LUND UNIVERSITY

Interventions for Young Women's STEM Interest

Targeting the Predictors Self-efficacy, Belongingness, and Career Goals

Giese, Laura

2025

Link to publication

Citation for published version (APA):
Giese, L. (2025). *Interventions for Young Women's STEM Interest: Targeting the Predictors Self-efficacy, Belongingness, and Career Goals*. [Doctoral Thesis (compilation), Department of Psychology]. Lund University.

Total number of authors:
1

General rights
Unless other specific re-use rights are stated the following general rights apply:
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.
- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: https://creativecommons.org/licenses/

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Download date: 05. Jun. 2026

Interventions for Young Women's STEM Interest

Targeting the Predictors Self-efficacy, Belongingness, and Career Goals

LAURA GIESE
DEPARTMENT OF PSYCHOLOGY | FACULTY OF SOCIAL SCIENCES | LUND UNIVERSITY

Interventions for Young Women’s STEM Interest -
Targeting the Predictors Self-efficacy, Belongingness, and Career Goals

Interventions for Young Women's STEM Interest

Targeting the Predictors Self-efficacy, Belongingness, and Career Goals

Laura Giese

DOCTORAL DISSERTATION

Doctoral dissertation for the degree of Doctor of Philosophy (PhD)
at the Faculty of Social Sciences at Lund University
to be publicly defended on September 26th, 2025, at 13.00
in Socialhögskolans hörsal, Allhelgona kyrkogata 8, Lund

Faculty opponent
Professor Sehoya Harris Cotner, University of Bergen

Dissertation advisors
Professor Fredrik Björklund, Lund University
Associate Professor Una Tellhed, Lund University

Organization: LUND UNIVERSITY

Document name: DOCTORAL DISSERTATION **Date of issue:** 2025-09-26

Author: Laura Giese

Title and subtitle: Interventions for Young Women's STEM Interest - Targeting the Predictors Self-efficacy, Belongingness, and Career Goals

Abstract: Science, technology, engineering and mathematics, often grouped under the acronym STEM, are traditionally male dominated fields. Especially in engineering and technology, women continue to be heavily underrepresented. The lack of women in STEM poses challenges for meeting the labor market demands, for product quality due to a lack of diverse perspectives in the design process, and for gender equality. Many sectors are making efforts to increase the proportion of women, but progress is slow. One reason why women are less likely to choose STEM careers is that they have lower interest in STEM compared to men. Besides dismantling gender stereotypes that create barriers for women's interest, research needs to create interventions that can increase women's STEM interest as well as address predictors of such interest. Three predictors of STEM interest that have received strong empirical support from previous research are self-efficacy, belongingness, and communal career goal endorsement. This thesis aims to find further support for the relationship between these predictors and STEM interest. Furthermore, it aims to evaluate an existing intervention as well as develop and test two novel interventions targeting these predictors in order to increase young women's interest in STEM.

Study I aimed to investigate the effect of a two-day intervention for high school students by a Swedish water supply company. It investigated effects on the participating women's interest in studying engineering, as well as on their self-efficacy, belongingness, and perceived communal career goal affordance in relation to an engineering program. Study II designed and tested two novel short interventions for high school students: a role model video of five female engineering students talking about their positive experiences with their studies, and an engineering ability quiz followed by encouraging feedback on one's performance. The study tested if the interventions increased high school women's belongingness and self-efficacy, and thereby their interest in studying engineering. Study III suggested an additional factor to the established agentic and communal career goals, namely environmental goals. The study tested whether environmental career goals constitute a separate factor, how important they are to primary school students, and whether they predict interest in STEM careers.

Study I and II found the expected gender differences in interest in studying engineering, which were mediated by gender differences in belongingness and self-efficacy (Study I and II) and by perceived communal career goal affordance (Study I). Study I found that the intervention increased young women's engineering self-efficacy, with the effect persisting three months later. The intervention also temporarily increased women's belongingness and perceived communal goal affordance in engineering but did not significantly increase their engineering interest. Study IIa found that women who saw the role model video had higher belongingness for engineering than women who did not see the video. Study IIb found that the engineering ability quiz and receiving positive feedback on their performance increased women's self-efficacy for and interest in studying engineering, but the study did not replicate the effect of the role model video. Study III found that environmental career goals constituted a separate factor, and that women had higher environmental goals than men. Having higher environmental goals predicted interest in STEM careers. However, regarding the perception of what kind of goals STEM careers allow to fulfil, perceived fulfilment of communal and agentic goals predicted interest in STEM careers, while the perceived fulfilment of environmental goals did not. Taken together, these findings suggest that targeting self-efficacy, belongingness, and career goals through interventions is a promising way to attract young women to STEM, but more research is needed on how to make effects last longer and how to more reliably affect interest through affecting its predictors.

Key words: STEM, Engineering, Gender, Interventions, Self-efficacy, Belongingness, Career Goals

Language: English **Number of pages**:76

ISBN: 978-91-8104-581-9

I, the undersigned, being the copyright owner of the abstract of the above-mentioned dissertation, hereby grant to all reference sources permission to publish and disseminate the abstract of the above-mentioned dissertation.

Signature Date 2025-08-15

Interventions for Young Women's STEM Interest

Targeting the Predictors Self-efficacy, Belongingness, and Career Goals

Laura Giese

LUND UNIVERSITY

Copyright

Cover image by Laura Giese

Pages 1-76 © 2025 Laura Giese, ORCID 0000-0002-5547-9210

Paper 1 © 2022 The Authors. Published by The Open University.

Paper 2 © 2025 The Authors. Published by Taylor & Francis Group.

Paper 3 © 2025 The Authors (Manuscript unpublished).

Published by:

Department of Psychology

Faculty of Social Sciences

Lund University

Lund 2025

ISBN 978-91-8104-581-9 (print)

ISBN 978-91-8104-582-6 (electronic)

Printed in Sweden by Media-Tryck, Lund University,
Lund, 2025

Media-Tryck is a Nordic Swan Ecolabel certified provider of printed material. Read more about our environmental work at www.mediatryck.lu.se

MADE IN SWEDEN

To Hanna, my favourite woman in STEM
and my role model for achieving big things.

Table of Contents

Acknowledgements

They say the right supervisor can make or break a PhD, and I couldn't have been luckier with mine. Fredrik and Una, you have been the best and most supportive supervisors I could have asked for. Thank you for sharing your wisdom, experience and enthusiasm with me, for your endless patience with me when I was struggling, and for your feedback, support and encouragement along the way. Thank you for always making time for me and my many questions and for being so engaged in my project. I always left meetings with you feeling more motivated and inspired. Fredrik, you have been a valuable mentor in many ways even beyond the PhD project, such as all your guidance along my journey from gathering my first teaching experience to trusting me to be responsible for your course. Una, you have contributed so much expertise and creative ideas to my project, and you always show that you care about me and trust me, academically and personally, which has helped me grow. And I really enjoyed travelling to Munich and Heidelberg with you.

These studies would not have been possible without Victoria Vollert, Emilia Dall'Osso and Carin Hernqvist. I really appreciate how much you all went out of your way to make my data collection possible, adjusted your activities at Tänk H_2O! and Kretseum to make time for my surveys, and got so hands on involved with collecting data on site. Collaboration projects trying to accommodate different interests can be challenging, but it was always a pleasure working with you.

My thanks also go to Marinette Hagman, Amanda Haux and Marie Nordkvist for initiating the collaborations at Kretseum and Tänk H_2O!, and to Jesper König and Kenneth M. Persson for being my link to the Sweden Water Research side of the project, and for making sure I had everything I needed from you.

I want to thank Rebecca Mellor and August Nilsson for your help with the data collection, Martin Bäckström for your valuable advice and help with the statistical analyses, and Daiva Daukantaité for your helpful feedback and an interesting discussion of my thesis at my final seminar.

To Eva Hoff and Sofia Bunke, thank you for your engagement for an active PhD student group at the Department of Psychology, and for the knowledge that you have our back. Sofia, your door was always open (literally and figuratively) and that meant a lot.

And of course, a big thanks to all the teachers and students who took part in these studies.

I also met some wonderful colleagues and friends along the way, and I couldn't have done this PhD without you. So many people believed in me, especially when I didn't myself, and I am extremely grateful for that.

Amanda, thank you for all your pep talks, for always having a listening ear for me, for the enjoyable lunch company and for making the best coffee at the department. And for your valuable feedback on a draft of this thesis. Benjamin, thank you for all your kindness and advice. I so appreciate how much you care about your colleagues' wellbeing and careers and go out of your way to help me and others. A big thanks also to you and Janne for convincing me to apply for the project in the first place, and to Janne for sparking my interest in the topic and in staying on the academic path from writing our master's thesis together. Katarina, thank you for all the wonderful heartfelt and funny conversations and for making me look forward to coming to the office. Kris, thank you for sharing your wisdom and humor with all of us for so many years. Mia, Nate, Lisa, and Osa, thank you for being excellent company in the office at different phases during my PhD and for working, laughing, or commiserating together with me. Thank you also to Laura, Gizem, Linn, Frida, Martina, and the rest of the Psychology PhD group for being such a lovely group of colleagues. Sharing parts or all of this crazy PhD experience with you has made the good parts more fun and the hard parts more bearable.

Thanks to Malmö akademiska kör and Gaudeamus for providing much-needed social and musical breaks from work every week. When I got lost in the overwhelming scope of the thesis, focusing on the present moment and creating music together was exactly the balance I needed. Thank you for the fika breaks, choir beers and travels and for getting to spend so much time with you lovely people.

To my parents, thank you for putting on a brave face when I moved abroad again, and for always encouraging and supporting me and letting me know that you are there for me with whatever I need. And thank you for always being curious and interested in my work while never pressuring me. Now you finally get to read my thesis. Hanna, thank you for being the biggest help and support in so many ways, both practically and emotionally. I can always share my struggles and successes with you, and you always believe in me and build me up.

Agata, you have been my constant cheerleader and by my side since my early days in Lund. Thank you for always letting me know that you are proud of me, your support means so much. Emma, thank you for your friendship for all these years and from far away, and for our many phone conversations that helped keep me sane throughout this project. Maren and Johannes, thank you for following my journey from Munich and always cheering me on. I still remember how enthusiastically you were encouraging me before I started the PhD. And Axel, thank you for counting down the final days till the defense with me and for making me look forward to what comes next.

Abstract

Science, technology, engineering and mathematics, often grouped under the acronym STEM, are traditionally male dominated fields. Especially in engineering and technology, women continue to be heavily underrepresented. The lack of women in STEM poses challenges for meeting the labor market demands, for product quality due to a lack of diverse perspectives in the design process, and for gender equality. Many sectors are making efforts to increase the proportion of women, but progress is slow. One reason why women are less likely to choose STEM careers is that they have lower interest in STEM compared to men. Besides dismantling gender stereotypes that create barriers for women's interest, research needs to create interventions that can increase women's STEM interest as well as address predictors of such interest. Three predictors of STEM interest that have received strong empirical support from previous research are self-efficacy, belongingness, and communal career goal endorsement. This thesis aims to find further support for the relationship between these predictors and STEM interest. Furthermore, it aims to evaluate an existing intervention as well as develop and test two novel interventions targeting these predictors in order to increase young women's interest in STEM.

Study I aimed to investigate the effect of a two-day intervention for high school students by a Swedish water supply company. It investigated effects on the participating women's interest in studying engineering, as well as on their self-efficacy, belongingness, and perceived communal career goal affordance in relation to an engineering program. Study II designed and tested two novel short interventions for high school students: a role model video of five female engineering students talking about their positive experiences with their studies, and an engineering ability quiz followed by encouraging feedback on one's performance. The study tested if the interventions increased high school women's belongingness and self-efficacy, and thereby their interest in studying engineering. Study III suggested an additional factor to the established agentic and communal career goals, namely environmental goals. The study tested whether environmental career goals constitute a separate factor, how important they are to primary school students, and whether they predict interest in STEM careers.

Study I and II found the expected gender differences in interest in studying engineering, which were mediated by gender differences in belongingness and self-efficacy (Study I and II) and in perceived communal career goal affordance (Study I). Study I found that the intervention increased young women's engineering self-efficacy, with the effect persisting three months later. The intervention also temporarily increased women's belongingness and perceived communal goal affordance in engineering but did not significantly increase their engineering interest. Study IIa found that women who saw the role model video had higher belongingness for engineering than women who did not see the video. Study IIb

found that the engineering ability quiz and receiving positive feedback on their performance increased women's self-efficacy for and interest in studying engineering, but the study did not replicate the effect of the role model video. Study III found that environmental career goals constituted a separate factor, and that women had higher environmental goals than men. Having higher environmental goals predicted interest in STEM careers. However, regarding the perception of what kind of goals STEM careers allow to fulfil, perceived fulfilment of communal and agentic goals predicted interest in STEM careers, while the perceived fulfilment of environmental goals did not.

Taken together, these findings suggest that targeting self-efficacy, belongingness, and career goals through interventions is a promising way to attract young women to STEM, but more research is needed on how to make effects last longer and how to more reliably affect interest through affecting its predictors.

Populärvetenskaplig Sammanfattning

Matematik, ingenjörsvetenskap, naturvetenskap och teknik är traditionellt starkt mansdominerade områden. På gruppnivå är kvinnor fortfarande mindre intresserade än män av att läsa tekniska ämnen som ingenjörsutbildningar. Företag inom tekniksektorn försöker öka andelen kvinnor av flera skäl: För att lösa arbetsmarknadens personalbehov, för att öka produktkvalitet genom att inkludera människor med olika perspektiv och erfarenheter i processen, och för ökad jämställdhet.

Forskning har visat att det som påverkar intresse för yrken är tron på den egna förmågan, förväntningar om mål som individen kan uppfylla genom olika yrkesval, och förväntningar om trivsel. Könsskillnader i dessa psykologiska upplevelser kan förklara varför kvinnor tenderar att ha lägre intresse för tekniksektorn jämfört med män. För att öka kvinnors intresse för tekniska yrken behövs interventioner, dvs olika pedagogiska insatser och aktiviteter, som syftar till att påverka kvinnors intresse eller påverka faktorerna som i sin tur påverkar intresse. Syftet med denna avhandling är att utveckla och utvärdera sådana interventioner.

Avhandlingen innehåller tre studier. Studie I utvärderade en befintlig pedagogisk insats som ett företag inom vattensektorn ger till gymnasieelever i syfte att öka deras intresse för yrkesområdet. Resultatet visade att kvinnor hade lägre intresse för ingenjörsvetenskap än män. Insatsen ökade unga kvinnors tro på deras förmåga att själva bli ingenjörer, samt påverkade deras förväntningar om trivsel och måluppfyllelse i sektorn positivt. Dock så ökade inte kvinnornas intresse för ingenjörsvetenskap i denna studie.

Studie II utvecklade och testade två nya korta interventioner som syftade till att öka intresset för att studera ingenjörsvetenskap. Den första var en video där fem kvinnliga ingenjörsstudenter berättade hur det är att studera till ingenjör. Den andra var ett quiz som testade om ungdomar har rätt förmåga för att bli ingenjör och gav uppmuntrande feedback. Resultaten visade att quizet ökade unga kvinnors tro på att de har rätt förmåga för att bli ingenjörer och ökade deras intresse för ingenjörsvetenskap. Videon ökade förväntningar om att kunna trivas socialt i ingenjörsutbildningar i en delstudie, men inte i en annan.

Studie III testade om miljörelaterade yrkesmål, som att vilja motverka klimatförändringar, är relevant för intresset att bli ingenjör och kan öka kvinnors intresse för tekniksektorn. Resultaten visade att ungdomar med högre miljö-relaterade yrkesmål var mer intresserade av att bli ingenjörer än andra. Det visade sig också att kvinnor hade högre miljömål än män. Däremot var deltagarna inte mer intresserade av yrken som sades kunna hjälpa miljön mer än andra yrken. Där spelade yrkets beskrivna lön och möjlighet att hjälpa människor större roll.

Sammantaget tyder dessa resultat på att ett lovande sätt att locka fler unga kvinnor till tekniska yrken är att skapa insatser som riktar in sig på att stärka tron på den egna förmågan samt förväntningar om trivsel och måluppfyllelse. Mer forskning behövs som visar hur effekter av interventioner kan stärkas ytterligare.

List of Papers

Paper I

Giese, L., Tellhed, U., & Björklund, F. (2022). STEM by the Lake: Raising High School Women's Engineering Self-Efficacy and Belongingness through an Educational Intervention about Water Issues and Careers. *International Journal of Gender, Science and Technology*, *14*(2), 207–231. https://genderandset.open.ac.uk/index.php/genderandset/article/view/1349

Paper II

Giese, L., Tellhed, U., Björklund, F., & Kalucza, J. (2025). 'You have exactly what it takes': two interventions for increasing women's self-efficacy and belongingness in engineering. *European Journal of Engineering Education*, 1–22. https://doi.org/10.1080/03043797.2025.2467827

Paper III

Giese, L., Tellhed, U., & Björklund, F. (2025). Making money (f)or saving the planet: How career goals predict adolescents' interest in STEM jobs in the water sector. *Manuscript under review*

Abbreviations

EEVT	Eccles' expectancy-value theory
EIGE	European Union Institute for Gender Equality
GCP	Goal congruity perspective
GPA	Grade point average
HEED	Health care, early education and domestic roles
NAEP	National Assessment of Educational Progress
SCCT	Social cognitive career theory
SEVT	Situated expectancy-value theory
STEM	Science, technology, engineering and mathematics
STEMO	Stereotypes, motivations and outcomes model
UAE	United Arab Emirates
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States of America
WEIRD	Western, educated, industrialized, rich, democratic

Introduction

Women are underrepresented in many areas of science, technology, engineering and mathematics (STEM). Especially engineering, which is the focus of this thesis, is a vast field that continues to be male dominated (e.g. Higher Education Statistics Agency, 2024; Statistics Sweden, 2022). Over the last decades, there has been extensive research on the gender disparity in STEM and many initiatives have been created to increase girls' and women's interest and participation in STEM. However, despite all these efforts, progress is still slow and the proportion of women in STEM educations and careers is not increasing as quickly as one would hope (see Casad et al., 2021).

