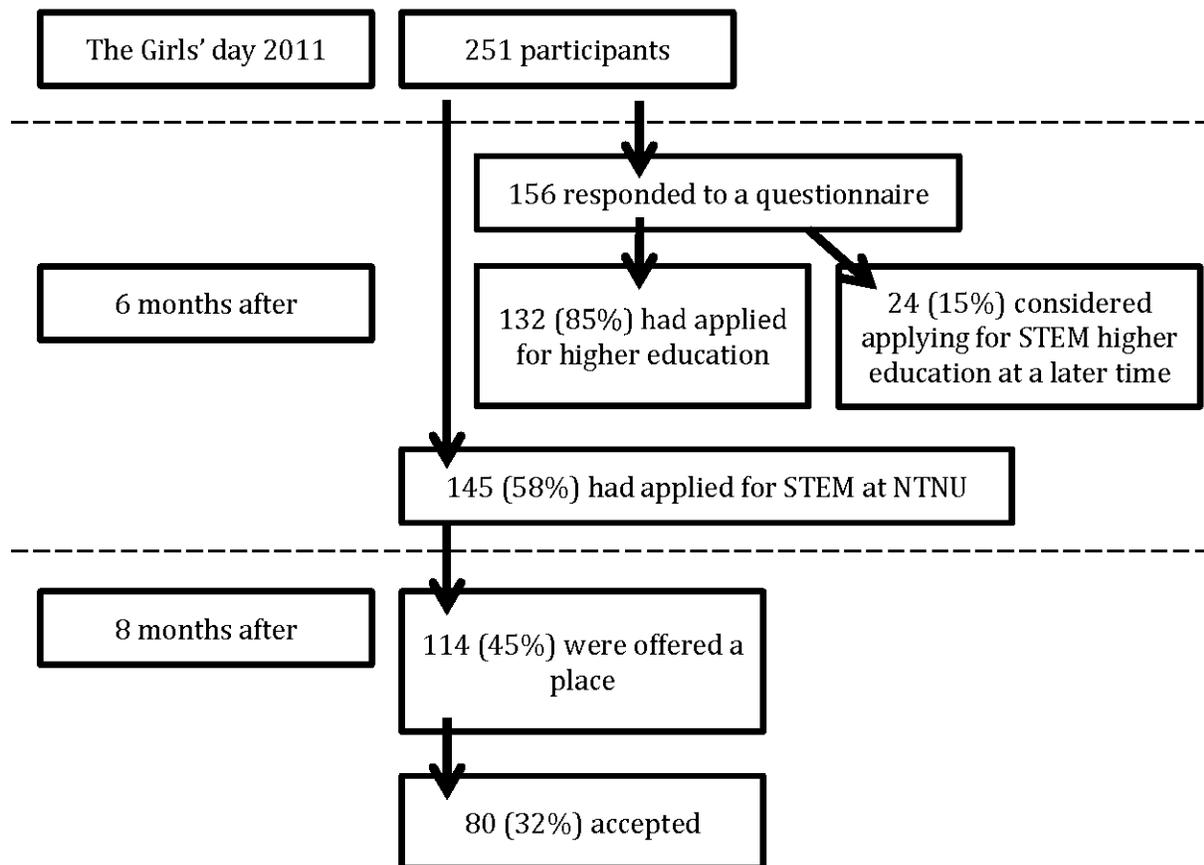


Figure 1. *The participants' educational choices after the event. The data concerning participants' choices of higher education in general are responses from the questionnaire survey, while the information concerning participants' choices of NTNU programmes is based on registration data.*

When asked about their experiences with TGD, 62 % answered in survey #1 (ten days after the event) that they had found at least one STEM study programme at NTNU they had decided to apply for. In survey #2 (six months after the event) 95 % of these respondents had applied for STEM higher education at NTNU. Figure 1 gives an overview of the participants' educational choices after the event.

### **How did TGD Influence the Participants' Decision Process Concerning What and Where to Study in Higher Education?**

The results from survey #1 showed that many participants considered The Girls' Day to have been helpful in their choice process. 64 % responded that they were more certain of *what* to study, and 74 % responded that they were more certain of *where* to study.

