The Pride and Joy of Engineering? The Identity Work of Male Working-Class Engineering Students

Anna T. Danielsson a, Allison J. Gonsalves b, Eva Silfver c and Maria Berge d

aDepartment of Education, Uppsala University, Uppsala, Sweden; bDepartment of Integrated Studies in Education, McGill University, Montreal, Canada; cDepartment of Education, Umeå University, Umeå, Sweden; dDepartment of Science and Mathematics Education, Umeå University, Umeå, Sweden

ABSTRACT
In this article, we explore the identity work done by four male, working-class students who participate in a Swedish mechanical engineering program, with a focus on their participation in project work. A focus on how individuals negotiate their participation in science and technology disciplines has proven to be a valuable way to study inclusion and exclusion in such disciplines. This is of particular relevance in engineering education where it is widely argued that change is needed in order to attract new groups of students and provide students with knowledge appropriate for the future society.

In this study we conceptualized identity as socially and discursively produced, and focus on tracing students’ identity trajectories. The empirical data consists of ethnographic field notes from lectures, video-recordings of project work, semi-structured interviews, and video-diaries recorded by the students. The findings show that even though all four students unproblematically associate with the ‘technicist’ masculinity of their chosen program it takes considerable work to incorporate the project work into their engineering trajectories. Further, ‘laddish’ masculinities re/produced in higher education in engineering also contribute to a ‘troubled’ identity trajectory for one of the interviewed students.

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Introduction
This article explores the identity work done by male, working-class students who participate in a Swedish mechanical engineering program. In doing so, it is situated within a growing field of research focused on identity issues within STEM (science, technology, engineering and mathematics). Examining how individuals negotiate their identification with STEM has proven to provide a valuable way to study inclusion and exclusion in the disciplines. However, in relation to engineering, this work has mostly concerned women and their negotiation of being the minority gender, in particular, how female engineers adopt and/or resist traditional gender roles. Research has documented the complex identity work women undertake to fit into engineering educations. For example, Holth has shown how women in Sweden typically take a longer and more winding road before starting...
to study engineering, whereas for many men it is a relatively straightforward choice. By shifting our focus to the ‘insiders’ – men who have chosen a male-dominated engineering education – we contribute knowledge about how engineering is made into such a straightforward choice for many men. But we also contribute a more nuanced understanding of how these students relate to their chosen program of study.

This research is situated in a time of change for engineering education. It is widely argued that engineering education needs to change to attract new groups of students and provide students with knowledge appropriate for the future society. The contemporary engineer needs to possess other skills in addition to those traditionally included in engineering education, for example, team-working skills. The new perceived demands on engineers are also manifested in pedagogical innovations within engineering education, for example, implementation of project-organized courses. However, such pedagogical innovations may not be beneficial in and of themselves; there is research indicating that women are excluded from full participation in engineering education teams. A study by Teknikföretagen, the Association of Swedish Engineering Industries, shows that ‘Most companies have a positive attitude to including elements in the educations that are not purely technical, as long as it does not happen at the expense of the technical education’. Further, a study of engineering education websites shows how traditional interpretations of engineering practice, focused on technical problem-solving and design, have a strong presence on many websites, although the websites also focus on ‘softer’ skills and sustainability.

The purpose of this article is to explore the identity work of four male working-class students enrolled in the engineering mechanics program. In doing so, the research questions are: (1) How do the students make sense of the engineering mechanics program in terms of educational content as well as the social aspects (e.g. extra-curricular activities) of the education? (2) How do the students negotiate their emerging engineering identities, particularly in relation to their enactment of categories of difference (such as gender, social class, and age)?