There has been a considerable amount of theorizing and empirical research on the factors that predict interest in STEM and explain part of the gender disparity. Now we need to build on the knowledge about what hinders women's interest and investigate how interventions can remove these barriers and increase women's interest through targeting its predictors. Many existing interventions have been created by educators and industry organizations, and they are often not scientifically evaluated for their effectiveness to raise interest (Valla & Williams, 2012). Moreover, scientifically designed interventions have shown mixed results in terms of increasing interest and are rarely tested in naturally existing field settings (Dennehy & Dasgupta, 2017). More research is therefore needed to learn through which mechanisms interventions can affect interest or its predictors and what aspects of interventions are effective.

This thesis evaluates one existing intervention, and designs and tests two novel interventions aimed at increasing teenage women's engineering interest, based on three theoretical predictors of interest, namely self-efficacy, belongingness, and career goals. The thesis further investigates how these predictors contribute to explaining gender differences in STEM interest and suggests expanding research on career goals by adding environmental goals as an additional factor.

Structure of the Thesis

In this thesis, I will describe the current extent of women's underrepresentation in STEM, provide some context for it, and motivate why this is an important issue to address. Then, I will present the theoretical framework this thesis is based on and give an overview over the theoretical predictors of career interest, as well as present previous research about interventions that aim to affect these predictors. Based on this research, I will summarize the aims for this thesis. This is followed by a summary of the three studies that make up the thesis, by giving a short overview over the background and then presenting the methods and results of each study. Finally, I will conduct an extended discussion of the results, how they relate to previous research, and theoretical and practical implications of the findings in this thesis, as well as putting it into a larger societal context. I will also discuss the limitations of this thesis and directions for future research.

Why Increase Women's Participation in STEM?

Why do we need to increase women's participation in STEM? Several arguments can be made for this, and here I will bring up four perspectives: A labor market perspective, a work quality perspective, a financial perspective, and an ideological gender equality perspective.

First of all, we need women in STEM in order to meet the recruitment needs of the labor market (Nordic Council of Ministers, 2021). STEM is a growing sector, there is already a shortage of skilled workers in STEM and several fields are expecting this shortage to grow further (Nordic Council of Ministers, 2021; Shoffner & Dockery, 2015; Swedish Public Employment Service, 2022). Since women are underrepresented in many of these fields, they are an underused resource in filling the demands of the labor market (Diekman et al., 2015). The European Commission has stated an explicit goal to increase women's participation in STEM (European Commission, 2021). The European Institute for Gender Equality (EIGE) estimated that closing the gender gap in STEM would increase productivity and reduce labor market shortages and thereby create additional economic growth in the European Union of €610-820 billion by 2050 (EIGE, 2017). One area in which STEM is growing in size and relevance and will need to fill a large number of positions is technological solutions addressing climate change issues, such as renewable energy (EIGE, 2024). Closing the gender gap in STEM is therefore one part of working towards a more sustainable future.

Secondly, the world is built for those who built it – and diverse perspectives create better technology. There are several examples of why research and products designed by male dominated engineering teams without a diverse perspective can cause problems for those not represented by them, from products being less useful up to being downright dangerous for women (Batz-Barbarich et al., 2024; Criado Perez, 2019). For example, car crash-test dummies have for decades been exclusively modelled on the average male body. Women, who are on average smaller, lighter, and have different muscle mass proportions than men, are less protected during car crashes because the safety features were not adapted for them. As a result, women are 71% more likely to be injured and 17% more likely to die when they are in a car crash (Criado Perez, 2019). Moreover, a lot of personal protective equipment, ranging from face masks to bullet proof vests, has been designed for the average man's size, which can in the best case be inconvenient or uncomfortable for the average woman, and at worst be ineffective and dangerous (Criado Perez, 2019). If more of this research and product development had been done by women or by gender balanced teams, they might be more likely to notice the disparity and push towards research including a diverse range of bodies, thereby making products accessible and safe for a wider range of the population. Increasing diversity in STEM by strengthening women's participation has also been flagged by the European Commission as crucial for meeting societal challenges related to the climate crisis, such as the "green transition" to a net zero emissions economy (European Commission, 2022). This of course also extends to many more kinds of diversity than gender, such as diversity regarding ethnicities and disabilities.

Third, STEM careers are often high in status and pay better than other fields (Shoffner & Dockery, 2015), especially compared to the female dominated "HEED" jobs in health care, early education and domestic roles (Block, Croft, et al., 2018; Croft et al., 2015). And as mentioned above, STEM jobs are becoming increasingly important in the future job market and therefore offer valuable career opportunities (Cedefop, 2016; Microsoft Corporation, 2017). That means that working in STEM can have great benefits for the individuals choosing these careers. When women are underrepresented in STEM sectors, many women are missing out on potential valuable career options that can provide good financial rewards and in which they might thrive, reinforcing existing financial gender inequality.

Finally, from an ideological gender equality perspective, everyone, including women, should be able to choose their educations and careers freely, not constrained by stereotypes or barriers put in their way by society. However, research shows that these barriers exist and influence women's choices (e.g. Ertl et al., 2017). How gender stereotypes currently create barriers for women and restrict their choices away from STEM will be presented in this thesis.

The Current Situation of Gender Representation in STEM

The reason for grouping science, technology, engineering and mathematics under the STEM acronym, is that these fields have a lot in common. They require similar skills, are often high in status, and have traditionally been male dominated with similar mechanisms behind the underrepresentation of women and other groups. Previous research has addressed STEM as a whole or individual fields within it. Adjusted to the age and subject understanding of their participants, research with younger children mostly concerns broader concepts such as math or science, while research at university level more often concerns specific disciplines, such as engineering or computer science, and differentiates more between different fields. STEM is a well-established acronym both within and outside of the research field and researchers use it as an umbrella term when referring to more than one field or making generalizations.

Engineering is one STEM field where women are heavily underrepresented, which is why it is the focus of this thesis. Engineering and computer science are the fields with the biggest gender disparity (e.g. Higher Education Statistics Agency, 2024). In Sweden, where the data for this thesis was collected, women make up 25-30% of engineering students at university (Royal Swedish Academy of Engineering Sciences, 2019) and 28% of engineers in the workforce (Statistics Sweden, 2022). Current figures from the US report that only 17% of engineers are women (US Bureau of Labor Statistics, 2024). Women's lower participation is an issue at every educational and career level. Women are less likely than men to choose STEM courses in school, less likely to study engineering at university level, and those who study it are less likely to then pursue an engineering career (see Batz-Barbarich, 2024). This has been termed the "leaky pipeline", to highlight that women drop out of STEM at every "decision point" and that the proportion of women therefore decreases at every step. However, the metaphor of a single narrowing pipeline has been criticized for being an oversimplification and failing to take into account contextual factors and nuances in women's experience in STEM as well as alternative pathways in STEM (Cannady et al., 2014).

On the other hand, not all STEM fields experience the same gender disparity. Women are generally well represented in environmental fields, life sciences, and medical sciences; fields which can be associated with helping others (see Weisgram et al., 2010). For example, women make up 45% of biology and chemistry students in the UK (Higher Education Statistics Agency, 2024) and 48% of the life science workforce in the US (Pew Research Center, 2021). In Swedish high schools, the natural science track is gender balanced with 55% women (Skolverket, 2025a), but women more often go on to choose biology, chemistry, and medical fields or non-STEM subjects at university, while more men go into engineering. Recent survey data shows that 24% of women in the natural science track consider engineering at university level, compared to 51% of men (Ungdomsbarometern, 2024a). There are similar differences even between different fields within engineering. In the US, the sector with the highest proportion of women is environmental engineering with 32% women, and those with the biggest gender imbalance are electrical and mechanical engineering which only have 10% women (US Census Bureau, 2023).

There is some evidence that the underrepresentation of women in STEM is a problem predominantly in WEIRD (Western, Educated, Industrialized, Rich, Democratic) countries, while the gender imbalance is not as pronounced in other parts of the world. In some Middle Eastern countries, there is no gender disparity in STEM, at least at university level. For example, women make up 45% of computer science students in Jordan (UNESCO, 2022) and 56% of STEM graduates at government universities in the United Arab Emirates (UAE Gender Balance Council, 2024). However, while women in the UAE study STEM to the same extent as men, they are much less represented in the STEM workforce (Alzaabi et al., 2021; Dickson & Alharthi, 2025). Sweden is an interesting country, because it ranks number 1 in gender equality in the EU (EIGE, 2023), but this does not translate into a higher proportion of women in STEM careers. This is part of a pattern that has been referred to as the gender-equality paradox, the finding that countries with higher gender equality show larger gender differences on career choice and some other psychological measures (Stoet & Geary, 2018). One possible suggestion to explain this paradox is that countries with higher gender equality tend to be higher in social welfare, which allows young people more freedom to base their career choices on interest, compared to countries with lower welfare, where the economic security that STEM careers provide might play a bigger role in women's career choice (Stoet & Geary, 2018). However, others have criticized this explanation and argue that the paradox may be fully explained by gender norms and stereotypes about STEM that are prevalent in more egalitarian countries (e.g. Breda et al., 2020). This makes it even more crucial to study the mechanisms behind women's underrepresentation.

Reasons for Women's Underrepresentation

What are the reasons behind girls' and women's underrepresentation in STEM? Research shows that this is related to gender stereotypes that create barriers for women (Ertl et al., 2017). There are stereotypes both about ability and about who fits in STEM, which act as gatekeepers, keeping women out of STEM (Cheryan et al., 2015).

Ability stereotypes associate technical ability with men (Eccles & Wigfield, 2020; Leslie et al., 2015; Master & Meltzoff, 2020; Miller et al., 2015; Tellhed et al., 2023). Already at six years old, children associate math with boys rather than girls (Cvencek et al., 2011) and are more likely to say that boys, but not girls, can be "really, really smart" (Bian et al., 2017). In a recent study, Swedish children tended to report that they believed men are better at technology than women (Tellhed et al., 2023). In a widely used test asking children to "draw a scientist", especially older children tend to draw a male scientist, indicating that they have stereotypes associating science with men (Miller et al., 2018). Generally, STEM is perceived as being for white men, and for those with innate talent for technology (Cheryan & Plaut, 2010; Shin et al., 2016).

Stereotypes about STEM are also in conflict with stereotypes about how women are. Gender stereotypes fundamentally distinguish between the two central dimensions of agency and communion. Agentic traits, which are stereotypically associated with men, are concerned with goal achievement and include being assertive, independent and competent. On the other hand, communal traits, which are stereotypically associated with women, are concerned with interpersonal relationships, and include being warm, supportive, and fair (Abele et al., 2016). These traits are related to stereotypical gender roles of men as agentic leaders and breadwinners and women as communal caretakers (Eagly et al., 2000) and to stereotypical career goals, such as wanting a high salary and status or wanting to help other people (Diekman et al., 2010; 2011). While the association of agency as male appears to weaken in Western countries in recent years, the association of communion as female is still prominent today (Gustafsson Sendén et al., 2019; Hentschel et al., 2019).

In contrast to the female gender stereotype of women being perceived as people-oriented, friendly and warm (Cheryan et al., 2013; Parks-Stamm et al., 2008), computer scientists are described as lacking interpersonal skills (Cheryan et al., 2013) and engineers are perceived as singularly focused on technology, socially isolated, and having masculine interests such as video games (Cheryan et al., 2015). These stereotypes describe STEM as incompatible with female gender stereotypes (Leslie et al., 2015) which may lead women to feel excluded from stereotyped STEM contexts such as engineering (Cheryan et al., 2017; Eccles, 1987; Shin et al., 2016; Wang & Degol, 2013). Swedish girls who have stronger gender stereotypes show lower interest in technology, while Swedish boys with stronger gender stereotypes show higher interest in technology (Tellhed et al., 2023).

These gender stereotypes can either have a direct effect on interest (Spencer et al., 2016; Steele, 1997; Steele & Aronson, 1995; Tellhed et al., 2023) or an indirect effect by impacting factors that then predict interest, such as the perception of fitting into a STEM context. For example, women who perceive themselves as less similar to the stereotypical engineer are less interested in engineering (Ehrlinger et al., 2018). The higher gender balance in biology, chemistry, and environmental engineering suggests that women are more likely to choose STEM when the stereotypes about the field align more with their interests and gender stereotypes. Environmental concern for example is stereotyped as feminine (Swim & Geiger, 2018), which could be related to the comparatively high proportion of women in environmental engineering. Several theories that aim to explain women's underrepresentation in STEM therefore state that gender stereotypes play an important role.

Theoretical Framework

The main research question of this thesis concerns how interventions can increase young women's interest in STEM. The goal is to test interventions based on predictors which have received the strongest empirical support in previous research, rather than testing a specific theoretical model. Therefore, my theoretical framework draws on several influential theories which explain how these psychological factors are theorized to affect career interest and choice, and how these factors can be affected through interventions.

The three predictors of STEM interest that I investigate in this thesis are self-efficacy, i.e. one's belief in one's ability to succeed in STEM (Bandura, 1977; 1997), belongingness, i.e. how well one fits in socially with others in STEM (Baumeister & Leary, 1995), and career goals, specifically the match between communal career goals and how well these are perceived to be fulfilled in STEM (Diekman et al., 2010; 2011). I will present research on each of these predictors in more detail in later sections. There are several influential theories describing the relationship between these factors (or conceptually similar constructs). There is significant overlap between the theories, but each contributes a different focus on how the variables of interest are theorized to relate to each other and there are some differences in how they name the constructs. Rather than closely following one specific theory, this thesis has been an applied project which has combined aspects from several of these theories.

The two most influential theories in this field are social cognitive career theory (Lent et al., 1994; Lent & Brown, 2019), which is the broadest theory of career choice, and Eccles' expectancy-value theory (Eccles, 1987; 1994), which has recently been refined into the situated expectancy-value theory (Eccles & Wigfield, 2020). Furthermore, a recent theory that combines elements from both of those theories is the stereotypes, motivations and outcomes model (Master & Meltzoff, 2020), which is inspired by Eccles' theory. Finally, the goal congruity perspective (Diekman et al., 2010; 2011; 2017) concerns the role of career goals for career interest.

Social Cognitive Career Theory

The aim of social cognitive career theory (SCCT; Lent et al., 1994; Lent & Brown, 2019) is to explain the links between a person and their career choice by taking factors from the environment into account. According to SCCT, self-efficacy and outcome expectations predict interest, i.e. people develop interest in areas in which they feel competent and expect positive outcomes (Lent et al., 1994). Interest in turn predicts choice goals, i.e. the intention to pursue a certain career choice, and actions towards this choice. Furthermore, the theory considers how gender and other contextual factors affect a person's self-efficacy and outcome expectations. SCCT is inspired by Bandura's social cognitive theory (Bandura, 1986) and includes the four sources of self-efficacy outlined by Bandura, namely mastery experience, vicarious experience, social encouragement, and low physiological arousal (Bandura, 1977; 1997). The strength of SCCT is that it can be applied to a wide range of career choice contexts and clearly incorporates the effect of self-efficacy on interest. It has also received ample empirical support over time (Lent & Brown, 2019). However, in the context of this thesis, SCCT is lacking in explaining the role of gender stereotypes.

Eccles' Expectancy-Value Theory

One influential theory that specifically takes into account how gender stereotypes play a role in career choice is Eccles' expectancy-value theory (EEVT; Eccles, 1987; 1994). EEVT postulates that a person's goals, motivations and self-schemata based on previous experiences and their environment will form their expectancies for success and their subjective task value. Expectancies for success refer to one's beliefs in one's ability, and the construct has significant overlap with self-efficacy as conceptualized in SCCT and by Bandura's social cognitive theory (Eccles & Wigfield, 2020). Subjective task value refers to the value one ascribes to a certain domain. This includes interest, attainment value (whether an activity fulfils one's needs, goals and personal values), utility value (how an activity facilitates reaching other longer-term goals or rewards), and perceived costs (such as fear of failure or social consequences, but also loss of invested time and energy). Together, the expectancies for success and the subjective task value influence one's achievement-related choices (see Eccles, 2011, for a review). It is relevant to note that EEVT includes interest as one of the aspects of subjective task value and thereby as a predictor of career choice, but interest is not an outcome variable of specific focus in this theory, as it is in SCCT. However, besides both factors predicting career choice, EEVT posits a bidirectional relationship between expectancies for success and subjective task value, which allows for self-efficacy predicting interest, in line with SCCT. Furthermore, EEVT specifically considers how gender stereotypes influence ability beliefs and can lead men and women to differ in their values and motives, which then predicts gender differences in career choice (Eccles, 2011). The theory has also been supported by empirical data (e.g. Eccles & Wang, 2016).

Recently, Eccles and Wigfield further developed EEVT into the situated expectancy-value theory (SEVT; Eccles & Wigfield, 2020), to add additional focus on situational and cultural factors and the dynamic nature of the processes. SEVT emphasizes how decisions at every step in the model are context dependent and that the different components of the original model can be weighted differently depending on the situation. The model also stresses the role of immediate environments as well as cultural background and socialization on affecting a person's expectancies and values in a given moment (Eccles & Wigfield, 2020). The emphasis on contextual factors and the focus on short-term, specific beliefs about e.g. ability as opposed to more general, long-term self-concepts is making the framework more closely aligned with SCCT.

Stereotypes, Motivations and Outcomes Model

Another model that builds on EEVT and expands the theory to increase the focus on belongingness as a predictor of interest, is the stereotypes, motivations and outcomes model (STEMO) by Master and Meltzoff (2020). STEMO's aim is specifically to explain the underrepresentation of women in STEM. The model postulates that gender stereotypes and social identity affect self-representations, such as identity, ability beliefs (which is related to self-efficacy), and sense of belonging in STEM (Master & Meltzoff, 2020). These self-representations in turn affect interest and academic outcomes. Like SCCT, STEMO emphasizes career interest as an outcome variable, since it has been shown to be the main predictor of career choice (Maltese & Tai, 2011). STEMO also incorporates information on how interventions could be employed at several steps of the model. Specifically, the model mentions interventions that broaden the stereotypes about STEM, and interventions that affect women's self-representation by strengthening belonging (Master & Meltzoff, 2020). This is especially relevant in the context of this thesis, which aims to create interventions to increase women's belongingness and self-efficacy.