The students who answered in survey #1 that the event had made them more certain of what to study, were prompted to write down the most important factor making them more certain. Here, the most common response was meeting university STEM students, both at the exposition stands on the last day of the event and in between the events in the organised programme. This result is supported by the responses to one of the closed-ended questions in survey #1, where 96 % of the respondents responded that meeting university students made them more motivated to choose a higher education in STEM. In survey #2 the same item was included, and now 88 % answered that meeting university students had made them more motivated to choose STEM (Table 3). The focus groups and open-ended questionnaire responses indicated that meeting university students gave the participants an opportunity to ask questions and get detailed information about the study programmes, job opportunities and the social life at the university. Most important, perhaps, was the opportunity to get the university students' stories about how they experienced everyday life as a STEM student. Here, the participants could learn about both the positive and negative aspects of student life, thus getting personal information that was perceived as trustworthy.

'I think it was great that there were so many students around all the time and that we got to hear from them how it really was to be a student in Trondheim'

'The fact that we got to hear from the students themselves how they experienced attending NTNU was really good. In my opinion students are the best source when it comes to finding out what it is like to go to NTNU, and thus one can find out things that are not in brochures or on the internet.'

The following sections demonstrate how meeting university students at the event can be related to several of the expectancy-value factors in the Eccles et al. model.

## **How Did Experiences from The Girls' Day Influence the Participants' Expectation of Success and Subjective Values Related to Tertiary Education Options in STEM?**

### *Interest and enjoyment*

Participants were asked, through an open-ended question in survey #1, what the event had showed them about what it is like to be a STEM university student, and what this has meant for their motivation to choose STEM in higher education. A common response was that they had learned that STEM education can be highly interesting and enjoyable.

'one learns a lot and the work one does seems really fun and interesting'  
'The Girls' Day showed me that being a STEM student is really fun, but demanding.'

Survey #1 results showed that 85 % of the respondents perceived a tertiary STEM education as more interesting after the event, while 76 % gave the same response in survey #2.

### *Attainment value*

In the focus group interviews participants reported that the university students functioned as role models. Typically they appreciated that the university students were only a few years older than them, demonstrated that they enjoyed their study, found time to spend on leisure activities, and that they had a normal 'style', contrasting the stereotypical portrait of the geeky science student. Moreover, the university students expressed that they too found science difficult and demanding. In this way, the university students were able to display possible future STEM identities that many of the participants found attractive and were able to identify with. The following quote refers to one of the lectures, held by a former student:

'I think she was really great, [...] she was like normal in a way [...], she was quite good-looking compared to the stereotype of persons, or women that do science and mathematics they are sort of like big glasses and a lot of pimples and stuff like that, but she had a nice style and like, and looked totally ordinary and then she was smart and then it was sort of PhD and she was quite young and, so I think it was a very good role model in a way'

Some of the focus group respondents reported that they were motivated by meeting other participants with similar interests to themselves.

'It has been nice meeting others from entirely different parts of the country that like the same things as you, not only the one person or just you in your class. So that, aha, okay, there are actually others that have the same interests too, it's not only me'

Meeting other participants was reported as motivating by 57 % in survey #1 and 48 % in survey #2. A few students also said that they appreciated in particular meeting other young women that were interested in physics, because back at

school the number of girls who had chosen physics was very low. On the closed-ended item 57 % in survey #1 and 61 % in survey #2 answered that meeting other like-minded young women that were interested in science was motivating. 96 % responded that 'experiencing NTNU' increased their motivation to choose tertiary STEM education (survey #1), whereas 91 % gave this response in survey #2. The responses in the focus group interviews indicated that this was related to meeting students and receiving information from them about what it is like to be a STEM student at this university. Moreover, it was related to how the participants experienced the university by getting a tour around campus, walking around the site, spending time at the location, attending lectures, visiting labs and classes, and getting glimpses of the every-day student life. For some students this might increase the attainment value they attach to studying at NTNU, because this experience gave them a starting point for seeing themselves as students at this university.

'it is something completely different, someone could have come to our school and told us about all these things and showed us some pictures, but [...] that is not the same thing, it is a completely different thing to come here and see things and get a sense of how it is and see, that is just to see the other students working around you without talking to them at all, but just see what they are doing.'

'I can easily picture myself as a student walking around in these hallways'

#### *Expectation of success and cost*

Meeting university students and seeing that they were ordinary people that the participants could identify with appeared also to have strengthened the participants' expectation of success. Some of them reasoned that 'if they can do it, so can we.'

'It is so great that the students here [...], they have the same [...], it is difficult for them too. When they are still this enthusiastic and love their study so much, even if they say that it is also demanding, that is very motivating'

'So that is like, we can do it too'

'They are ordinary people too.'