Situating the study

While much of the research on gender and identity in engineering contexts has focused on women, there is also a line of research focused on the relationship between men/masculinity and technology, in and beyond engineering. The culture of engineering has been described as one focused on technology and rationality, where these things are seen as more important than social skills and personal relationships. Wajcman argues that control of technology is at the core of hegemonic masculinity, and she distinguishes between two different technological masculinities: one based on mechanical skills and physical strength and one based on ‘the professionalized, calculative rationality of the technical specialist’. Drawing on Wajcman’s work, Mellström has shown that identification with technology across very different contexts is considered an important part of the performance of masculinity. Mellström also argues that, in Sweden, practical skills have traditionally been highly valued and are tightly interconnected with ‘being a man’, particularly in rural areas and among working-class men. In both the engineering contexts where he did ethnographic studies the engineers related the ability to take care of a wide range of practical problems to being recognized as a competent man. Similarly, McIlwee and Robinson have shown the importance of hands-on competence in order to be recognized
as an engineer, and found that male engineers were keen to demonstrate this competence, even in professional contexts where it was not demanded.\textsuperscript{14}

Faulkner discusses this technically focused narration of engineering in terms of a ‘nuts and bolts’ identity, and argues that it resonates with a ‘working class “muscular masculinity” involving physical mastery’.\textsuperscript{15} It follows that a tinkering approach to technology has been a typical route into engineering for many men, including those from non-academic backgrounds.\textsuperscript{16} It has also been argued that the professional technological world in a sense is a world of ‘eternal youth’, that rewards boyish curiosity and inventiveness.\textsuperscript{17} As such, technology, as a man’s way of life, is something that is often established in early childhood and, thus, the boy interested in technology is expected to become an engineer when he grows up. This is not to say that a hands-on relationship to technology as an entry-way to engineering is not available to women, but Faulkner points out that considerably more men than women have been socialized into such a relationship to technology. However, as Faulkner has shown it is not always easy for engineers to reconcile the technicist engineering identity with the heterogeneous reality of their actual work. She argues that there are tensions in the stories told by engineers about what counts as ‘real engineering’ between the technical and social aspects of their work; and individual engineers need to engage in identity work to accommodate these aspects. Still, while it is argued that the contemporary engineer needs an expanded set of skills (including team work, creativity, critical and ethical considerations), a passionate interest in technology remains important in the narration of an engineering identity.

As shown above, participation in engineering is imbued with gendered and classed connotations. This is also the case for the choice of higher education more generally, and literature dealing with male working-class students’ relationship to higher education provide additional perspectives on the engineering students’ narratives explored in this article. Ball, Davies, David, and Reay argue that for most young working-class people not going to university is a non-decision, while for middle-class students going to university is a non-decision.\textsuperscript{18} While the Nordic countries are typically associated with less social class stratification and also have had massive increase in their higher education participation, Isopahkala-Bouret et al. still note that

Many of the reproductive patterns of academic, high-/middle-class families found in the international literature are also found in Nordic contexts. Students with the highest amount of cultural capital, measured in the form of the highest level of the education of parents, tend to concentrate in established research-intensive universities, the dominant H.E. institutions.\textsuperscript{19}

Likewise, Swedish upper secondary education is also stratified by social class.\textsuperscript{20}

Working-class students are often engaged in difficult identity negotiations, weighing the potential benefits of a higher education against the potential cost of losing one’s working-class cultural identity.\textsuperscript{21} Drawing on an interview study involving 19 mature working-class students, Reay argues that working-class students are balancing between higher education as a means to realizing their potential and maintaining an ‘authentic self’, that is ‘being able to hold onto a self rooted in a working-class past’. One way the students in her study reconciled this balancing was by not applying to prestigious universities, but instead opting for what they considered to be the best universities for them.\textsuperscript{22} Similarly, Ball et al. argue that choices of higher education institutions are infusured with class and ethnicity, and that students’ dilemmas are not just a matter of choosing higher education
or not, but a choice of what is perceived an appropriate institution for them. In some cases, students explicitly considered going to a university where people shared their culture and ethnicity. As such, ‘the perceptions, distinctions and choices of higher education institutions used and made by students play a part in reconstituting and reproducing the divisions and hierarchies in higher education’.23 This is also increasingly the case in the Swedish higher education context, where the expansion of higher education has meant that more importance today is placed on ‘what degree and from which educational institution’.24 The expansion of higher education in the Nordic countries have as such taken place largely by first-generation students entering less prestigious programs and institutions.25