Goal Congruity Perspective

The final relevant theory concerning the predictors of career interest covered in this thesis is the goal congruity perspective (GCP; Diekman et al., 2010; 2011; 2017). This theory posits that career interest is predicted by goal congruity, i.e. a match between career goal endorsement (how important certain goals are to the individual) and perceived career goal affordance (to what extent specific jobs or careers are perceived to fulfil those goals). The theory distinguishes between agentic career goals, such as a high salary and a successful career, which have historically been associated with male gender stereotypes, and communal career goals, such as helping others and doing good for society, which have been associated with female gender stereotypes. The GCP predicts that women's lower interest in STEM is related to the fact that they endorse communal career goals to a higher degree than men but don't perceive that these goals can be fulfilled in STEM (Diekman et al., 2017).

Summary

To summarize, the main predictors of career interest explored in this thesis, namely self-efficacy, belongingness, and career goals, are represented in the theories presented above. Self-efficacy is included in SCCT, EEVT/SEVT and STEMO, but in slightly different forms. SCCT names it as one of the main predictors of career interest (Lent et al., 1994), EEVT and SEVT include it within the concept of expectancies for success as a predictor of STEM career choice (Eccles & Wigfield, 2020), and STEMO uses the umbrella term ability beliefs, which includes self-efficacy, as one of the self-representations influencing interest and academic outcomes (Master & Meltzoff, 2020). Sense of belonging is the main focus of the STEMO model. EEVT/SEVT mention how personal and social identities influence a person's attainment value, which could include the social identity of whether one perceives to fit or belong in STEM, but it is not a focus of the model, which is what STEMO seeks to remedy. Career goals, which are the focus of the GCP, are included in EEVT/SEVT within their concept of attainment value, and STEMO specifically refers to broadening stereotypes about STEM to include a diverse range of goals (Master & Meltzoff, 2020).

Taken together, these models provide a theoretical basis for hypothesizing that self-efficacy, belongingness and career goals affect women's interest in STEM and interventions aimed at increasing these factors for women could be ways to increase their interest. Information on how these predictors might be affected through interventions can also be found in the theories above. Bandura's social cognitive theory (Bandura, 1977; 1997) and SCCT (Lent et al., 1994) posit four potential sources of self-efficacy. Furthermore, STEMO specifically suggests interventions to increase women's sense of belonging in STEM, such as broadening the stereotypes of who fits in STEM and using role models (Master & Meltzoff, 2020).

Factors Affecting STEM Interest and Choice

As described above, according to the theoretical framework of this thesis, interest is the main predictor of choosing a STEM career. Moreover, STEM interest is predicted by self-efficacy, belongingness, and career goal congruity. In the coming sections I describe the research on each of these factors in more detail.

Interest

Interest is one of the most important factors determining the choice of a STEM career. Interest in STEM before college is the strongest predictor for college students to major in STEM (Maltese & Tai, 2011). There is extensive data supporting that the gender disparity in who chooses a STEM career or education is related to a gender difference in interest in STEM, but there are mixed findings regarding when this difference in interest appears. Some studies find that children form their level of interest in relation to STEM already in elementary school (Maltese & Tai, 2010). One large scale study found that girls who are interested in STEM become interested around age 11-12, but for many, interest decreases again around age 15 (Microsoft Corporation, 2017). Several studies indicate that the gender difference is apparent latest in high school. Data from the US (Sadler et al., 2012) and from Sweden (Royal Swedish Academy of Engineering Sciences, 2019) shows that girls' interest in technology drops during high school, while boys' interest remains the same, leading to a significant gender difference in interest at the end of high school. Furthermore, girls are more likely than boys to have high abilities in both verbal and mathematical domains (for reviews, see Diekman et al., 2015; Wang & Degol, 2013). Therefore, girls who are interested in STEM have a wider choice of career options and are more likely to choose careers that involve verbal rather than mathematical skills, where they are not subjected to negative stereotypes about their gender.

Self-efficacy

The first predictor of STEM interest that I will present in more detail is self-efficacy. Self-efficacy is defined as a person's belief in their ability to succeed in a certain domain, such as the ability to successfully complete an engineering education (Bandura, 1977; 1997). As mentioned above, EEVT and SCCT emphasize the importance of self-efficacy as a predictor of interest or career choice and EEVT/SEVT include how self-efficacy is influenced by gender stereotypes (Eccles, 1987; 1994; Eccles & Wigfield, 2020; Lent et al., 1994). Self-efficacy has been found to be a strong predictor of career interest and choices, even stronger than actual ability (Bandura, 1997; S. D. Brown et al., 2008; Lent & Brown, 2019). It thus plays a role in women's underrepresentation in engineering, because women tend to have lower self-efficacy for engineering and other STEM fields than men (Hackett, 1995) and this explains gender differences in STEM interest (Lent & Brown, 2019; Tellhed et al., 2017). Self-efficacy was the strongest mediator of the gender differences in STEM interest for Swedish high school students (Tellhed et al., 2017; 2018).

Studies show that similar to their interest in STEM, girls' self-efficacy for math and science decreases during the school years, especially during the transitions into middle school and high school (see Barth & Masters, 2020). But women's lower self-efficacy does not reflect their actual ability. Research on ability shows gender *similarity* in relevant abilities such as mathematics and technical skills or even finds that girls perform better (Ceci et al., 2009; Hyde et al., 2019; Lindberg et al., 2010). For example, a higher proportion of girls than boys in Swedish primary schools pass their technology courses, and there is no gender difference in passing mathematics courses (Skolverket, 2023). In the US, 8^{th} grade girls performed better than boys on the "Technology and Engineering Literacy" section of the National Assessment of Educational Progress (NAEP) (US Department of Education, 2018). Regarding what the gender difference in self-efficacy stems from, research has found evidence that girls underestimate their ability in STEM (Cadaret et al., 2017) but also evidence that boys overestimate their ability (Bench et al., 2015; Watt, 2010).

That many women underestimate their own competence in STEM is related to the gender stereotypes that associate technology with men (Master et al., 2017; Master & Meltzoff, 2020; Miller et al., 2015; Shin et al., 2016; Tellhed et al., 2023) and portray women as having lower ability in STEM. These stereotypes can have negative effects on women's self-efficacy (Eccles, 2011; Shapiro & Williams, 2012). Female engineers who have higher implicit stereotypes linking engineering to men have lower self-efficacy in engineering (Block, Hall, et al., 2018), and Robnett and Thoman (2017) identified a cluster of "self-doubting achievers", high achieving women in STEM majors whose self-efficacy remained low despite their good performance.

The aim of this thesis is to find interventions to increase women's self-efficacy in STEM, because increasing self-efficacy might be one possible way to affect interest, supported by SCCT, EEVT/SEVT, and empirical data. One approach for how it might be possible for interventions to affect women's self-efficacy can be found in Bandura's social cognitive theory (1977; 1986), which formulates four sources of self-efficacy. These sources are also included in SCCT, which is inspired by Bandura's theory (Lent et al., 1994).

According to Bandura (1977; 1997), self-efficacy can be developed through mastery experience (the experience of succeeding in a domain), vicarious experience (having relevant role models), social persuasion (receiving encouragement and feedback by relevant others), and low physiological arousal (low stress or anxiety). Research has produced mixed findings regarding the relative importance of these sources. Most studies tend to find that mastery experience (i.e. previous performance experiences) is the most important source (Britner & Pajares, 2006; Butz & Usher, 2015; Usher & Pajares, 2008), but some find that mastery experience is more important for men while social persuasion and vicarious experience from significant others in their life is more important for women to develop self-efficacy expectations (Zeldin et al., 2008). Yet others find that which of these is the strongest factor can vary over time (Phan & Ngu, 2016). Women's lower self-efficacy can be related to them having fewer opportunities to gain these experiences. Women tend to have less exposure to STEM experiences and therefore fewer chances to gain mastery experiences in STEM (Master et al., 2017; Williams & Subich, 2006), because they select fewer technical subjects in school and spend less time with technical things in their leisure activities, such as playing video games. Women also have less opportunities for vicarious experience in STEM because due to the underrepresentation of women in STEM, they have fewer relatable role models in public and media and likely among the people in their lives, who could help them build their own STEM self-efficacy.

Stereotypes also create barriers for women's self-efficacy through a process called stereotype threat (Steele, 1997; Steele & Aronson, 1995). This refers to the fear of confirming a negative stereotype about one's group, such as women being afraid of underperforming in a male dominated domain where they are stereotyped as less competent. This threat has been shown to negatively impact performance (Spencer et al., 2016). It also hinders the development of self-efficacy, because stereotype threat impairs the ability to accurately judge one's own performance (Tellhed & Adolfsson, 2018) which is needed to develop self-efficacy. Furthermore, stereotype threat can trigger stress and negative physiological arousal, which also hinders self-efficacy development (Bandura, 1977; 1997). Recently however, the concept of stereotype threat has been scrutinized due to difficulty replicating some of the findings (see Fourgassie et al., 2025).

Belongingness

The second predictor of STEM interest is one's sense of belonging in STEM, also called belongingness. Belongingness is defined as the perception of fitting in socially with others (Baumeister & Leary, 1995; Walton & Cohen, 2007). This factor is the focus of the recently developed STEMO model (Master & Meltzoff, 2020). Belongingness is an important predictor of STEM interest for both men and women (Cheryan et al., 2017; Cheryan & Plaut, 2010; Tellhed et al., 2017). Women studying STEM majors report lower belonging in STEM than men, and belonging was correlated with the number of other women in their major (Rainey et al., 2018). Swedish high school women also expect to have lower belongingness for STEM educations than men (Tellhed et al., 2017). Women generally feel less belongingness when they are numerically underrepresented (Schuster & Martiny, 2017). Nearly a third of women in engineering and technical roles are often the 'only woman in the room' (McKinsey, 2022), which likely contributes to that feeling.

Women also feel less belongingness when their gender is negatively stereotyped in a field (Cheryan et al., 2017). Their low belongingness could further be related to the way STEM work itself is perceived, such as not fulfilling communal career goals well (Diekman et al., 2011) and being done in isolation (Holmegaard et al., 2014) and the way people working in STEM are perceived, such as lacking interpersonal skills (Cheryan et al., 2013).

Moreover, there is a gender difference in science identity, meaning the degree to which one considers themselves as a "science person" (Rainey et al., 2018) with women reporting lower science identity than men. Students who identify with engineering are more likely to choose a STEM career (Hazari et al., 2010) and to persist in studying it (Jones et al., 2013). Gender differences in belongingness have been found to mediate gender differences in STEM interest (Good et al., 2012; Tellhed et al., 2017).

Belongingness and self-efficacy are both strong predictors of STEM interest. In a Swedish study with primary school students, self-efficacy was the strongest predictor (Tellhed et al., 2017; 2018), while a study from the US found belongingness to be the strongest (Cheryan & Plaut, 2010). In another study, women's perception that they matched the cultural image of a successful tech worker (related to belongingness) was a stronger predictor of their intentions to persist in tech companies than whether they matched the skill stereotype of people in tech careers (related to self-efficacy; Wynn & Correll, 2017).

Career Goals

The third predictor of STEM interest this thesis focuses on are career goals. Diekman's goal congruity perspective differentiates between agentic, that is stereotypically masculine career goals, such as getting a high salary and status, and communal, stereotypically feminine career goals, such as working with people and helping others (Diekman et al., 2010; 2011; 2017). Women tend to have (endorse) communal career goals to a higher extent than men. However, STEM is perceived as not fulfilling (affording) communal career goals well (Diekman et al., 2010; 2011). This contributes to women's underrepresentation in these fields because many don't perceive that they can fulfill their career goals in STEM (E. R. Brown et al., 2015; Diekman et al., 2010; 2011; 2017; Gartzia, 2022). Communal career goals were a significant mediator of gender differences in STEM interest in a sample of Swedish school students (Tellhed et al., 2018). While studies including several predictors usually find that self-efficacy and belongingness are stronger predictors of interest, communal career goal endorsement is still a significant contributor (e.g. Tellhed et al., 2018). Perceiving STEM as not fulfilling communal career goals well might be a self-fulfilling prophecy, because it attracts people who do not value communal goals highly, which therefore reinforces the stereotype and further deters people with high communal goal endorsement (Diekman et al., 2017).

Environmental career goals

In Study III of this thesis, I suggest expanding the career goals scale by a third factor, environmental goals, as a further predictor of STEM career interest. Environmental career goals include aspects such as counteracting climate change through one's profession and working on solutions for a sustainable world. Concern about climate change has become more important over the last decade, especially for girls (Olsson & Gericke, 2017; Stevenson et al., 2019). Many young people in Sweden consider "environmental and climate issues" as the most important societal issue (Ungdomsbarometern, 2024b). However, there is currently no research about whether this translates into being an important goal for one's career. Since environmental interest is stereotyped as feminine (Brough et al., 2016; Swim & Geiger, 2018) and women have been found to have higher environmental concern and pro-environmental behavior than men (Echavarren, 2023; Zelezny et al., 2000), environmental goals could be a gender-related factor. Since many fields within engineering and technology play a big role for technological advances towards solving climate problems, there is a clear link between many areas of STEM and environmental interest. Study III tests how important environmental goals are to young people in Sweden, whether they predict interest in STEM, and whether this can be a way to attract young women into STEM.

Interventions

The main research question of this thesis is how interventions can increase young women's self-efficacy, belongingness and perceived communal career goal affordance in STEM, and thereby increase their interest. Interventions are a common approach to increasing women's interest in STEM. Many interventions are created by educators and the industry, but they are rarely scientifically evaluated with regards to their effectiveness (Prieto-Rodriguez et al., 2020; Shoffner & Dockery, 2015; Valla & Williams, 2012).

Increasing Self-efficacy

Many studies have used interventions that aim to increase girls' and women's self-efficacy for STEM and research shows that they can have positive effects (Cheryan et al., 2017). One popular approach is mentoring programs, which have shown some evidence that they are related to high school women's higher self-efficacy (Holmes et al., 2012; Hughes et al., 2013). In this section, I will present findings from interventions that target specific sources of self-efficacy, as outlined by Bandura (1977; 1997).

Practical interventions that can provide women with mastery experience include problem-based-learning (S. W. Brown et al., 2013) and visits to a university engineering makerspace (a space where students can create things and experiment with tools and technology), which have shown positive effects on self-efficacy and belongingness, even for short visits (Andrews et al., 2021).

There are mixed findings regarding whether vicarious experience (i.e. role models) can affect self-efficacy (Lin, 2016). Some studies have found support (Zeldin & Pajares, 2000) but many others did not. Findings include that reading role model biographies of non-stereotypical STEM professionals increased self-efficacy for students already in STEM but not for non-STEM students (Shin et al., 2016). Furthermore, Gladstone et al. found that role models with a growth mindset (conveying that ability can be developed through training instead of being fixed) increased self-efficacy for Girls of Color but did not increase White girls' self-efficacy (Gladstone et al., 2024).

Since women underestimate their abilities in STEM (Cadaret et al., 2017), and since underrepresented groups tend to need extra encouragement (Shoffner & Dockery, 2015), feedback and social persuasion might be extra important for women to increase their self-efficacy in STEM. Some studies indicate that feedback from teachers has positive effects on girls' self-efficacy (Park et al., 2023; Schunk & Ertmer, 2000; Schunk & Swartz, 1993). However, other studies did not find that mastery experience or feedback explained effects on self-efficacy (Hier & Mahony, 2018). This indicates that more research is needed on under what conditions mastery experience and feedback can impact self-efficacy.

While most studies only include one or two of the sources of self-efficacy, one intervention that targeted all four sources through building things (mastery experience), professionals as role models (vicarious experience), verbal encouragement (social persuasion), and relaxation exercises (low arousal) found positive effects on self-efficacy (Betz & Schifano, 2000). Unrau et al. found in a meta-analysis that interventions for reading self-efficacy have stronger effects the more sources of self-efficacy they address (Unrau et al., 2018).

Taken together, these results indicate that interventions can have positive effects on women's self-efficacy, but that more research is needed on the effects of interventions that target specific sources of self-efficacy. At present, there is a lack of short, feasible interventions that can be implemented on a large scale. In Study II, I therefore design and test an intervention based on Bandura's social cognitive theory (Bandura 1977; 1997), that aims to give Swedish high school women mastery experience and social persuasion and thereby increase their self-efficacy for studying engineering at university.

Increasing Belongingness

Since belongingness is another important predictor of STEM interest, research has tried to find interventions that increase women's belongingness and identification with STEM, in order to increase their interest.

The STEMO model suggests broadening the cultural stereotypes about who belongs in STEM to include diverse examples of people in STEM in order to increase belongingness (Master & Meltzoff, 2020). One study found that reading newspaper articles stating that people in computer science no longer conform to stereotypes raised girls' interest (Cheryan et al., 2013). In line with this, STEM students who read biographies of non-stereotypical role models reported higher identification with and interest in STEM than students who did not read these biographies (Shin et al., 2016; Stout et al., 2011)

Interventions aimed at changing stereotypes about the culture of STEM include using audio recordings describing a welcoming culture for women, which was found to raise women's grades (Walton et al., 2015). Furthermore, studies found that a program offering women in STEM academic resources and social support was related to higher identification with STEM (Ramsey et al., 2013) and that women with female mentors felt higher belonging, which was related to higher interest in staying in STEM (Dennehy & Dasgupta, 2017). Research further indicates that belongingness can increase for students from underrepresented groups if they learn that it is common to experience initial challenges fitting in, and that they can overcome these challenges with time (Casad et al., 2018; Walton & Cohen, 2007).

Most interventions for belongingness are aimed towards women who are already in STEM. There are very few studies testing interventions for potential prospective students. Therefore, Study I and II in this thesis test interventions with high school students who are in the natural science track, which is a very early decision towards STEM, but before they make a choice towards a university education. In Study II, I design and test an intervention based on the STEMO model (Master & Meltzoff, 2020), which suggests broadening the stereotypes about who fits in STEM in order to increase belongingness, and based on the stereotype inoculation model (Dasgupta, 2011), which suggests that identification with role models is an important factor affecting belongingness.