In survey #1, 63 % responded that the event made them think that even more time and work is needed for completing a tertiary STEM education than they had thought beforehand. Of these, 8 % reported that their expectation of success was weakened after the event. 54 % reported their expectation of success to be unchanged, while 38 % answered that it had increased. The responses were very similar in survey #2. 59 % answered that the event made them think that more time and work is needed to complete a tertiary STEM education, and of these 38 % answered that their expectation of success had increased (Table 2).

Table 2. *TGD Participants' Responses to Closed-Ended Items.*

*Note. The item 'My belief that I can complete a STEM higher education programme' is interpreted as a measure of expectation of success related to a possible higher education STEM programme. The item 'How much time and work I think is needed to complete a higher education STEM programme' is interpreted as a measure of cost.*

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| Students who responded 'More than before' on the item 'How much time and work I think is needed to complete higher education STEM programme' (cost) |        |                    |                |                      |                   |
|---|--------|--------------------|----------------|----------------------|-------------------|
|   | Survey | Weaker than before | Same as before | Stronger than before | N                 |
| My belief that I can complete a STEM higher education programme (expectation of success)  | #1     | 8 %                | 54 %           | 38 %                 | 117 (63 %) of 185 |
|   | #2     | 8 %                | 54 %           | 38 %                 | 91 (59 %) of 155  |

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Some of the students reported in survey #1 that they had been encouraged by their impression of the environment at the university, expecting to find motivation and help from peers and teachers.

'The Girls' Day showed me that it takes discipline [...], autonomy, a lot of responsibility, motivation and willpower to be a science and mathematics student. It will be demanding too, but with this good study environment and teachers I got the impression that [...] it will work out wonderfully.'

In addition, some of the students refer to the 'motivation lecture' on the last day of the event, where they were told that a STEM university study requires a lot of hard work. Here, they were also presented with some strategies for making it easier and more enjoyable. In this way, the lecture is likely to have lowered the cost they attach to failing or not understanding some tasks, in addition to giving them strategies on how to succeed in their studies.

'I think it is important to think about what he said [...] that you attend this study because you don't already know this, so you mustn't panic if you do not understand it immediately.'

'And we will handle it better if we are prepared that, okay, it is going to be a difficult start, both mentally and with the courses'

One of the few students who responded that TGD made her less motivated to choose STEM higher education (Table 3), related this to expectation of success in her response to an open-ended question in survey #2:

'Participating in The Girls' Day 2011 made me doubt whether I would be able to complete a graduate engineering education.'

### *Utility value*

Although the students were not introduced to many specific jobs that STEM education can lead to during the event, they appreciated learning that a STEM education at NTNU opens up a broad range of different jobs. Furthermore, they appreciated learning that it will be easy to get a job with this background, both because companies are highly interested in candidates with a STEM degree from NTNU, and because a lot of companies are particularly interested in recruiting women with a STEM degree.

'It has demonstrated that it is easy to get a job after having graduated from NTNU and that makes you look at it as a safe choice, when you sort of hear that almost everyone is headhunted before they even finish (...) the industry appreciates people who had attended different study programmes at NTNU. It makes you more positive'

'I have understood that it opens up a lot of opportunities.'

'Particularly being a girl with a science and technology degree is very popular and many (students) get job offers before they have finished their degrees'

63 % (survey #1) and 51 % (survey #2) answered that the information they received about job opportunities at the exposition stands had made them more motivated. The information they received about study programmes on the stands was found motivating by 87 % in survey #1, while 69 % gave this answer in survey #2.

### **How Was the Participants' Motivation for Working with School Mathematics and Science Influenced by The Girls' Day?**

69 % responded that the event made them more motivated to work with school mathematics and science (survey #1). In the focus group interviews conducted immediately after the event, several students said that they were now motivated to work harder, in order to get the grades needed to get accepted into NTNU.

Moderator: 'How will it be to come back to R2 [upper secondary mathematics] and physics and chemistry ... [after TGD]?'

Student: 'We have increased our motivation.'

Several students: 'Yes.'

Student: 'A little more can-do attitude now, want to like manage, manage to get an even better mark.'

Several students: (expressing consent)

Student: 'So that you [...] are guaranteed to be accepted into your dream study'.

In survey #2, 44 % answered that the event had made them more motivated for working with school mathematics and science.