Looking particularly at men on the route to higher education through alternative entry courses, Burke found that their aspiration to higher education was linked to a desire for an ideal form of respectable masculinity, which included a distancing from physical labor, having a well-paid job and a stable home and family life.26 These men, thus, constructed their educational participation as a project of becoming better men. A key theme in their talk was the overcoming of what they perceived to be natural flaws, such as laziness and disorganization, to be recognized as respectable higher education students. Laziness was also cited by the men as the key obstacle to their educational success. Burke argued that ‘they struggle to regulate, control and correct the male characteristics that are widely constructed as natural ways of being a man’.27 The construction of laziness cited by the students in Burke’s study has been argued to operate as a ‘self-worth protection strategy’, given that ‘academic ability is inextricably intertwined with feelings of self-worth’.28 This does not mean that academic success is not valued, but that such success is to be achieved ‘effortlessly’, not through hard work and studying which is construed in opposition to being ‘naturally able’.29

**Theoretical framing**

This article is inspired by sociocultural theories of activity and identity, where identity is conceptualized as co-produced with social, material and cultural activities. Consequently, we see identity as socially and discursively produced a continuously negotiated experience that is constituted in the intersection of different discourses.30 As such, we chose the term ‘identity work’ to draw attention to identity as an ongoing process, in which students position themselves, but also involving how others recognize and respond to those positionings (in line with the use of ‘identity work’ in Calabrese Barton et al.).31 Further, we are interested in the students’ identity trajectories, here understood as a trajectory of becoming an engineer with a focus on how the students navigate stories of what being and becoming an engineer entails.32

**Identity performances**

Following Butler identity is understood as performative, a ‘doing’.33 Although there is no ‘core’ identity, people are not completely free to perform in any way they like, since performances are shaped by social expectations and available discourses.34 Within a social context there are recognizable ways of being – intelligible identities, that re-produce certain normative values and relations.35 Performances of identity, thus, become intelligible
when aligned with social expectation for a certain individual within a certain context. Hence, rendering yourself intelligible in a context is dependent not only on performance, but also on recognition. In this article, we focus in particular on how engineering students do gender/masculinities and social class performances. As such, social class is conceptualized in a parallel fashion to how gender/masculinities are conceptualized; as a process in which social class positions, differences, and inequalities are constructed. In line with Halberstam we do not consider the performance of masculinities as exclusive to men, even though bodily affordances constrain recognizable gender performances. In this article, we focus on masculinities as multiple to signal that performances of masculinity may vary across social and cultural contexts, and may have different cultural meanings when intersecting with, for example, social class.

**Identity trajectories**

We conceptualize identity work over time as identity trajectories to investigate the manner in which students engage with discourses of engineering education and masculinity as they move through their academic programs. In work examining how latecomers to science move in ways that construct identities as insiders or outsiders in relation to science, Jackson and Seiler explored how trajectories are formed as students’ experience moments of stronger or weaker identification to science, fluctuating over time. They argue that the use of ‘trajectories’ does not need to imply linearity, but that these movements result in a momentum in relation to science that occurs as a ‘build-up of resources that creates a patterning or thickening of identity’. Wenger presents us with a framing of trajectories of identification as inbound, outbound or peripheral, indicating the route an individual takes towards membership in a community of practice. Wenger describes an inbound trajectory as one where newcomers are joining the community with the aim of becoming full participants, and, as such, they are invested in a future participation in the community. An outbound trajectory is one that leads out of the community. A peripheral trajectory is a trajectory that does not lead to full participation, either of choice or necessity, but still has the potential to contribute significantly to the individual’s identity. We wish to stress here that although a route or a momentum may appear inbound, we do not intend that these trajectories are without struggle. Thus, to help us conceptualize trajectories with more nuance, we suggest that identity trajectories may be troubled or untroubled at various points.