Increasing Communal Goal Affordance

Several studies have found that explaining how communal career goals can be fulfilled in STEM may raise women's interest and participation in STEM (Batz-Barbarich et al., 2024; E. R. Brown et al., 2015; Diekman et al., 2011). This is especially true for women who have limited experience in the field (Diekman et al., 2017) and who therefore rely more on stereotypes. Moreover, framing science and engineering as a means of helping others through collaborative efforts can increase women’s interest in these fields (Belanger et al., 2017; Diekman et al., 2011). Clark et al. (2016) found that reading about STEM role models engaged in communal work was related to perceiving STEM as more communal and predicted more positive attitudes towards STEM careers. Furthermore, presenting STEM as fulfilling communal goals may also increase women’s confidence that they could succeed in STEM (Batz-Barbarich et al., 2024).

Role Model Interventions

Many interventions rely on role models to increase self-efficacy or belongingness for underrepresented groups. The stereotype inoculation model (Dasgupta, 2011) postulates that ingroup peers and relatable role models function as “social vaccines” that can increase belongingness and inoculate members of their group against the harmful effects of stereotypes in stereotyped settings such as engineering (Dasgupta, 2011). Even short exposure to counterstereotypical role models can have an effect on women’s gender stereotypes (see Olsson & Martiny, 2018, for a review). One meta-analysis found that field studies with ingroup role models have small positive effects on STEM interest and academic performance for underrepresented students (Lawner et al., 2019) but did not find an effect for lab studies. De Gioannis et al. claim that the evidence for the effectiveness of role model interventions is controversial and needs further study (De Gioannis et al., 2023).

Role models can be tricky, because if they are not calibrated carefully, they can have no or even negative effects (Betz & Sekaquaptewa, 2012; Parks-Stamm et al., 2008; Rudman & Phelan, 2010). If role models are perceived as too successful and too feminine, their success is perceived as unattainable, and they can be demotivating and even reduce women’s interest and self-efficacy in male dominated STEM fields (Betz & Sekaquaptewa, 2012; Ziegler & Stoeger, 2008). This is related to upward comparison threat, i.e. the negative effects of comparing oneself to someone perceived to be better (Betz & Sekaquaptewa, 2012; Parks-Stamm et al., 2008; Rudman & Phelan, 2010). Upward comparison threat of successful role models can be counteracted by simultaneously giving women positive feedback about their own potential in the field, which can protect their self-efficacy (Parks-Stamm et al., 2008). *Coping models*, who struggle and overcome problems before succeeding, are better at boosting women’s confidence than *mastery models*, who appear to seldom make mistakes (Schunk, 1983).

The stereotype inoculation model states that identification with role models is important in order to affect someone’s belongingness (Dasgupta, 2011). Gladstone and Cimpian (2021) found that role models were most effective if they were perceived as competent, but not exceptionally competent, psychologically or demographically similar to the audience, and if their success was perceived as also being attainable for the audience. Another problem is that one single role model might be perceived as a “token” (Kanter, 1977) and cause her to be evaluated negatively, rather than dispelling stereotypes (Heilman & Blader, 2001). A group of role models might therefore be more effective than individual role models, to reduce the risk of tokenism and include a social aspect. In Study II, I design and test a role model intervention in which a group of five female engineering students discuss their positive experiences with their studies and are shown socializing and studying together.

Methods of Role Model Presentation

Most role model interventions are text based, such as reading newspaper articles or role model biographies (Cheryan et al., 2013; Shin et al., 2016) or in-person as confederates, role models or mentors (see De Gioannis et al., 2023; Lawner et al., 2019). In-person role models can inadvertently be perceived as intimidating or otherwise difficult for the audience to identify with (Lawner et al., 2019) and the researcher has limited control over the interaction. Another problem with in-person role model interventions is that they are not feasible on a large scale. Text based interventions on the other hand are feasible and can easily be tailored exactly to the audience, but they lack vividness and therefore attractiveness.

Recently, a few studies have started to test video as a new way to present role models. Since it is more vivid than text, but at the same time more feasible than in-person interactions with role models, video may provide a practical solution for large-scale interventions. Some promising results using video interventions come from Pietri et al., who found that after watching a video showing a female computer scientist, students had higher interest in computer science and stronger identification with the scientist compared to students who only read a transcript of the video (Pietri et al., 2021). Furthermore, video interventions have been found to increase positive attitudes towards women in STEM and reduce gender bias (Moss-Racusin et al., 2018). In a pilot study, watching videos of demographically similar former students improved attrition rates for engineering students (Lee et al., 2024). These findings indicate that video might be a promising and feasible way to present role models. In Study II of this thesis, I design and test a video intervention showing a group of female role models.

Timing for Interventions

One question is at what age interventions should target students in order to be most effective. On the one hand, the earlier they intervene, the more interest they can capture, before many young girls lose interest and move away from STEM (e.g. Microsoft Corporation, 2017; Sadler et al., 2012). On the other hand, the effects of earlier interventions, especially short ones, might have disappeared among other messages that young girls are exposed to in school and through media, by the time they make career decisions. Therefore, another effective time point for interventions might be closer to when young people think about their careers or make career choices, which is when they are at risk of dropping out of the "leaky pipeline". Furthermore, with older students, interventions can be more targeted towards specific education programs and careers, rather than abstract concepts of being a scientist or engineer.

In Sweden, students attend 9 years of compulsory primary school, until they are about 15 years old. For high school, students pick an educational track with a specific focus, such as natural science, technology, social science, economics, or vocational tracks (Skolverket, 2025b). This means that students make their first career decision at age 15 when choosing a track for high school. The last year of primary school might therefore be a suitable time for interventions because students are likely already thinking about their career plans and might be receptive to career related interventions.

Furthermore, students in the natural science or technology track in Swedish high schools are a suitable target group for STEM interventions because they have already shown some interest and ability in STEM areas. Therefore, they might benefit most from interventions further encouraging this, while students in other tracks who have started moving into different educational directions might be less receptive to interventions targeting STEM interest.

Conceptual Model

The conceptual model in Figure 1 summarizes the predictors of career interest and choice that are the focus of this thesis as well as how the studies in this thesis aim to affect these predictors through interventions. The left part of the figure visualizes the types of interventions this thesis tests and evaluates, and which variable they are hypothesized to affect. Mastery experiences of performing well on STEM tasks and positive feedback on one's performance are hypothesized to increase self-efficacy. Relatable role models are hypothesized to increase self-efficacy and belongingness. Information countering stereotypes about who fits in STEM is hypothesized to increase belongingness, and information that STEM can fulfill career goals that are important to women is hypothesized to increase perceived career goal congruity. The middle part of the figure depicts the three predictors self-efficacy, belongingness, and career goal congruity, which the interventions aim to affect. These predictors are then hypothesized to affect interest. Finally, interest is hypothesized to affect career choice, but this step is not tested in this thesis.

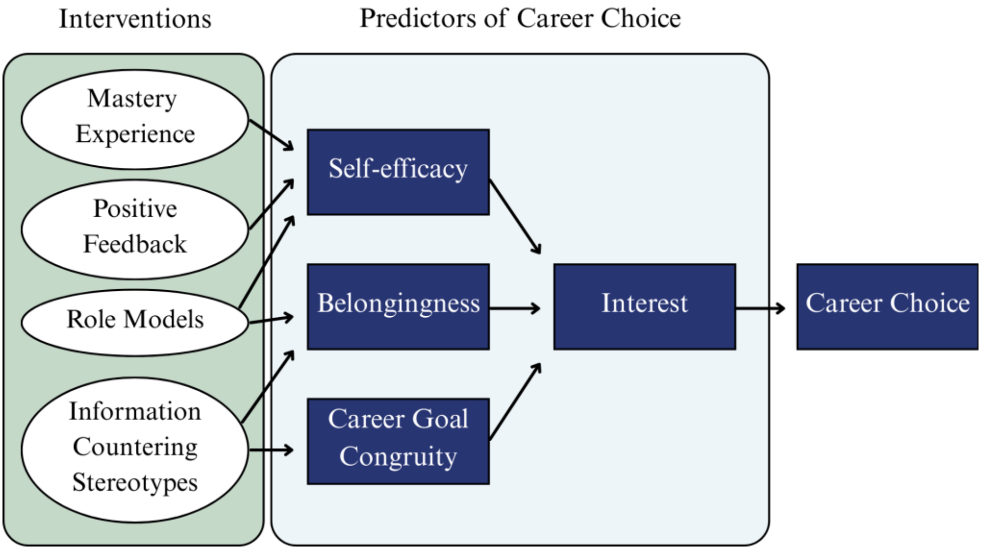

Figure 1. Conceptual model of the predictors of interest and career choice and how interventions can affect them

What's Not Included

The scope of this thesis is of course limited. There are several other predictors of STEM interest or relevant factors that could not be included. Other factors that can influence self-efficacy include for example having a growth mindset compared to a fixed mindset (whether one believes that STEM competence is developed through hard work and training or based on innate talent; Dweck, 2000; 2006; Kramer et al., 2023), and a more detailed analysis of stereotype threat (Steele, 1997; Steele & Aronson, 1995).

Moreover, other fields face similar problems with gender imbalance. Many blue-collar fields with manual labor are also struggling to recruit women, but the mechanisms might be different than in academic STEM contexts (e.g. Torre, 2019). On the other hand, healthcare, early education, and the domestic sphere (HEED) are female dominated fields that face a gender imbalance in the opposite direction, but do not have the same mechanisms as STEM for example, because HEED jobs are generally lower in status and men are often sought after rather than having to fight against similar barriers (Block, Croft, et al., 2018; Croft et al., 2015). HEED and blue-collar sectors are areas that are also in need of research and initiatives working towards reducing the gender disparity. In what way the mechanisms are similar (e.g. based on gender stereotypes) or different (e.g. related to status) is beyond the scope of this thesis.

This thesis focuses solely on gender imbalance between men and women, because that is currently where there are theories and enough previous research about the mechanisms of underrepresentation, partly because the groups are big enough to study. For statistical power reasons, the studies in this thesis exclude people with other gender identities, such as non-binary people, from all analyses that include gender, because the numbers of participants that identified as something other than woman or man were too small and heterogenous (e.g. only specifying "other" identity) to form a comparison group.

Intersectionality

This thesis focuses on women as an underrepresented group in STEM. However, gender is not the only category with a disparity in STEM. In Western countries, non-White people are underrepresented in STEM, especially Black and Hispanic groups (e.g. Pew Research Center, 2021). The underrepresentation of different ethnic groups might be due to similar processes and some of the findings regarding interventions for women might apply to these groups as well, but the specific processes behind their underrepresentation are beyond the scope of this thesis.

Furthermore, other categories can intersect with gender to affect the STEM interest of women belonging to multiple underrepresented groups. Research from the US indicates that Black women are even less likely than White women to feel belongingness in STEM (Rainey et al., 2018). However, there is also evidence that women from racial minorities are not subjected to the same STEM-gender stereotypes by others or that they endorse these stereotypes to a lesser extent (Casad et al., 2017; O'Brien et al., 2015).

Recent research from Sweden suggests that implicit gender stereotypes associating technology with men may be weaker among girls with a foreign background compared to girls with a Swedish background (Tellhed et al., 2023) and that girls with a foreign background have higher self-efficacy than Swedish girls (Tellhed et al., 2022). However, these studies do not include data on which countries the girls with foreign backgrounds are from, which makes it difficult to interpret the findings. One issue with research regarding ethnicity in Sweden is that Sweden has no widely established measure of ethnicity. The official statistics differentiate between having a Swedish background (born in Sweden and having at least one parent born in Sweden) and a foreign background (born outside of Sweden or having both parents born outside of Sweden; Statistics Sweden, 2002). Furthermore, research indicates that Swedish people associate negative connotations with the concept of "race" or racialization (Adolfsson, 2024), which can make it difficult to include questions regarding ethnicity in survey studies. It is important to develop more detailed measures of ethnicity in Sweden, in order to examine how groups at different intersections of ethnicity and gender perceive STEM as a possible career choice.

In this thesis, I only briefly touch on issues related to intersectionality in Study III by exploring differences in STEM interest and career goals between young women with a Swedish background and those with a foreign background. While a deeper intersectional analysis would provide valuable information regarding potential differential impacts of cultural stereotypes about who belongs in STEM (Cole, 2009), it is unfortunately beyond the scope of this thesis.

General and Specific Aims of the Thesis

General aims of the thesis include contributing to the literature on understanding the factors behind the gender disparity in STEM and specifically engineering, and whether interventions can contribute to decreasing the gender difference in interest. Furthermore, part of the thesis was a cooperation with Swedish water companies, who wanted information on how they could increase young people's interest in working in STEM jobs in the water sector. Collaborating on two interventions designed by the water companies, the goal was to evaluate their current interventions and advise on how to improve them to increase their effectiveness in attracting young people.

The specific aims of the thesis are to investigate predictors of women's interest in engineering and to find interventions that can increase these predictors and thereby increase women's interest in engineering specifically, and in STEM more generally. For that purpose, this thesis investigates gender differences in interest in engineering and STEM, as well as gender differences in the predictors of this interest. Furthermore, the studies in this thesis test if gender differences in the predictors of interest mediate the gender difference in interest (Study I and II), i.e. if the gender difference in interest can be statistically explained by gender differences in the predictors. I focus on three predictors that have been supported by theory and empirical data, namely self-efficacy (Study I and Study II), belongingness (Study I and Study II), and career goals (Study I and Study III). In Study III, on top of looking at previously established factors of career goals, namely agentic and communal goals, I also explore the existence and role of a third type of career goals, namely environmental career goals, and how endorsement and affordance of these goals is related to interest in STEM.

Another aim of Study I and Study II is to test whether interventions can increase young women's self-efficacy and belongingness and thereby increase their interest in engineering. In Study I, I evaluate an existing intervention, a two-day course about water issues that is run by a local water supply company in Southern Sweden. In Study II, I design two short interventions based on psychological theory that aim to increase young women's self-efficacy and belongingness and test them in Swedish high schools.

Summary of the Studies

Study I

Background

Study I was an evaluation of an existing industry-financed intervention, the two-day course “Tänk H_2O!” for high school students run by a local water supply company. The course aims to raise students’ awareness of water and sustainability issues and their interest in careers in the water sector. The aim of the study was to evaluate the effectiveness of the intervention at increasing young people’s interest in studying engineering, especially women’s interest. The study investigated potential gender differences in interest in engineering as well as the predictors self-efficacy, belongingness, and communal goal endorsement, and whether gender differences in these predictors mediated a gender difference in engineering interest. It also tested whether taking part in the intervention could increase specifically young women’s engineering self-efficacy, belongingness, and perceived communal goal affordance for engineering, and thereby increase their interest in engineering.

Method

I conducted a longitudinal quasi-experimental survey study with 722 Swedish high school students (including 403 women and 316 men). The average age was 17.2 years. I conducted three measurement time points and compared an intervention group to a comparison group. The intervention group consisted of students in 29 classes who took part in the course “Tänk H_2O!”. Participation in this course was based on the teachers applying for their class to receive a scholarship for the course. I then recruited a comparison group of 18 classes that did not participate in the course. The majority of students were in the natural science track in school. Students completed a survey via the online platform Qualtrics or on paper two weeks before their participation in the course, immediately after the course, and three months later. The comparison group completed the three surveys in similar time intervals.

Intervention

The intervention was the two-day interdisciplinary course “Tänk H_2O!” about water and sustainability issues run by the Swedish company Sydvatten, who provides drinking water for the south of Sweden (https://sydvatten.se/for-skolor/stipendiet-tank-h20/). The course takes place mostly outdoors by a lake in the Swedish countryside. It consists of ten workshops on different topics regarding water and sustainability, ranging from the hydrological cycle and how clean tap water is produced, to political conflicts in connection with water and presenting different jobs in the water sector. Students build models of water flow dynamics, examine water samples under a microscope, and brainstorm solutions for conflicts of interest around water as a resource.

Measures

Interest in studying engineering was measured with three items, such as “How interested are you in studying an engineering program at university?”, self-efficacy was measured with three items, including “How confident are you that you could pass an engineering program with the highest or second highest grade?”, and belongingness was measured with three items, such as “How well do you expect to fit in socially with your classmates if you studied an engineering program?”. Endorsement of agentic and communal career goals was measured with Diekman’s goal endorsement scales (Diekman et al., 2011). Perceived affordance of agentic and communal career goals was measured with one item each. Stereotype threat was measured with three items, such as “If you studied an engineering program, how likely do you think it is that teachers and classmates have preconceptions about you because of your gender?”. All questions were answered on 5-point Likert scales ranging from 1 = “not at all” to 5 = “very much”.

Results

First, Study I found the expected baseline gender differences, in that women had lower self-efficacy, belongingness, and interest in engineering than men, but had higher communal goal endorsement and stereotype threat. It also found that the gender differences in belongingness, self-efficacy, and communal goal endorsement partially mediated the gender difference in interest, with belongingness being the strongest mediator.

Regarding the effects of the intervention, this study found that the intervention increased the young women’s self-efficacy compared to the baseline and compared to the control group and the effect was still significant three months later. The intervention also increased women’s belongingness and communal goal affordance, i.e. the perception that engineering could fulfil communal goals, compared to the baseline and compared to the control group, but these effects did not last three months later. Lastly, women reported lower stereotype threat after the intervention compared to the baseline, but the same pattern was true for the control group, so the groups did not differ significantly from each other.

Despite the significant increases in all three predictors of interest, and the mediation showing that the predictors explained the gender difference in interest, the intervention did not increase women's interest in engineering. Women who took part in the course did not have significantly higher interest in engineering after the intervention than before or compared to the control group.