Table 3  
*TGD participants' responses to closed-ended items.*

|  | <b>Survey #</b> | <b>Weaker than before</b> | <b>Same as before</b> | <b>Stronger than before</b> |
|--|-----------------|---------------------------|-----------------------|-----------------------------|
| <b>How has the following changed due to The Girls' Day?</b>  |                 |                           |                       |                             |
| My belief that a STEM education would be interesting   | 1               | 1 %                       | 14 %                  | 85 %                        |
|  | 2               | 3 %                       | 21 %                  | 76 %                        |
| <b>My motivation for working with school science and mathematics</b>   |                 |                           |                       |                             |
|  | 1               | 0 %                       | 31 %                  | 69 %                        |
|  | 2               | 2 %                       | 54 %                  | 44 %                        |
| <b>How has the following experiences at The Girls' day influenced your motivation to choose a STEM higher education?</b> |                 |                           |                       |                             |
| Meeting other like-minded girls that are interested in science and mathematics   | 1               | 2 %                       | 41 %                  | 57 %                        |
|  | 2               | 2 %                       | 37 %                  | 61 %                        |
| Meeting university students  | 1               | 0 %                       | 4 %                   | 96 %                        |
|  | 2               | 2 %                       | 10 %                  | 88 %                        |
| Meeting other TGD participants   | 1               | 2 %                       | 41 %                  | 57 %                        |
|  | 2               | 1 %                       | 51 %                  | 48 %                        |
| Experiencing NTNU  | 1               | 0 %                       | 4 %                   | 96 %                        |
|  | 2               | 1 %                       | 8 %                   | 91 %                        |
| <b>The information about study programmes I received at exposition stands</b>  |                 |                           |                       |                             |
|  | 1               | 0 %                       | 13 %                  | 87 %                        |
|  | 2               | 2 %                       | 29 %                  | 69 %                        |
| <b>The information about job opportunities I received at exposition stands</b>   |                 |                           |                       |                             |
|  | 1               | 0 %                       | 37 %                  | 63 %                        |
|  | 2               | 1 %                       | 48 %                  | 51 %                        |

## DISCUSSION

Who participated in TGD, and how did the event influence their STEM motivations? Students had to apply to participate in the event, and a hypothesis could be that TGD mainly attracts students that already were interested in or had decided they would apply for a STEM programme at NTNU. However, Bøe and Henriksen (2013a) investigated the aspirations of physics students in upper secondary school in Norway (N=585), and found that only 46 % said that they knew what kind of job they wanted in the future. Many Norwegian students chose science and mathematics in upper secondary school to keep their options open for many different future study options and jobs (Bøe, 2012; Grønmo et al., 2010; Lie et al.,

2010). Since many students in upper secondary school are undecided about their future education and jobs, it is likely that events like TGD could play a role in making its participants' choices more informed. The numerous positive responses to questions about TGD's influence on participants' STEM motivations in Table 3 suggest that this event might have contributed positively in many participants' choice process.

### **Meeting Personally with University STEM Students**

According to The Girls' Day participants, meeting university STEM students was important to their experience of the event. Previous studies have also found interaction with older students to be an important factor in STEM recruitment events (e.g. Cantrell & Ewing-Taylor, 2009; Woolston et al., 1997). The personal meeting with STEM students in TGD appears to have been important in two ways in particular. First, the participants valued the opportunity to ask questions and receive what they regarded as *believable* information about study programmes, social life at the university, and job opportunities. From the results, it seems like being at the actual campus talking to actual STEM students, experiencing a glimpse of a possible student life, made the participants trust the information and feel that they 'got more' than teachers, parents, brochures and the internet could provide. We would argue that the direct interaction with STEM students allowed the participants to clarify and possibly develop their subjective value of STEM studies. Second, the focus groups indicated that the university STEM students came across as *achievable* role models. Løken (2013) investigated narratives from Norwegian female first year higher education STEM students, and described, based on the story of one informant, how role models can be 'unattainable and alienating' if they appear extremely smart. The university students in TGD were described by the participants as 'normal', 'ordinary people' and even 'good looking'. Thus, the STEM students demonstrated desirable and achievable identities that were within reach. This can be interpreted as signs that the attainment value of STEM studies was strengthened among the participants. Although young women are underrepresented at most of the study programmes presented at TGD, participants met both male and female university students at the event.