Study II

Background

In Study II, I designed and evaluated two brief interventions that aimed to increase high school women's belongingness and self-efficacy for engineering and thereby increase their interest in studying engineering. Specifically, the goal was to create two short digital interventions that are feasible to implement on a large scale in high school contexts. The target group for the interventions were students in the natural science track in high school, since they have a basic interest in STEM and might be suitable candidates for an engineering education. The first intervention was a video of five female role models discussing their positive experiences with studying engineering. Based on the STEMO model (Mater & Meltzoff, 2020) and the stereotype inoculation model (Dasgupta, 2011), this intervention aimed to increase young women's expected belongingness for engineering. The second intervention was an engineering ability quiz followed by positive, encouraging feedback about their performance. Based on Bandura's theory about the sources of self-efficacy (Bandura, 1977; 1997), this intervention aimed to increase young women's self-efficacy by providing mastery experience through completing the quiz and social persuasion in the form of the encouraging feedback. This study consists of two partial studies – Study IIa tested the video intervention, and Study IIb tested the video and the quiz intervention and added a pre-intervention baseline measure. In both partial studies, I tested potential gender differences in belongingness and self-efficacy, whether these mediate a gender difference in engineering interest, and whether the interventions increase these variables for high school women.

Study IIa

Method

In Study IIa, high school students in the natural science educational track watched a role model video of five female engineering students talking about their positive experiences with their studies. I measured participants' expected belongingness, self-efficacy, and interest in engineering and compared this to scores from a control group who did not see the video. I collected data from 16 classes in Swedish high schools, with 322 students in total in the final sample (177 women and 145 men) with an average age of 17.0 years.

Intervention

I filmed an 8-minute role model video of five female engineering students talking about their positive experiences with their studies. They answered questions such as what made them interested in studying engineering, what they like best about their field, what they find easy, what is difficult for them and how they overcome that, what the labs and the social life are like and why they think young people should study engineering. The role models portrayed a friendly supportive atmosphere by listening attentively to each other, laughing and nodding. Between questions the video showed scenes of the women studying together or having coffee together.

Measures

I measured expected belongingness with six items such as "How well do you think you would fit in socially with your classmates if you studied an engineering program?", self-efficacy with five items including "How well do you think you could understand the content of an engineering course?", and interest with three items, including "How interested are you in studying an engineering program?". All items were measured on 5-point Likert scales from 1 = "not at all" to 5 = "very much".

Results

This study found the expected gender differences in all variables. Women reported lower belongingness, self-efficacy and interest in engineering compared to men. Furthermore, the gender differences in belongingness and self-efficacy fully mediated the gender difference in interest with no significant difference in relative strength of the mediators. Regarding the effect of the video intervention, women who saw the role model video had higher belongingness in engineering than women who did not see the video. There were no differences in interest or in self-efficacy between women who saw the video and those who did not. Identification with the role models significantly predicted higher belongingness.

Study IIb

Method

Study IIb added an engineering ability quiz followed by positive, encouraging feedback. It also included a pre-intervention baseline measure for comparing answers before and after the interventions. I collected data from 873 students in 39 classes in the natural science educational track in Swedish high schools. The final sample consisted of 461 women and 412 men. This study had four conditions: participants either watched the video, completed the engineering ability quiz and received positive feedback, received both interventions, or received no intervention. I measured participants' self-efficacy, belongingness, and interest in engineering two weeks before and immediately after the intervention.

Interventions

Video: The video was the same as in Study IIa.

Quiz: For the engineering ability quiz, I adapted nine multiple choice questions from the "Technology and Engineering Literacy" section of the "National Assessment of Educational Progress" (NAEP, US Department of Education, n.d.). The questions measured skills that engineers need in their work, such as information processing, problem solving and critical thinking. The questions concerned different topics, for example putting the steps for designing a tent into the right order, or trouble shooting a malfunctioning computer screen.

Feedback: Dependent on their score on the engineering quiz, participants were then shown one of four feedback categories, with feedback ranging from "You seem to have exactly what it takes to successfully complete an engineering education." for the highest scores and "Good job trying to solve the tasks! With a little more practice, you can surely solve more next time." for the lowest scores. The lower two feedback categories also included the information that the skills measured in the quiz can be improved with training.

Measures

I measured interest, self-efficacy and belongingness with shorter versions of the scales used in Study IIa, including four items for each variable.

Results

This study also found the expected baseline gender differences in self-efficacy, belongingness and interest in engineering, with women scoring lower than men in all three variables. Gender differences in belongingness and self-efficacy partially mediated the gender difference in interest, and belongingness was a significantly stronger predictor compared to self-efficacy. Moreover, women at more competitive schools with higher admission grade point average (GPA) scored higher on interest, belongingness, identification with the role models and performed better on the quiz compared to women from schools with lower admission GPA.

81% of women and 89% of men scored in the top two categories on the quiz and received positive feedback about their potential to successfully complete an engineering education. Moreover, women who scored in the top two categories on the quiz had significantly higher self-efficacy after the intervention compared to before, while self-efficacy did not increase for women in the study conditions who did not do the quiz. Women who only did the quiz but did not watch the video also had significantly higher self-efficacy compared to the control group who received no intervention. Higher scores on the quiz predicted a higher increase in self-efficacy.

Furthermore, interest also increased significantly from baseline for women who did the quiz and scored in the top two categories but did not change for women who did not do the quiz. For women who did the quiz and watched the video, interest was also significantly higher post intervention compared to the control group who received no intervention.

However, this study could not replicate the effect of the video on belongingness found in Study IIa. There were no significant differences in belongingness before and after watching the video, and between women who watched the video and those who did not. For women who watched the video, identification with the role models predicted a higher increase in belongingness.

In summary, this study found that the engineering ability quiz intervention with positive feedback increased young women's self-efficacy and interest in engineering but found mixed results regarding whether the video intervention could increase the young women's belongingness.

Study III

Background

Study III looked at a third predictor of STEM interest, namely career goals. One aim of the study was to explore environmental career goals as a potential third factor on top of the previously established agentic and communal career goals. This is because STEM plays a big role in finding technological solutions to sustainability issues, and wanting to save the planet and combat climate change could be a pathway into interest in STEM. Since previous research has shown that women are more interested in environmental issues than men, this could be a gender-related factor.

The second aim of Study III was to test how important environmental, agentic, and communal career goals are for young people, and whether the importance of these goals (endorsement) and the perception that they could be fulfilled in different STEM jobs (affordance) predicted their interest in STEM jobs in the water sector.

Method

Study III was a survey study with students in year 9 of Swedish primary schools. This study was part of a larger study including a visit to a science center run by a local water management company, but the data reported in this thesis is the part that I collected in schools before the students' visit to the science center. Participants were 487 students (including 240 women and 226 men) from 23 classes, with an average age of 15.3 years. Sixty-one percent of those had a foreign background, i.e. were born outside of Sweden, or had both parents born outside of Sweden (Statistics Sweden, 2002).

Measures

Endorsement of agentic and communal career goals was measured with items adapted from Diekman et al. (2011). Agentic goals were measured with four items, namely "a high salary", "status", "a successful career", and "achieving top performance", and communal goals were measured with three items, namely "working with people", "helping others", and "caring for people". I also constructed a novel environmental goals scale with three items, namely "having a job that improves the environment", "counteracting climate change", and "working on solutions for a sustainable world".

Participants then read short descriptions of four different STEM jobs in the water sector, namely water engineer, environmental engineer, laboratory engineer, and operations technician, and were asked to rate their interest in each job and in studying natural science and technology. Goal affordance for each job was measured with one item asking to what extent participants believed that the job can afford e.g. "getting a high salary, status, achieving top performance and having a successful career" for agentic goal affordance, and similar items for communal and environmental goal affordance. All questions were answered on 5-point Likert scales from 1 = "not at all" to 5 = "extremely".

Results

Confirmatory factor analysis showed that a 3-factor model including agentic, communal and environmental career goals had a good fit, and all items had significant loadings on the respective factors. Moreover, the model had a better fit than a 2-factor model (agentic and communal), that included the environmental items within the communal factor. This result indicates that environmental career goals constituted a separate factor from communal and agentic career goals. Communal and environmental goals were moderately correlated.

The study also found gender differences in some of the variables. Women had significantly higher endorsement of environmental and communal career goals than men, but lower interest than men in the STEM jobs water engineer and operations technician as well as in studying technology. The study found no gender differences in interest in the jobs environmental engineer and laboratory engineer or in studying science. In absolute values, both women and men rated the agentic goals of a high salary and a successful career as the most important goals. Young people with a foreign background scored higher than young people with a Swedish background on all variables except for agentic goal endorsement.

Environmental goal endorsement positively predicted interest in the STEM jobs and subjects, which means that people who scored higher on environmental goals were more interested in the STEM jobs and subjects. Endorsement of agentic and communal goals did not predict STEM interest. However, regarding career goal affordance (perceived fulfilment), perceived communal goal affordance predicted STEM interest for women, and both agentic and communal goal affordance predicted STEM interest for men, but environmental goal affordance was not a significant predictor, not even for those who scored high in environmental goal affordance. This result indicates that it is still getting a high salary and working with people what attracts young people to STEM jobs.

Discussion

Summary of the Main Findings

I will briefly summarize the main findings of the three studies in this thesis and then discuss them in more detail, sorted by different themes. All three studies found expected gender differences in interest in engineering or STEM, as well as the expected gender differences in the predictors. Study I and Study II found that the gender differences in belongingness and self-efficacy (and communal goal endorsement in Study I) mediated the gender differences in interest, and in most cases, belongingness was the strongest predictor. In Study I, the two-day course intervention increased women's self-efficacy, belongingness, and communal goal affordance, but not their interest in studying engineering. In Study II, the engineering ability quiz intervention increased women's self-efficacy and interest in engineering. The role model video intervention produced mixed results, showing higher belongingness compared to a control group in Study IIa, but no increase in belongingness in Study IIb. Study III found that environmental career goals are a separate factor from communal and agentic career goals, and that environmental goal endorsement predicted interest in STEM.

Findings on Gender Differences

These studies generally found the expected gender differences in interest in engineering or STEM careers, as well as its predictors. In Study I and Study II, women had lower interest than men in engineering. In Study III women had lower interest than men in two of the four STEM jobs and in studying technology. These findings are in line with a host of previous research that women have lower interest in STEM than men (e.g. Tellhed et al., 2017; 2018). However, Study III found no gender differences in the two STEM jobs with environmental and chemistry associations, as well as in studying science. This indicates that women may be interested in parts of STEM that align with gender stereotypical goals and interests and fields that are not heavily stereotyped. Study I and II found that women had lower self-efficacy and lower belongingness than men. This also corresponds to previous findings (Hackett, 1995; Lent & Bown, 2019; Tellhed et al., 2017; 2018). Study I and Study III found that women had higher communal career goal endorsement than men, replicating findings by Diekman and colleagues (Diekman et al., 2010; 2011; 2017). Furthermore, in Study III, women had higher environmental goal endorsement than men. This is in line with findings that women have higher environmental concern than men (Echavarren, 2023; Zelezny et al., 2000). Since many STEM fields fulfil environmental goals well, this could be a path towards increasing women's interest in careers in STEM.

Explaining the Processes Behind STEM Interest

In both Study I and Study II, the gender differences in interest in engineering were mediated by gender differences in belongingness and self-efficacy, and in Study I additionally by a gender difference in communal goal endorsement. This supports established theories about the processes behind the gender difference in STEM interest, such as SCCT (Lent et al., 1994), EEVT (Eccles, 1987; 1994), SEVT (Eccles & Wigfield, 2020) and STEMO (Master & Meltzoff, 2020), as well as previous empirical findings (e.g. Tellhed et al., 2017; 2018). Findings regarding whether self-efficacy or belongingness is a stronger predictor of interest have been mixed. In Study IIa, there was no significant difference in relative strength of the mediators. In Study I and Study IIb, belongingness was the stronger mediator of gender differences in interest. In comparison to this, in another large study of Swedish students (Tellhed et al., 2017; 2018) self-efficacy was the largest predictor. However, this difference could be related to the samples. The samples in this thesis consisted mostly (Study I) or exclusively (Study II) of students in the natural science track in high school, i.e. those who have already chosen a STEM program. These students may already have a higher baseline self-efficacy for STEM, compared to the broader, more representative sample of primary school students in Tellhed et al.'s study. It could be that under these circumstances, belongingness concerns play a bigger role for career interest in STEM. These findings support the STEMO model (Master & Meltzoff, 2020), which emphasizes the important role of belongingness in explaining gender differences in interest.

In Study IIa and Study IIb, identification with the role models in the intervention video predicted belongingness. This finding supports the stereotype inoculation model, which states that role models need to be relatable in order to be effective (Dasgupta, 2011), as well as findings that role models should be psychologically or demographically similar to the observer (Gladstone & Cimpian, 2021).

In Study I, communal career goal endorsement was a significant predictor of engineering interest for women, which supports the goal congruity perspective (Diekman et al., 2010; 2011; 2017) and empirical findings (Tellhed et al., 2018). In Study III, environmental career goal endorsement was the only type of goal that predicted interest in STEM careers. This is a new finding, since environmental goals had not been tested previously. Regarding perceived career goal fulfilment, both communal and agentic goal affordance predicted interest in Study III, while environmental career goal affordance did not. This is in line with previous findings that communal goal affordance predicts women's STEM interest (Diekman et al., 2010; 2011; 2017) and with the finding that those types of goals were rated as more important by participants in this study compared to environmental career goals. Study III builds on and expands Diekman's goal congruity perspective (Diekman et al., 2010; 2011; 2017) by suggesting environmental goals as a third factor. While agency and communion can be applied to many career contexts, environmental goals might be more specific to some fields. But in the context of STEM careers that can be related to working with sustainability, they could become a useful addition to the goal endorsement scale.

Taken together, these findings on gender differences in interest and the processes explaining this difference contribute to explaining women's underrepresentation in STEM. The knowledge about the mechanisms behind the gender gap can be helpful in finding ways to increase women's interest and participation in STEM through designing tailored interventions.

Effects of the Interventions

What Predictors were Affected

In Study I, the industry-designed intervention "Tänk H_2O!" increased young women's self-efficacy, belongingness, and perceived communal career goal affordance in engineering, and reduced their stereotype threat. However, despite these increases in the predictors, the intervention did not increase women's interest in studying engineering. Study I only tested effects of the intervention as a whole and could not disentangle specific components that might have caused the effects, but I speculate that participating in the intervention workshops provided the women with mastery experiences and that the teachers and course leaders could be perceived as role models (vicarious experience), all in a non-competitive setting that did not create stress or anxiety related to STEM activities (low physiological arousal). Furthermore, participants received information about careers in the water sector which countered potential stereotypes about the content of engineering jobs. This might have increased the perceived affordance of communal career goals in engineering.

In Study II, completing the engineering quiz and receiving positive feedback increased young women's self-efficacy and interest in engineering. This finding supports EEVT/SEVT, SCCT and STEMO in that self-efficacy is closely linked to interest (Eccles, 1987; 1994; Eccles & Wigfield, 2020; Lent et al., 1994; Master &

Meltzoff, 2020). The effects of the quiz intervention further support Bandura's social cognitive theory in that mastery experience and social persuasion are important sources for developing self-efficacy (Bandura, 1977; 1997).

In Study II, the role model video intervention was related to higher belongingness in Study IIa, which supports the STEMO model (Master & Meltzoff, 2020), but the video did not increase belongingness in Study IIb. These findings indicate that relatable role models might be able to increase belongingness, but further research is needed into under what conditions they are effective. The women in Study IIa identified with the role models to a higher extent than the women in Study IIb. This could contribute to the difference in effectiveness of the video and highlights the importance of tailoring role model interventions to the audience in order to increase chances that participants relate to the role models, as posited by the stereotype inoculation model (Dasgupta, 2011).

In summary, in the interventions evaluated in this thesis, affecting young women's self-efficacy was easier than affecting their belongingness for engineering. This is a promising result, since self-efficacy is a key factor in women's underrepresentation in STEM (Eccles & Wang, 2016; Hackett, 1995; Lent & Brown, 2019; Master & Meltzoff, 2020; Tellhed et al., 2017; 2018; Watt, 2010). However, despite increases in self-efficacy and belongingness, and the finding that these predictors mediated the gender difference in interest, which gives theoretical support for expecting an increase in interest, it was difficult to increase interest in engineering with these interventions. Only the quiz intervention in Study IIb had an effect on the young women's engineering interest. This indicates that stronger increases in the predictors might be necessary in order to affect interest or other factors that were not measured in these studies have a more consequential impact on career interest.

The Magnitude of the Effects

Although the effects of the interventions were mostly small, they can still be considered an encouraging result. Considering the brief length of the interventions and the low starting level of interest, it is promising that even such short interventions can have effects on women's self-efficacy and belongingness, with the effects on self-efficacy in Study I still being significant three months later. Especially keeping in mind that interventions have also been found to have no or even negative effects on women's STEM perceptions (Betz & Sekaquaptewa, 2012), this is a promising result.

Furthermore, the intervention in Study I was designed by industry professionals instead of researchers and without the explicit goal of addressing specifically women or exclusively engineering careers. This increases the ecological validity of the findings and is an encouraging result for the industry. This could also imply that more tailored interventions designed in collaboration with researchers could have even larger effects.

Study I found that the effects of the course intervention on belongingness and communal goal affordance had reduced or disappeared three months later. That is not surprising given the short intervention length of only two days. On the other hand, it is a very promising result that the effect on self-efficacy was still significant three months later. Effects of short interventions are often reduced again after some time (Boeve-de-Pauw et al., 2022), so a boost or reminder or integrating them into a larger set of interventions might support longer lasting effects.

Theoretical Contribution of this Thesis

The aim of the thesis was mostly an applied goal, to find practical interventions that can increase young women's interest in STEM. But the thesis also provides some theoretical contributions. The findings from the three studies in this thesis contribute to the theoretical understanding of the processes behind women's under-representation in STEM. Results regarding the gender differences in interest and its predictors provide further support for the established theories, such as EEVT/SEVT, SCCT and STEMO, in how self-efficacy and belongingness predict and mediate interest in engineering, social cognitive theory about the sources of self-efficacy, and GCP in how endorsement and affordance of different types of career goals are related to interest (Bandura, 1977; 1997; Diekman et al., 2010; 2011; Eccles, 2011; Eccles & Wigfield, 2020; Lent et al., 1994; Master & Meltzoff, 2020). Another theoretical contribution of this thesis is the support for the existence of an environmental career goal factor. Study III expands on Diekman et al.'s goal congruity perspective (2010; 2011; 2017), by showing that environmental career goals are a separate factor from communal and agentic career goals but moderately correlated with communal goals. These contributions can lead to practical implications that need to be investigated further by future research.

Practical Implications

Study I was an applied study in collaboration with an existing industry intervention. The evaluation of its effectiveness gives useful direct feedback for the course organizers that they can use to make their intervention more effective for future visiting classes. Study II contributes examples of two feasible interventions (the engineering ability quiz with feedback and the role model video) that can, with some improvements to make them more effective, be implemented for high school students directly in school settings. One big advantage of the interventions in Study

II is that they are fully digital and can therefore be implemented on a large scale and without special training or resources. The findings that the quiz intervention in Study II increased self-efficacy and interest can be useful for study guidance counsellors, who want to use similar interventions with their students. Overall, this study provided practical examples of what can become feasible interventions for different school contexts.

The results of all three studies can be useful for other, similar interventions who can build on these findings. The result from Study I that self-efficacy remained increased three months after the intervention is extra promising because it shows that even short interventions can have longer lasting effects, which is rare for a brief and not tailored intervention. One piece of advice for other interventions coming from the results of this study is to follow up their intervention with a reminder or a boost after some time, to help potential effects last longer.

The results of Study III that environmental career goal endorsement predicted STEM interest for women and men can be used by the water sector or other STEM sectors for their recruitment, because it informs them that people high in environmental career goals might be a useful target group for recruitment into STEM educations and jobs and that messages about how STEM jobs can fulfil agentic and communal goals might attract young people.

Lastly, in this thesis I want to underline the importance of empirically evaluating existing industry interventions in order to increase their effectiveness, and the importance of tailoring interventions to the target group, such as ensuring that role models are relatable and participants can identify with them.

Societal Impact

Study I and Study III were conducted in collaboration with local companies from the Swedish water sector. Study III was part of a bigger project in collaboration with the science center "Kretseum" run by the local water management company VA Syd. Apart from the research described in Study III, another aim of this collaboration was an empirical evaluation of the science center's exhibition "The Sustainable City", which teaches primary school children how water, energy, and waste is handled in a sustainable city. The goal of the evaluation was to test if visiting the science center would increase adolescents' interest in working in the water sector in the future. The results of this evaluation study are published in a Swedish Report (Björklund et al., 2023).

The collaborations with the industry on these two studies have several implications for their societal impact. Firstly, this means I could integrate expertise from the industry partners in the study design and materials. But secondly, there were external stakeholders with an interest in the research, which increases the societal impact of this thesis. The intervention I evaluated in Study I and the science center exhibition I evaluated in connection with Study III are existing interventions that continue to be active and reach several hundred young people every year. The results from my research are not only useful for the specific interventions I investigated, but due to the collaboration, this thesis is placed within a network of companies and organizations (such as the reference group for the research project) that can benefit from the results.

The Larger Context

There is considerable societal debate around whether research and interventions aiming to increase women's participation in STEM are necessary or even wanted. There are people who believe that men and women have different strengths, and if women are not interested in STEM, we should just let them choose other careers, and that these research and intervention efforts are not necessary. However, as presented above, the research shows that this is not true. Studies on gender similarity in ability have shown that there is no gender difference in ability that would explain a naturally occurring difference in interest (Ceci et al., 2009; Hyde et al., 2019; Lindberg et al., 2010). However, if women's career choice is guided by harmful and faulty stereotypes, then they are not able to make a fully informed choice, and if barriers are put in their way, then it is not a free and fair choice either. Furthermore, even if one wants to dismiss this research and does not believe in gender equality as a worthy pursuit on its own, the labor market needs alone are enough to justify increased efforts to attract women into STEM. The STEM sector is growing and needs to fill a large number of positions (Nordic Council of Ministers, 2021; Shoffner & Dockery, 2015; Swedish Public Employment Service, 2022). If half of the population is ignored in the efforts to attract skilled workers, the sector will not be able to meet these labor market demands, leading to economic loss (EIGE, 2017).

One dilemma that comes up in this context is the issue of "fixing the women" versus "fixing the system" (see Bates, 2022). Efforts such as interventions to increase women's self-efficacy and belongingness could be interpreted as if there was something wrong with the women, that they need to be "fixed" in order to fit into STEM. That is not the intention of this thesis and the responsibility for fixing the gender imbalance should not fall onto the women themselves. Instead, we should be "fixing the system" by removing barriers for women to enter STEM and creating a STEM culture and workplaces that are welcoming to women and other underrepresented groups. Advocates for women and minorities in STEM have further argued that STEM companies must also focus on internal reforms and reevaluate inequitable hiring practices and unsupportive workplace cultures (Chou, 2013).

A big part of removing barriers is changing the existing stereotypes about who has STEM competence and who fits in STEM to not exclude women and other underrepresented groups. However, changing stereotypes in society is a long and difficult process, and while we see some progress, the negative effects of the engrained stereotypes will take time to change. So, in order to create meaningful change now, we should work on both fronts and simultaneously find ways to increase interest for young women today, for which interventions are a promising method.

Strengths and Limitations

Strengths

Few existing regular interventions are empirically evaluated (Prieto-Rodriguez et al., 2020; Shoffner & Dockery, 2015). One strength of Study I is that it empirically evaluates the effectiveness of one such intervention, compares the effects against a control group, and includes both a baseline and a three-month follow-up measure, which is rare in intervention studies (Valla & Williams, 2012). This aspect of the study design is also a strength of Study IIb, which tests two novel interventions and furthermore includes both a baseline measure and a control group. Another strength of the studies in this thesis are the comparatively large samples with repeated measures from over 700 participants in Study I and II and over 400 participants in Study III.

Limitations

The natural science student samples in Study I and II have limited generalizability because the students presumably have a higher baseline interest in science than students in other educational tracks. But while not being representative for the whole population of Swedish high school students, they are a useful target group for studying STEM interest and interventions, because those students are most likely to benefit from such interventions and being encouraged to continue into STEM for higher education. Importantly, the goal of interventions is not to push young women with no interest into STEM careers but to increase interest for those who might benefit from it, but are discouraged by barriers related to gender stereotypes.

In Study I, allocation to the conditions was quasi-experimental. Participation in the study was based on taking part in the course “Tänk H_2O!”, and which classes were awarded scholarships to take part in the course was based on their teacher’s application. Therefore, I could not randomize classes to conditions. Since teachers’ interest in the topic was a non-random variable (those with the best applications received the scholarships) there could be systematic differences between participating classes and control group classes due to the teaching they received before their visit to the course. To minimize this, I chose classes as the control group that had applied to the course but had not received the scholarship (which were most similar in teacher interest and also had topics related to water on their curriculum) or other classes from the same schools, in order to make them as similar as possible in other ways. In Study II, participants were randomized to each condition on class level.

The length of the surveys in all three studies was guided to a high degree by anticipations about the students' motivation, especially because the studies were conducted as repeated measures. Therefore, it was a conscious decision to make the surveys as short as possible (e.g. having 1-item measures of goal affordance and subject interest in Study III) in order to avoid attrition due to lack of motivation and fatigue.

Lastly, the data collection for Study III was conducted during the Covid-19 pandemic. Because of that, data collection had to be postponed or discontinued several times.

Practical Challenges of Applied Research in Schools

Because I recruited whole classes to take part in the studies, participants did not choose to take part in the study themselves, but the teachers decided that their class would participate. I emphasized during data collection that participation was voluntary, and students could choose not to take part, but this setting might have affected participants' motivation, compared to participants who would have made the decision to participate on their own, without e.g. social encouragement by their peers or teachers. This could have affected the results. On the other hand, this fact might make the results more realistic and increase ecological validity, because this makes the intervention setting closer to real life situations in which students could encounter similar interventions, which might also be administered at class level and not based on individual choice to participate. The effects of the interventions were small, but therefore I believe that as a real-life intervention for young people who take part on their own initiative, the effects might be even stronger.

Another problem with the data collection was a high degree of (random) attrition. Since I collected data in schools during class time, students who were missing from class that day for unrelated reasons could not take part in the data collection for that time point. There has been some non-random attrition related to the study, where students who were present decided not to take part or did not complete one or more of the surveys, but most of the missing data cases came from students who happened to miss class at the time of data collection. Since this reason for missing the data collection was unrelated to the study, any effects on the results should be negligible.

Ethical Considerations

One ethical consideration with intervention studies is that they by nature intend to have a psychological impact on participants. Therefore, it is important that this impact is beneficial and does not harm participants. In Study II, I made sure that the information that was delivered in the role model video was positive and true, and that the feedback on the engineering quiz was positive (maybe exaggerated, but not misleading), to avoid the risk of any negative effects on self-efficacy for participants who scored low on the quiz. In general, these interventions did not consist of more manipulation or impact than what teenagers are exposed to in other contexts where they actively seek out or are presented with information about potential careers, such as in class, at career fairs or from study guidance counsellors.

Taking a step back, there is a larger ethical dilemma to consider: With the numbers of women in some STEM fields still being low, and stereotypes being common among society and potential colleagues and superiors, there is a risk that we are telling women that STEM is a good fit for them and that they will fit in socially, but this might end up not being the case for some of them. Either because they don't enjoy being the only woman in the room or because they end up in a context where they experience a non-welcoming climate and are stereotyped negatively. Are we sending women to serve as guinea pigs, to pave the way for creating a more gender balanced and welcoming environment for future women, but at the expense of their own happiness? I sincerely hope that is not the case. I would argue that interventions and encouragement can only do so much, and women need to have a wider array of other positive experiences related to STEM for them to choose a STEM path. In other words, interventions alone do not manipulate someone into entering a field they would otherwise not consider at all. We can and absolutely should not convince women to enter STEM who do not want to. But for those who are on the fence, or who are thriving in mathematics and biology classes but have not considered continuing further in STEM, e.g. due to stereotypes, these interventions might be helpful. The goal of interventions should be to remove barriers for women, to allow them to make free and more informed career choices that would fit them as individuals.

Directions for Future Research

Future research should investigate how to improve the interventions presented in this thesis for practical use. The interventions showed some promising effects but produced mixed findings regarding the effectiveness of the video intervention. Generally, most of the effects were rather small. The quiz and video interventions can provide a starting point, but future research should look into improving them to create larger and more practically impactful effects. This includes tailoring them better to their target audience and ensuring that they convey the intended messages, as well as working on filmmaking aspects to make the role model video more engaging for viewers. Another suggestion for future studies is to add qualitative studies (e.g. focus groups with participants) to get a more in-depth picture of the experiences of the young women taking part in the interventions, in order to find out more about what aspects of the intervention affected them in what way.

Study III tested a new environmental goals scale. This was meant as a proof of concept if such a factor and scale can be useful, but future research should work on building and validating a proper environmental goals scale and testing it in different contexts.

Further research should also investigate what effects of STEM interventions look like at different intersections of social groups. For example, large parts of young people in Sweden have a foreign background, meaning that they were either born abroad or that both of their parents were born abroad (Statistics Sweden, 2002). Study III showed signs that there were differences in STEM interest between participants with a foreign background and those with a Swedish background, but our measure was not detailed enough to draw meaningful conclusions from this. However, since Tellhed and colleagues also found some evidence that girls with a foreign background might have less implicit gender stereotypes and higher self-efficacy than girls with a Swedish background (Tellhed et al., 2022; 2023), this indicates that there could be relevant patterns of intersectional effects. This is an interesting result to investigate further, because it could mean that young people with a foreign background in Sweden are potentially a particularly reachable target group to recruit into STEM.

Furthermore, Study II found that women from more competitive schools with higher admission grade point average (GPA) identified more with the role models and had higher belongingness and interest compared to women at schools with lower average GPA. This is especially relevant for studies with role models, because how relatable the role models are to the target audience can impact their effectiveness. Therefore, presenting a diverse group of role models is important. It is also interesting to what extent results from role model studies are generalizable to other contexts. Further research should therefore investigate how to tailor role models to a diverse audience.

Lastly, longitudinal studies would provide many valuable benefits. They can test causal relationships and mediation effects, and follow the development of effects over time – both to see how long potential immediate effects of interventions last, but also because the impact of interventions might take time to take effect and only appear later (for example in specific contexts where the experiences from the intervention become relevant), which short-term studies might not be able to capture.

Conclusions

Despite many years of research and initiatives to raise women's interest, progress on increasing the proportion of women in STEM is still slow. Meeting the needs of the labor market, improving product quality through more diverse teams, and working towards gender equality are some of the reasons why increasing women's participation in STEM is an important goal and why we need to create effective interventions to increase women's interest in STEM.

The studies in this thesis provide findings from a Swedish context to support previous research on gender differences in STEM interest and its predictors. The three studies with Swedish high school and primary school students found that self-efficacy and belongingness (and to a lesser extent communal and environmental goal endorsement) are significant predictors of young women's STEM interest, and gender differences in these variables partly explain the gender differences in young people's STEM interest. Therefore, these factors contribute to the underrepresentation of women in STEM fields.

Furthermore, through evaluating an existing industry intervention and designing and testing two novel short interventions, the studies found that brief interventions can increase young women's self-efficacy, belongingness and interest in engineering, with some effects on self-efficacy still being significant three months later. However, despite affecting the predictors of engineering interest, affecting young women's engineering interest is difficult. This points to the importance of tailoring interventions specifically to the intended goals and the target group, in order to increase their effectiveness. The findings from these studies can be useful for similar interventions as well as for school staff such as study guidance counselors who aim to increase young people's interest in STEM careers.

However, it is important to note that interventions aimed at increasing the interest of individual women should not be the only solution towards achieving gender balance in STEM. A more effective way forward is to simultaneously work on "fixing the system" and dismantling harmful stereotypes in society in order to make STEM a welcoming and inclusive place for people of all genders and other currently underrepresented groups.

References

Abele, A. E., Hauke, N., Peters, K., Louvet, E., Szymkow, A., & Duan, Y. (2016). Facets of the fundamental content dimensions: Agency with competence and assertiveness - Communion with warmth and morality. *Frontiers in psychology*, *7*, 1810. https://doi.org/10.3389/fpsyg.2016.01810

Adolfsson, C. (2024). 'It feels made up': Post racialism and colorblind ideology within individual constructions of self identity. *Ethnicities*, *24*(6), 899–919. https://doi.org/10.1177/14687968231191751

Alzaabi, I., Ramírez-García, A., & Moyano, M. (2021). Gendered STEM: A Systematic Review and Applied Analysis of Female Participation in STEM in the United Arab Emirates. *Education Sciences*, *11*(10), 573. https://doi.org/10.3390/educsci11100573

Andrews, M. E., Borrego, M., & Boklage, A. (2021). Self-efficacy and belonging: the impact of a university makerspace. *International Journal of STEM Education*, *8*(1), 24. https://doi.org/10.1186/s40594-021-00285-0

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. https://doi.org/10.1037/0033-295x.84.2.191

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. Freeman

Barth, J. M., & Masters, S. (2020). Changes in Math and Science Interest over School Transitions: Relations to Classroom Quality, Gender Stereotypes, and Efficacy. *International Journal of Gender, Science & Technology*, *12*(1). https://genderandset.open.ac.uk/index.php/genderandset/article/view/658

Bates, L. (2022). *Fix the system, not the women*. Simon and Schuster.

Batz-Barbarich, C., Strah, N., & Tay, L. (2024). The impact of changing engineering perceptions on women's attitudes and behavioral intentions towards engineering pursuits. *International Journal of STEM Education*, *11*(1), 23. https://doi.org/10.1186/s40594-024-00476-5

Baumeister, R. F., & Leary, M. R. (1995). The Need to Belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation. *Psychological Bulletin*, *117*(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Belanger, A. L., Diekman, A. B., & Steinberg, M. (2017). Leveraging communal experiences in the curriculum: Increasing interest in pursuing engineering by changing stereotypic expectations. *Journal of Applied Social Psychology*, *47*(6), 305–319. https://doi.org/10.1111/jasp.12438

Bench, S. W., Lench, H. C., Liew, J., Miner, K., & Flores, S. A. (2015). Gender Gaps in Overestimation of Math Performance. *Sex Roles*, *72*(11–12), 536–546. https://doi.org/10.1007/s11199-015-0486-9

Betz, D. E., & Sekaquaptewa, D. (2012). My Fair Physicist? Feminine Math and Science Role Models Demotivate Young Girls. *Social Psychological and Personality Science*, *3*(6), 738–746. https://doi.org/10.1177/1948550612440735

Betz, N. E., & Schifano, R. S. (2000). Evaluation of an intervention to increase realistic self-efficacy and interests in college women. *Journal of Vocational Behavior*, *56*(1), 35-52. https://doi.org/10.1006/jvbe.1999.1690

Bian, L., Leslie, S.-J., & Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science*, *355*(6323), 389–391. https://doi.org/10.1126/science.aah6524

Björklund, F., Giese, L., & Tellhed, U. (2023). *Pedagogisk verksamhet - ett verktyg för framtida kompetensförsörjning?* (09 uppl.) Svenskt Vatten Utveckling SVU. https://vattenbokhandeln.svensktvatten.se/wp-content/uploads/2023/11/svu-rapport-2023-09.pdf

Block, K., Croft, A., & Schmader, T. (2018). Worth Less?: Why Men (and Women) Devalue Care-Oriented Careers. *Frontiers in Psychology*, *9*, 1353. https://doi.org/10.3389/fpsyg.2018.01353

Block, K., Hall, W. M., Schmader, T., Inness, M., & Croft, E. (2018). Should I Stay or Should I Go? *Social Psychology*, *49*(4), 243–251. https://doi.org/10.1027/1864-9335/a000343

Boeve-de Pauw, J., Ardies, J., Hens, K., Wullemen, A., Van de Vyver, Y., Rydant, T., De Spiegeleer, L. & Verbraeken, H. (2022). Short and long term impact of a high-tech STEM intervention on pupils' attitudes towards technology. *International Journal of Technology and Design Education*, *32*(2), 825-843. https://doi.org/10.1007/s10798-020-09627-5