### **Decision Points and Long-Term Effect**

Most of the participants responded that meeting university students and experiencing the university had made them more motivated to choose a STEM programme in higher education. The responses to these items were very similar in both the first and the second survey, indicating that participants still reported that the event had increased their motivation to choose a STEM programme six months after the event. However, the number of participants who responded that the event made them more motivated to work with school science and mathematics declined substantially, from 69 % in the first survey to 44 % in the second survey. It is not surprising that some of the general motivation 'boost' from such an event wears off after some time back in the classroom. The students will have met challenging subject matter, tests etc. during the previous months. However, it is noteworthy that 44 % still responded that the event had increased their motivation to work with these school subjects. A possible explanation is that many of these students

kept their motivation up because they wanted to make sure they achieved the required grades to apply for STEM programmes at NTNU.

In the investigation by Jensen and Henriksen (2013), first year tertiary students tended to describe popular science literature and experiences in childhood as triggers for a long-lasting science interest, while outreach and experiences in upper secondary school were more important in confirming a science interest in relation to educational decision points. It is also likely that The Girls' Day was more strongly related to confirming a science interest in relation to educational decision points, than as a source of interest.

### **Increase in Perceived Cost Without Reducing Expectation of Success**

63 % of The Girls' Day participants reported that taking part in this event made them think that even more time and work is needed to complete a STEM education than they thought previously. Considering that secondary students generally tend to associate high costs with STEM subjects (Lyons & Quinn, 2010; Osborne & Collins, 2001; Tytler et al., 2008), this high percentage was somewhat surprising. Even more interestingly, only 8 % of those students agreed that their expectation of succeeding in a STEM education was weakened after the event, while as many as 38 % of them said it was in fact strengthened. These results suggest that students may have increased their perceived cost of studying, in terms of time and effort needed, without it affecting their expectation of success negatively. The Eccles et al. model predicts that increased perceived cost reduces the total subjective value of, for example, a STEM study for a student, which is in turn predicted to reduce expectation of success (Eccles & Wigfield, 2002).

However, the findings in this study indicate that the ways in which The Girls' Day participants learned about the high costs may also affect their expectation of success positively, and counteract and possibly outweigh negative effects. First, the motivation lecture and the university STEM students who talked about the high demands in effort and workload, also talked about study groups and a support system designed to help students cope with the work. Second, the focus groups indicated that the difficulties involved in a STEM study were demystified by hearing about them from university STEM students who appeared to be 'normal'. The Girls' Day participants got the impression that practically everyone found their STEM studies to be difficult and demanding. Struggling was normal, but the students still managed. Succeeding in STEM education came across as not only for a small minority of the cleverest elite. In this sense, the university STEM students were achievable role models. Normalising both the feeling that STEM studies are demanding and the type of students able to cope with these demands appears to make the costs less of a threat to the students' expectation of success. This implies that preparing students for the challenges involved in studying STEM at university and providing them with strategies to cope with these challenges, may lead fewer students to shy away from STEM based on an unfounded fear of failing, and reduce drop-out due to a gap between expectation and experience. This presupposes, of course, that students actually meet with the support system they expect.

## **CONCLUSIONS**

This article has investigated how the STEM motivations of high-achieving female upper secondary students were influenced by their participation in a two-day recruitment event, The Girls' Day, at the Norwegian University of Science and Technology. A survey administered to participants ten days after the event, demonstrated that two thirds of the respondents expressed the opinion that The Girls' Day had made them more certain of what to study. The respondents pointed to meeting university students as the main factor contributing to making them more certain. Our analyses suggest further that meeting university students as well as other experiences during the event, affected the participants' STEM motivations by influencing their expectation of success in and subjective value of STEM tertiary education. Specifically, the university students were seen as achievable role models for future STEM identities, thereby strengthening the participants' expectation of success and their attainment value related to STEM. A majority of the participants reported that after the event, they believed tertiary education in STEM to cost more time and effort than they believed before the event. However, this increase in perceived cost was not accompanied by weakened expectation of success. Rather, the results indicate that many participants increased their expectation of success despite learning about the costs, because they were also introduced to strategies for coping with high difficulty and workload.

## **LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH**

When interpreting the results of the present investigation, it must be kept in mind that TGD participants were high-achieving students who had expressed an active interest in STEM studies at NTNU. Thus, findings may not be directly transferable to recruitment initiatives aiming at broader populations. In the light of the findings presented, it would be of particular interest to study the interplay between perceived cost and expectation of success in more depth, for example whether knowledge of coping strategies could moderate the relationship between the two aspects. The participants in the present study consisted of high-achieving girls, and the concepts were investigated using questionnaire single-items and focus groups. Thus, in future research an instrument could be developed further, and different target groups could be investigated (both girls and boys, and a wider range of achievement levels). Moreover, different interventions and contexts, e.g. class room settings, could be explored.

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