Breda, T., Jouini, E., Napp, C., & Thebault, G. (2020). Gender stereotypes can explain the gender-equality paradox. *Proceedings of the National Academy of Sciences*, *117*(49), 31063–31069. https://doi.org/10.1073/pnas.2008704117

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching*, *43*(5), 485–499. https://doi.org/10.1002/tea.20131

Brough, A. R., Wilkie, J. E. B., Ma, J., Isaac, M. S., & Gal, D. (2016). Is Eco-Friendly Unmanly? The Green-Feminine Stereotype and Its Effect on Sustainable Consumption. *Journal of Consumer Research*, *43*(4), 567–582. https://doi.org/10.1093/jcr/ucw044

Brown, E. R., Thoman, D. B., Smith, J. L., & Diekman, A. B. (2015). Closing the communal gap: The importance of communal affordances in science career motivation. *Journal of Applied Social Psychology*, *45*(12), 662–673. https://doi.org/10.1111/jasp.12327

Brown, S. D., Tramayne, S., Hoxha, D., Telander, K., Fan, X., & Lent, R. W. (2008). Social cognitive predictors of college students' academic performance and persistence: A meta-analytic path analysis. *Journal of Vocational Behavior*, *72*(3), 298–308. https://doi.org/10.1016/j.jvb.2007.09.003

Brown, S. W., Lawless, K. A., & Boyer, M. A. (2013). Promoting Positive Academic Dispositions Using a Web-based PBL Environment: The GlobalEd 2 Project. *Interdisciplinary Journal of Problem-Based Learning*, *7*(1). https://doi.org/10.7771/1541-5015.1389

Butz, A. R., & Usher, E. L. (2015). Salient sources of early adolescents' self-efficacy in two domains. *Contemporary Educational Psychology*, *42*, 49–61. https://doi.org/10.1016/j.cedpsych.2015.04.001

Cadaret, M. C., Hartung, P. J., Subich, L. M., & Weigold, I. K. (2017). Stereotype threat as a barrier to women entering engineering careers. *Journal of Vocational Behavior*, *99*, 40–51. https://doi.org/10.1016/j.jvb.2016.12.002

Cannady, M. A., Greenwald, E., & Harris, K. N. (2014). Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving Our Students and the STEM Workforce? *Science Education*, *98*(3), 443–460. https://doi.org/10.1002/sce.21108

Casad, B. J., Franks, J. E., Garasky, C. E., Kittleman, M. M., Roesler, A. C., Hall, D. Y., & Petzel, Z. W. (2021). Gender inequality in academia: Problems and solutions for women faculty in STEM. *Journal of Neuroscience Research*, *99*(1), 13–23. https://doi.org/10.1002/jnr.24631

Casad, B. J., Hale, P., & Wachs, F. L. (2017). Stereotype threat among girls: Differences by gender identity and math education context. *Psychology of Women Quarterly, 41,* 513-529. https://doi.org/10.1177/0361684317711412

Casad, B. J., Oyler, D. L., Sullivan, E. T., McClellan, E. M., Tierney, D. N., Anderson, D. A., Greeley, P. A., Fague, M. A., & Flammang, B. J. (2018). Wise psychological interventions to improve gender and racial equality in STEM. *Group Processes & Intergroup Relations*, *21*(5), 767–787. https://doi.org/10.1177/1368430218767034

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's Underrepresentation in Science: Sociocultural and Biological Considerations. *Psychological Bulletin*, *135*(2), 218–261. https://doi.org/10.1037/a0014412

Cedefop (2016). *Skill Shortage and Surplus Occupations in Europe.* http://www.cedefop.europa.eu/files/9115_en.pdf

Cheryan, S., Master, A., & Meltzoff, A. N. (2015). Cultural stereotypes as gatekeepers: increasing girls' interest in computer science and engineering by diversifying stereotypes. *Frontiers in Psychology*, *6*, 49. https://doi.org/10.3389/fpsyg.2015.00049

Cheryan, S., & Plaut, V. C. (2010). Explaining Underrepresentation: A Theory of Precluded Interest. *Sex Roles*, *63*(7–8), 475–488. https://doi.org/10.1007/s11199-010-9835-x

Cheryan, S., Plaut, V. C., Handron, C., & Hudson, L. (2013). The Stereotypical Computer Scientist: Gendered Media Representations as a Barrier to Inclusion for Women. *Sex Roles*, *69*(1–2), 58–71. https://doi.org/10.1007/s11199-013-0296-x

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why Are Some STEM Fields More Gender Balanced Than Others? *Psychological Bulletin*, *143*(1), 1–35. https://doi.org/10.1037/bul0000052

Chou, T. (2013, October 11). Where are the numbers? *Medium.* https://medium.com/@triketora/where-are-the-numbers-cb997a57252

Clark, E. K., Fuesting, M. A., & Diekman, A. B. (2016). Enhancing interest in science: exemplars as cues to communal affordances of science. *Journal of Applied Social Psychology*, *46*(11), 641–654. https://doi.org/10.1111/jasp.12392

Cole, E. R. (2009). Intersectionality and research in psychology. *American Psychologist*, *64*(3), 170–180. https://doi.org/10.1037/a0014564

Criado Perez, C. (2019). *Invisible Women: Exposing Data Bias in a World Designed for Men*. Penguin Random House

Croft, A., Schmader, T., & Block, K. (2015). An Underexamined Inequality. *Personality and Social Psychology Review*, *19*(4), 343–370. https://doi.org/10.1177/1088868314564789

Cvencek, D., Meltzoff, A. N., & Greenwald, A. G. (2011). Math–Gender Stereotypes in Elementary School Children. *Child Development*, *82*(3), 766–779. https://doi.org/10.1111/j.1467-8624.2010.01529.x

Dasgupta, N. (2011). Ingroup Experts and Peers as Social Vaccines Who Inoculate the Self-Concept: The Stereotype Inoculation Model. *Psychological Inquiry*, *22*(4), 231–246. https://doi.org/10.1080/1047840x.2011.607313

De Gioannis, E., Pasin, G. L., & Squazzoni, F. (2023). Empowering women in STEM: a scoping review of interventions with role models. *International Journal of Science Education, Part B*, *13*(3), 261–275. https://doi.org/10.1080/21548455.2022.2162832

Dennehy, T. C., & Dasgupta, N. (2017). Female peer mentors early in college increase women's positive academic experiences and retention in engineering. *Proceedings of the National Academy of Sciences*, *114*(23), 5964–5969. https://doi.org/10.1073/pnas.1613117114

Dickson, M., & Alharthi, M. (2025). "What do I wish I had known? Don't expect the road to be full of flowers": Advice from female STEM leaders in the GCC countries to younger women working in STEM fields. *Social Sciences & Humanities Open*, *11*, 101502. https://doi.org/10.1016/j.ssaho.2025.101502

Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking Congruity Between Goals and Roles. *Psychological Science*, *21*(8), 1051–1057. https://doi.org/10.1177/0956797610377342

Diekman, A. B., Clark, E. K., Johnston, A. M., Brown, E. R., & Steinberg, M. (2011). Malleability in Communal Goals and Beliefs Influences Attraction to STEM Careers: Evidence for a Goal Congruity Perspective. *Journal of Personality and Social Psychology*, *101*(5), 902–918. https://doi.org/10.1037/a0025199

Diekman, A. B., Steinberg, M., Brown, E. R., Belanger, A. L., & Clark, E. K. (2017). A Goal Congruity Model of Role Entry, Engagement, and Exit: Understanding Communal Goal Processes in STEM Gender Gaps. *Personality and Social Psychology Review*, *21*(2), 142–175. https://doi.org/10.1177/1088868316642141

Diekman, A. B., Weisgram, E. S., & Belanger, A. L. (2015). New Routes to Recruiting and Retaining Women in STEM: Policy Implications of a Communal Goal Congruity Perspective. *Social Issues and Policy Review*, *9*(1), 52–88. https://doi.org/10.1111/sipr.12010

Dweck, C. (2000). *Self-theories: Their role in motivation, personality, and development.* Psychology Press.

Dweck, C. (2006). *Mindset: The new psychology of success.* Random House

Eagly, A. H., Wood, W., & Diekman, A. B. (2000). Social role theory of sex differences and similarities: A current appraisal. In T. Eckes & H. M. Trautner (Eds.), *The developmental social psychology of gender* (pp. 123–174). Erlbaum.

Eccles, J. S. (1987). Gender Roles and women's achievement-related decisions. *Psychology of Women Quarterly*, *11*(2), 135-172. https://doi.org/10.1111/j.1471-6402.1987.tb00781.x

Eccles, J. S. (1994). Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of women quarterly*, *4*(18), 585–609. https://doi.org/10.1111/j.1471-6402.1994.tb01049.x

Eccles, J. S. (2011). Gendered educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *International Journal of Behavioral Development*, *35*(3), 195–201. https://doi.org/10.1177/0165025411398185

Eccles, J. S., & Wang, M.-T. (2016). What motivates females and males to pursue careers in mathematics and science? *International Journal of Behavioral Development*, *40*(2), 100–106. https://doi.org/10.1177/0165025415616201

Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology*, *61*, 101859. https://doi.org/10.1016/j.cedpsych.2020.101859

Echavarren, J. M. (2023). The Gender Gap in Environmental Concern: Support for an Ecofeminist Perspective and the Role of Gender Egalitarian Attitudes. *Sex Roles*, *89*(9–10), 610–623. https://doi.org/10.1007/s11199-023-01397-3

Ehrlinger, J., Plant, E. A., Hartwig, M. K., Vossen, J. J., Columb, C. J., & Brewer, L. E. (2018). Do Gender Differences in Perceived Prototypical Computer Scientists and Engineers Contribute to Gender Gaps in Computer Science and Engineering? *Sex Roles*, *78*(1–2), 40–51. https://doi.org/10.1007/s11199-017-0763-x

Ertl, B., Luttenberger, S., & Paechter, M. (2017). The impact of gender stereotypes on the self-concept of female students in STEM subjects with an under-representation of females. *Frontiers in Psychology*, *8*, 703. https://doi.org/10.3389/fpsyg.2017.00703

European Commission (2021). *2021 Report on gender equality in the EU*. https://data.europa.eu/doi/10.2838/57887

European Commission: Directorate-General for Research and Innovation (2022). *Bridging the gender gap in STEM: strengthening opportunities for women in research and innovation*. Publications Office of the European Union. https://data.europa.eu/doi/10.2777/774922.

European Institute for Gender Equality (EIGE) (2017). *Economic benefits of gender equality in the EU: How gender equality in STEM education leads to economic growth*. https://eige.europa.eu/sites/default/files/documents/2017.2082_mh0217177enn_pdfweb_20170803123353.pdf

European Institute for Gender Equality (EIGE) (2023). *Gender Equality Index*. Retrieved September 19, 2024.https://eige.europa.eu/gender-equality-index/2023/country/SE

European Institute for Gender Equality (EIGE) (2024, February 09). *From STEM to Sustainability: Empowering Women and Girls in Science*. https://eige.europa.eu/newsroom/news/stem-sustainability-empowering-women-and-girls-science?language_content_entity=en

Fourgassie, L., Subra, B., & Sanitioso, R. B. (2025). Revisiting the concept of stereotype threat(s): Is it all about the situation? *Psychological Review, 132*(4), 1002–1013. https://doi.org/10.1037/rev0000555

Gartzia, L. (2022). Self and other reported workplace traits: A communal gap of men across occupations. *Journal of Applied Social Psychology*, *52*(8), 568–587. https://doi.org/10.1111/jasp.12848

Gladstone, J. R., & Cimpian, A. (2021). Which role models are effective for which students? A systematic review and four recommendations for maximizing the effectiveness of role models in STEM. *International Journal of STEM Education*, *8*(1), 59. https://doi.org/10.1186/s40594-021-00315-x

Gladstone, J. R., Tallberg, M., Jaxon, J., & Cimpian, A. (2024). What makes a role model motivating for young girls? The effects of the role model's growth versus fixed mindsets about ability and interest. *Journal of Experimental Child Psychology*, *238*, 105775. https://doi.org/10.1016/j.jecp.2023.105775

Good, C., Rattan, A., & Dweck, C. S. (2012). Why Do Women Opt Out? Sense of Belonging and Women's Representation in Mathematics. *Journal of Personality and Social Psychology*, *102*(4), 700–717. https://doi.org/10.1037/a0026659

Gustafsson Sendén, M., Klysing, A., Lindqvist, A., & Renström, E. A. (2019). The (Not So) Changing Man: Dynamic Gender Stereotypes in Sweden. *Frontiers in Psychology*, *10*, 37. https://doi.org/10.3389/fpsyg.2019.00037

Hackett, G. (1995). Self-efficacy in career choice and development. In: A. Bandura (Ed.), *Self-efficacy in Changing Societies* (pp. 232–258). https://doi.org/10.1017/cbo9780511527692.010

Hazari, Z., Sonnert, G., Sadler, P. M., & Shanahan, M. (2010). Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *Journal of Research in Science Teaching*, *47*(8), 978–1003. https://doi.org/10.1002/tea.20363

Heilman, M. E., & Blader, S. L. (2001). Assuming Preferential Selection When the Admissions Policy Is Unknown: The Effects of Gender Rarity. *Journal of Applied Psychology*, *86*(2), 188–193. https://doi.org/10.1037/0021-9010.86.2.188

Hentschel, T., Heilman, M. E., & Peus, C. V. (2019). The Multiple Dimensions of Gender Stereotypes: A Current Look at Men's and Women's Characterizations of Others and Themselves. *Frontiers in Psychology*, *10*, 11. https://doi.org/10.3389/fpsyg.2019.00011

Hier, B. O., & Mahony, K. E. (2018). The Contribution of Mastery Experiences, Performance Feedback, and Task Effort to Elementary-Aged Students' Self-Efficacy in Writing. *School Psychology Quarterly*, *33*(3), 408–418. https://doi.org/10.1037/spq0000226

Higher Education Statistics Agency. (2024). *What do HE Students Study?* https://www.hesa.ac.uk/data-and-analysis/students/what-study

Holmegaard, H. T., Madsen, L. M., & Ulriksen, L. (2014). To Choose or Not to Choose Science: Constructions of desirable identities among young people considering a STEM higher education programme. *International Journal of Science Education*, *36*(2), 186–215. https://doi.org/10.1080/09500693.2012.749362

Holmes, S., Redmond, A., Thomas, J., & High, K. (2012). Girls Helping Girls: Assessing the Influence of College Student Mentors in an Afterschool Engineering Program. *Mentoring & Tutoring: Partnership in Learning*, *20*(1), 137–150. https://doi.org/10.1080/13611267.2012.645604

Hughes, R. M., Nzekwe, B., & Molyneaux, K. J. (2013). The Single Sex Debate for Girls in Science: a Comparison Between Two Informal Science Programs on Middle School Students' STEM Identity Formation. *Research in Science Education*, *43*(5), 1979–2007. https://doi.org/10.1007/s11165-012-9345-7

Hyde, J. S., Bigler, R. S., Joel, D., Tate, C. C., & van Anders, S. M. (2019). The Future of Sex and Gender in Psychology: Five Challenges to the Gender Binary. *American Psychologist*, *74*(2), 171–193. https://doi.org/10.1037/amp0000307

Jones, B. D., Ruff, C., & Paretti, M. C. (2013). The impact of engineering identification and stereotypes on undergraduate women's achievement and persistence in engineering. *Social Psychology of Education*, *16*(3), 471–493. https://doi.org/10.1007/s11218-013-9222-x

Kanter, R. M. (1977). Some Effects of Proportions on Group Life: Skewed Sex Ratios and Responses to Token Women. *American Journal of Sociology*, *82*(5), 965–990. https://doi.org/10.1086/226425

Kramer, A., Dringenberg, E., Morris, C., & McCarthy, D. (2023). An Intervention to Promote Growth Mindset and STEM Self-Efficacy of High School Students: Exploring the Complexity of Beliefs. *Journal of Pre-College Engineering Education Research (J-PEER), 13*(1), Article 1. https://doi.org/10.7771/2157-9288.1355

Lawner, E. K., Quinn, D. M., Camacho, G., Johnson, B. T., & Pan-Weisz, B. (2019). Ingroup role models and underrepresented students' performance and interest in STEM: A meta-analysis of lab and field studies. *Social Psychology of Education*, *22*(5), 1169–1195. https://doi.org/10.1007/s11218-019-09518-1

Lee, H. R., Rutherford, T., Hanselman, P., Rodriguez, F., Ramirez, K. F., & Eccles, J. S. (2024). Role Models in Action Through YouTube Videos for Engineering Community College Students. *Research in Higher Education*, 1–33. https://doi.org/10.1007/s11162-023-09772-5

Lent, R. W., & Brown, S. D. (2019). Social cognitive career theory at 25: Empirical status of the interest, choice, and performance models. *Journal of Vocational Behavior*, *115*, 103316. https://doi.org/10.1016/j.jvb.2019.06.004

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance. *Journal of Vocational Behavior*, *45*, 79–122. https://doi.org/10.1006/jvbe.1994.1027

Leslie, S.-J., Cimpian, A., Meyer, M., & Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science*, *347*(6219), 262–265. https://doi.org/10.1126/science.1261375

Lin, G.-Y. (2016). Self-Efficacy Beliefs and Their Sources in Undergraduate Computing Disciplines. *Journal of Educational Computing Research*, *53*(4), 540–561. https://doi.org/10.1177/0735633115608440

Lindberg, S. M., Hyde, J. S., Petersen, J. L., & Linn, M. C. (2010). New Trends in Gender and Mathematics Performance: A Meta-Analysis. *Psychological Bulletin*, *136*(6), 1123–1135. https://doi.org/10.1037/a0021276

Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the Fridge: Sources of early interest in science. *International Journal of Science Education*, *32*(5), 669–685. https://doi.org/10.1080/09500690902792385

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education*, *95*(5), 877–907. https://doi.org/10.1002/sce.20441

Master, A., Cheryan, S., Moscatelli, A., & Meltzoff, A. N. (2017). Programming experience promotes higher STEM motivation among first-grade girls. *Journal of Experimental Child Psychology*, *160*, 92–106. https://doi.org/10.1016/j.jecp.2017.03.013

Master, A., & Meltzoff, A. N. (2020). Cultural Stereotypes and Sense of Belonging Contribute to Gender Gaps in STEM. *International Journal of Gender, Science and Technology*, *12*(1), 152–198. http://genderandset.open.ac.uk/index.php/genderandset/article/view/674/1124

McKinsey (2022). *Women in the Workplace 2022*. https://wiw-report.s3.amazonaws.com/Women_in_the_Workplace_2022.pdf

Microsoft Corporation (2017). *Why Europe's girls aren't studying STEM*. Microsoft Philanthropies. https://news.microsoft.com/wp-content/uploads/2017/02/Microsoft_girls_in_STEM_final-Whitepaper.pdf

Miller, D. I., Eagly, A. H., & Linn, M. C. (2015). Women's Representation in Science Predicts National Gender-Science Stereotypes: Evidence From 66 Nations. *Journal of Educational Psychology*, *107*(3), 631–644. https://doi.org/10.1037/edu0000005

Miller, D. I., Nolla, K. M., Eagly, A. H., & Uttal, D. H. (2018). The Development of Children's Gender-Science Stereotypes: A Meta-analysis of 5 Decades of U.S. Draw-A-Scientist Studies. *Child Development*, *89*(6), 1943–1955. https://doi.org/10.1111/cdev.13039

Moss-Racusin, C. A., Pietri, E. S., Hennes, E. P., Dovidio, J. F., Brescoll, V. L., Roussos, G., & Handelsman, J. (2018). Reducing STEM Gender Bias With VIDS (Video Interventions for Diversity in STEM). *Journal of Experimental Psychology: Applied*, *24*(2), 236–260. https://doi.org/10.1037/xap0000144

Nordic Council of Ministers. (2021). *Genusperspektiv på framtidens högteknologiska arbetsliv: En nordisk forskningsöversikt om utbildningsval inom STEM (Science, Technology, Engineering and Mathematics). [A Gender Perspective on the High-Tech Work Life of the Future: A Nordic Literature Review of Educational Choice of STEM]*. https://www.norden.org/en/node/59898

O'Brien, L. T., Blodorn, A., Adams, G., Garcia, D. M., & Hammer, E. (2015). Ethnic variation in gender-STEM stereotypes and STEM participation: An intersectional approach. *Cultural Diversity & Ethnic Minority Psychology*, *21*(2), 169–180. https://doi.org/10.1037/a0037944

Olsson, D., & Gericke, N. (2017). The effect of gender on students' sustainability consciousness: A nationwide Swedish study. *The Journal of Environmental Education*, *48*(5), 357–370. https://doi.org/10.1080/00958964.2017.1310083

Olsson, M., & Martiny, S. E. (2018). Does exposure to counterstereotypical role models influence girls' and women's gender stereotypes and career choices? A review of social psychological research. *Frontiers in psychology*, *9*, 2264. https://doi.org/10.3389/fpsyg.2018.02264

Park, L. E., O'Brien, C., Italiano, A., Ward, D. E., & Panlilio, Z. (2023). "That's a great question!" instructors' positive responses to students' questions improve STEM-related outcomes. *Self and Identity*, *22*(6), 849–895. https://doi.org/10.1080/15298868.2023.2207836

Parks-Stamm, E. J., Heilman, M. E., & Hearns, K. A. (2008). Motivated to Penalize: Women's Strategic Rejection of Successful Women. *Personality and Social Psychology Bulletin*, *34*(2), 237–247. https://doi.org/10.1177/0146167207310027

Pew Research Center (2021, April 1). *STEM Jobs See Uneven Progress in Increasing Gender, Racial and Ethnic Diversity*. https://www.pewresearch.org/science/2021/04/01/stem-jobs-see-uneven-progress-in-increasing-gender-racial-and-ethnic-diversity/

Phan, H. P., & Ngu, B. H. (2016). Sources of Self-Efficacy in Academic Contexts: A Longitudinal Perspective. *School Psychology Quarterly*, *31*(4), 548–564. https://doi.org/10.1037/spq0000151

Pietri, E. S., Johnson, I. R., Majid, S., & Chu, C. (2021). Seeing What's Possible: Videos are more Effective than Written Portrayals for Enhancing the Relatability of Scientists and Promoting Black Female Students' Interest in STEM. *Sex Roles*, *84*(1–2), 14–33. https://doi.org/10.1007/s11199-020-01153-x

Prieto-Rodriguez, E., Sincock, K., & Blackmore, K. (2020). STEM initiatives matter: results from a systematic review of secondary school interventions for girls. *International Journal of Science Education*, *42*(7), 1144–1161. https://doi.org/10.1080/09500693.2020.1749909

Rainey, K., Dancy, M., Mickelson, R., Stearns, E., & Moller, S. (2018). Race and gender differences in how sense of belonging influences decisions to major in STEM. *International Journal of STEM Education*, *5*(1), 10. https://doi.org/10.1186/s40594-018-0115-6

Ramsey, L. R., Betz, D. E., & Sekaquaptewa, D. (2013). The effects of an academic environment intervention on science identification among women in STEM. *Social Psychology of Education*, *16*(3), 377–397. https://doi.org/10.1007/s11218-013-9218-6

Robnett, R. D., & Thoman, S. E. (2017). STEM success expectancies and achievement among women in STEM majors. *Journal of Applied Developmental Psychology*, *52*, 91-100. https://doi.org/10.1016/j.appdev.2017.07.003

Royal Swedish Academy of Engineering Sciences (2019). *Teknisk obalans? Kvinnor och män i teknik. [Technical imbalance? Women and men in technology].* https://www.iva.se/publicerat/rapport-teknisk-obalans/

Rudman, L. A., & Phelan, J. E. (2010). The Effect of Priming Gender Roles on Women's Implicit Gender Beliefs and Career Aspirations. *Social Psychology*, *41*(3), 192–202. https://doi.org/10.1027/1864-9335/a000027

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education*, *96*(3), 411–427. https://doi.org/10.1002/sce.21007

Schunk, D. H. (1983). Developing children's self-efficacy and skills: The roles of social comparative information and goal setting. *Contemporary Educational Psychology, 8*, 76–86. https://doi.org/10.1016/0361-476X(83)90036-X

Schunk, D. H., & Ertmer, P. A. (2000). Self-regulation and academic learning: Self-efficacy enhancing interventions. In M. Boekaerts, P.R. Pintrich, & M. Zeidner (Eds) *Handbook of self-regulation* (pp. 631-649). Academic Press. https://doi.org/10.1016/b978-012109890-2/50048-2

Schunk, D. H., & Swartz, C. W. (1993). Goals and Progress Feedback: Effects on Self-Efficacy and Writing Achievement. *Contemporary Educational Psychology*, *18*(3), 337–354. https://doi.org/10.1006/ceps.1993.1024

Schuster, C., & Martiny, S. E. (2017). Not Feeling Good in STEM: Effects of Stereotype Activation and Anticipated Affect on Women's Career Aspirations. *Sex Roles*, *76*(1-2), 40–55. https://doi.org/10.1007/s11199-016-0665-3

Shapiro, J. R., & Williams, A. M. (2012). The Role of Stereotype Threats in Undermining Girls' and Women's Performance and Interest in STEM Fields. *Sex Roles*, *66*(3-4), 175–183. https://doi.org/10.1007/s11199-011-0051-0

Shin, J. E. L., Levy, S. R., & London, B. (2016). Effects of role model exposure on STEM and non-STEM student engagement. *Journal of Applied Social Psychology*, *46*(7), 410–427. https://doi.org/10.1111/jasp.12371

Shoffner, M. F., & Dockery, D. J. (2015). Promoting interest in and entry into science, technology, engineering, and mathematics careers. In: P. J. Hartung, M. L. Savickas, & W. B. Walsh (Eds.), *APA handbook of career intervention, Volume 2: Applications.* (pp. 125–137). American Psychological Association. https://doi.org/10.1037/14439-010

Skolverket [Swedish National Agency for Education] (2023). *Slutbetyg i grundskolan, våren 2023 [Final Grades in Primary School, Spring 2023]* https://www.skolverket.se/publikationsserier/beskrivande-statistik/2023/slutbetyg-i-grundskolan —varen-2023.

Skolverket [Swedish National Agency for Education] (2025a). *Tabell 5A: Elever på program redovisade efter typ av huvudman och kön läsåret 2024/25 [Table 5A: Students on programs reported by type of principal and gender in the 2024/25 academic year].* Retrieved March 31, 2025. https://www.skolverket.se/skolutveckling/statistik/sok-statistik-om-forskola-skola-ochvuxenutbildning?sok=SokC&verkform=Gymnasieskola&omrade=Skolor%20och%20elever&lasar=2024%2F25&run=1

Skolverket [Swedish National Agency for Education] (2025b). *Gymnasieprogrammen (Gy 11). [High school programs (Gy 11)]*. Retrieved August 01, 2025. https://www.skolverket.se/undervisning/gymnasieskolan/program-och-amnen-i-gymnasieskolan/gymnasieprogrammen-gy11

Spencer, S. J., Logel, C., & Davies, P. G. (2016). Stereotype Threat. *Annual Review of Psychology*, *67*(1), 1–23. https://doi.org/10.1146/annurev-psych-073115-103235

Statistics Sweden (2002). *Statistics on persons with foreign background: Guidelines and recommendations.* *h*ttps://www.scb.se/contentassets/60768c27d88c434a8036d1fdb595bf65/mis-2002-3.pdf

Statistics Sweden (2022). *Anställda 16-64 år i riket efter yrke, arbetsställets sektortillhörighet och kön [Employees Aged 16–64 in the Country by Occupation, Workplace Sector Affiliation and Gender]*. https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__AM__AM0208__AM0208E/YREG50BAS/.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, *52*(6), 613-629. https://doi.org/10.1037/0003-066X.52.6.613

Steele, C. M., & Aronson, J. (1995). Stereotype Threat and the Intellectual Test Performance of African Americans. *Journal of Personality and Social Psychology*, *69*(5), 797–811. https://doi.org/10.1037/0022-3514.69.5.797

Stevenson, K. T., Peterson, M. N., & Bondell, H. D. (2019). The influence of personal beliefs, friends, and family in building climate change concern among adolescents. *Environmental Education Research*, *25*(6), 832–845. https://doi.org/10.1080/13504622.2016.1177712

Stoet, G., & Geary, D. C. (2018). The Gender-Equality Paradox in Science, Technology, Engineering, and Mathematics Education. *Psychological Science*, *29*(4), 581–593. https://doi.org/10.1177/0956797617741719

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the Tide: Using Ingroup Experts to Inoculate Women's Self-Concept in Science, Technology, Engineering, and Mathematics (STEM). *Journal of Personality and Social Psychology*, *100*(2), 255–270. https://doi.org/10.1037/a0021385

Swedish Public Employment Service (2022, May 19). *Heta yrken 2026.[Hot professions 2026, Press Release]*. https://arbetsformedlingen.se/om-oss/press/pressmeddelanden?id=D9C0FC6A36143C62.

Swim, J. K., & Geiger, N. (2018). The gendered nature of stereotypes about climate change opinion groups. *Group Processes & Intergroup Relations*, *21*(3), 438–456. https://doi.org/10.1177/1368430217747406

Tellhed, U., & Adolfsson, C. (2018). Competence and confusion: How stereotype threat can make you a bad judge of your competence. *European Journal of Social Psychology*, *48*(2), O189–O197. https://doi.org/10.1002/ejsp.2307

Tellhed, U., Björklund, F., & Kallio Strand, K. (2022). Sure I can code (but do I want to?). Why boys' and girls' programming beliefs differ and the effects of mandatory programming education. *Computers in Human Behavior*, *135*, 107370. https://doi.org/10.1016/j.chb.2022.107370

Tellhed, U., Björklund, F., & Kallio Strand, K. (2023). Tech-Savvy Men and Caring Women: Middle School Students' Gender Stereotypes Predict Interest in Tech-Education. *Sex Roles*, *88*(7–8), 307–325. https://doi.org/10.1007/s11199-023-01353-1

Tellhed, U., Bäckström, M., & Björklund, F. (2017). Will I Fit in and Do Well? The Importance of Social Belongingness and Self-Efficacy for Explaining Gender Differences in Interest in STEM and HEED Majors. *Sex Roles*, *77*(1–2), 86–96. https://doi.org/10.1007/s11199-016-0694-y

Tellhed, U., Bäckström, M., & Björklund, F. (2018). The role of ability beliefs and agentic vs. communal career goals in adolescents' first educational choice. What explains the degree of gender-balance? *Journal of Vocational Behavior*, *104*, 1–13. https://doi.org/10.1016/j.jvb.2017.09.008

Torre, M. (2019). Women in Blue: Structural and Individual Determinants of Sex Segregation in Blue-Collar Occupations. *Gender & Society*, *33*(3), 410-438. https://doi.org/10.1177/0891243219830974

UAE Gender Balance Council (2024). https://www.gbc.gov.ae/

UNESCO (2022, February 11). *Jordanian Women Shine in Science.* https://www.unesco.org/en/articles/jordanian-women-shine-science

Ungdomsbarometern [The Youth Barometer] (2024a). *Det presumtiva ingenjörsstudentslandskapet [The Prospective Engineering Student Landscape]*. [Unpublished Report for Lund University Faculty of Engineering (LTH)].

Ungdomsbarometern [The Youth Barometer] (2024b). *Generationsrapporten 2024 [The Generation Report 2024].* https://www.ungdomsbarometern.se/rapportslapp-generationsrapporten-2024/

Unrau, N. J., Rueda, R., Son, E., Polanin, J. R., Lundeen, R. J., & Muraszewski, A. K. (2018). Can Reading Self-Efficacy Be Modified? A Meta-Analysis of the Impact of Interventions on Reading Self-Efficacy. *Review of Educational Research*, *88*(2), 167–204. https://doi.org/10.3102/0034654317743199

US Bureau of Labor Statistics (2024). *Labor Force Statistics from the Current Population Survey*. Retrieved April 09, 2025. https://www.bls.gov/cps/cpsaat11.htm

US Census Bureau (2023). *American Community Survey. Detailed Occupation for the Civilian Employed Female Population 16 Years and Over (Table B24116)*. Retrieved January 27, 2025. https://data.census.gov/table/ACSDT1Y2023.B24116?q=Fast&y=2023.

US Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP) (n.d.). *2014 and 2018 Technology and Engineering Literacy Assessment*. Retrieved January 13, 2021. https://www.nationsreportcard.gov/nqt/.

US Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP) (2018). *Highlights from the 2018 Assessment*. https://www.nationsreportcard.gov/tel_2018_highlights/

Usher, E. L., & Pajares, F. (2008). Sources of Self-Efficacy in School: Critical Review of the Literature and Future Directions. *Review of Educational Research*, *78*(4), 751–796. https://doi.org/10.3102/0034654308321456

Valla, J. M., & Williams, W. (2012). Increasing Achievement and Higher-Education Representation of Under-Represented Groups in Science, Technology, Engineering and Mathematics Fields: A Review of Current K-12 Intervention Programs. *Journal of Women and Minorities in Science and Engineering*, *18*(1), 21–53. https://doi.org/10.1615/jwomenminorscieneng.2012002908

Walton, G. M., & Cohen, G. L. (2007). A Question of Belonging: Race, Social Fit, and Achievement. *Journal of Personality and Social Psychology*, *92*(1), 82–96. https://doi.org/10.1037/0022-3514.92.1.82

Walton, G. M., Logel, C., Peach, J. M., Spencer, S. J., & Zanna, M. P. (2015). Two Brief Interventions to Mitigate a “Chilly Climate” Transform Women’s Experience, Relationships, and Achievement in Engineering. *Journal of Educational Psychology*, *107*(2), 468–485. https://doi.org/10.1037/a0037461

Wang, M.-T., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields. *Developmental Review*, *33*(4), 304–340. https://doi.org/10.1016/j.dr.2013.08.001

Watt, H. M. G. (2010). Gender and Occupational Choice. In: J. C. Chrisler & D. R. McCreary (Eds.), *Handbook of Gender Research in Psychology, Volume 2: Gender Research in Social and Applied Psychology* (pp. 379–400). https://doi.org/10.1007/978-1-4419-1467-5_16

Weisgram, E. S., Bigler, R. S., & Liben, L. S. (2010). Gender, values, and occupational interests among children, adolescents, and adults. *Child Development, 81*, 778 –796. https://doi.org/10.1111/j.1467-8624.2010.01433.x

Williams, C. M., & Subich, L. M. (2006). The gendered nature of career related learning experiences: A social cognitive career theory perspective. *Journal of Vocational Behavior*, *69*(2), 262–275. https://doi.org/10.1016/j.jvb.2006.02.007

Wynn, A. T., & Correll, S. J. (2017). Gendered Perceptions of Cultural and Skill Alignment in Technology Companies. *Social Sciences*, *6*(2), 45. https://doi.org/10.3390/socsci6020045

Zeldin, A. L., Britner, S. L., & Pajares, F. (2008). A comparative study of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *Journal of Research in Science Teaching*, *45*(9), 1036–1058. https://doi.org/10.1002/tea.20195

Zeldin, A. L., & Pajares, F. (2000). Against the Odds: Self-Efficacy Beliefs of Women in Mathematical, Scientific, and Technological Careers. *American Educational Research Journal*, *37*(1), 215–246. https://doi.org/10.2307/1163477

Zelezny, L. C., Chua, P., & Aldrich, C. (2000). New Ways of Thinking about Environmentalism: Elaborating on Gender Differences in Environmentalism. *Journal of Social Issues*, *56*(3), 443–457. https://doi.org/10.1111/0022-4537.00177

Ziegler, A., & Stoeger, H. (2008). Effects of Role Models from Films on Short-Term Ratings of Intent, Interest, and Self-Assessment of Ability by High School Youth: A Study of Gender-Stereotyped Academic Subjects. *Psychological Reports*, *102*(2), 509–531. https://doi.org/10.2466/pr0.102.2.509-531

Printed by Media-Tryck, Lund 2025 NORDIC SWAN ECOLABEL 3041 0903

LUND UNIVERSITY

Faculty of Social Sciences
Department of Psychology

ISBN 978-91-8104-581-9