Much as Butler aimed to ‘trouble’ any kind of presumption of a fixed identity, we suggest that students may experience their identity trajectories as troubled or untroubled separately or even simultaneously at any given point. Taking up this dynamic conceptualization of identity, we explore the trajectories of four men in mechanical engineering, as they navigate stories of what it takes to be recognized as a competent member of the EMP (Engineering Mechanics Program) community. Although we rely on mostly interview and video-diary data, we agree with Jackson and Seiler that these narratives of identity rather than identity-in-action can provide ‘insights into another aspect of identity work that continues after an experience takes place, but still represents students’ attempts to author themselves in relation to science’. Thus, the perspectives we gain from students’ narrations can provide insight into how participants interpret events, and make choices in response to them.
Methodology

Research context and data collection

In Sweden, as in many other contexts, engineering and engineering education is coupled with positive values related to economic growth, global competitiveness and the sustainability of the welfare state. Engineering, entrepreneurship, and innovations have been portrayed as keys to the Sweden’s economic development since the end of the nineteenth century and, as such, also strongly connected to ideas about ‘Swedishness’ and what characterizes the nation.

There are a variety of different engineering programs in Sweden. In a few, women predominate (usually programs with strong connections to biology and chemistry) and in others men do (all programs with strong connections computer science, IT, mechanics and electronics). This article reports on a study of the Swedish Engineering Mechanics Program. EMP is the branch of engineering that involves the design, production, and operation of machinery and, as such, represent one of the more traditional engineering programs. Further, it is one of the largest programs in Sweden in terms of student numbers (both on the bachelor and master level). In Sweden, engineering education is organized as a two-tier system:

- Högskoleingenjör (bachelor), a three-year degree which combines theoretical elements of engineering with more vocational elements. The degree awarded is a Bachelor of Engineering.
- Civilingenjör (master), a five-year, more theoretical degree compared to the högskoleingenjör. The degree awarded is a Master of Engineering.

Here it can be noted that while it is possible to continue from bachelor to master, the two versions of engineering education in Sweden can largely be understood as existing in parallel; when applying to university students apply to either a bachelor or a master program (hence, in the context of engineering the master program is not to be considered a continuation of the bachelor program). Our previous work shows that the EMP at the bachelor level is often described as being for students who wish to develop products, while the EMP at the master level is for students who wish to develop society. Bachelor’s degree websites present vocational options while master’s degree websites present wider career options: the EMP student at the bachelor level is expected to learn to handle and improve technology, while an EMP student at the master level is expected to develop technology. In this article, we focus on the bachelor version of the program, which combines theoretical elements of engineering with more vocationally focused ones. Over 80% of the students in the bachelor EMP are men, and about half of the students have parents who have studied at university (in contrast, over 80% of the students in the master EMP have parents who have studied at university). Over the last few decades, higher education in Sweden has seen a rapid expansion, and similarly to other European countries Sweden has moved from an ‘elite’ to a ‘mass’ system. In the Nordic countries, educational law and policies have been implemented to create equitable opportunities to enter higher education. However, despite the existence of financial support for Swedish students as well as a lack of many structural obstacles (such as tuition fees), Swedish higher education is still stratified by social class. This is seen most clearly in terms of which students graduate from what institutions.
and with what degrees (as exemplified by the master and bachelor of engineering programs above). In this context it can also be noted that 11% of Master of Engineering Students continue to PhD programs, whereas only 1% of Bachelor of Engineering students do so.

In this article, we are interested in how the EMP students make sense of their educational program and their concomitant identity work. To explore this in an in-depth and nuanced way, we conducted a small-scale ethnographic study, where student interviews and video-diaries were combined with observations of lectures and video-recordings of project work. Through the combination of several different data collection methods, we were able to generate ‘thick’ empirical data, that provided multiple perspectives on the same issue, and where differences between men could be identified and brought to the fore (in contrast to comparing male and female students). It was important for us to not rely on interviews only, as we anticipated it might be difficult for the male students to voice issues related to identity (in particular concerning masculinity and other dimensions of potential privilege).

The data was collected at a large Swedish university, during a module about ‘Machine Elements’. The module ‘Machine Elements’ was taught by a combination of lectures and independent project work in small groups. Eight lectures were observed by the fourth author, herself with a Master degree in engineering, and documented using field notes. The observer’s background in engineering allowed for her to gain a detailed understanding of the lecture content, including an appreciation how the lecturer constituted a classroom engineering community, using, for example, jokes. All field notes were sent to two of the other co-authors, with backgrounds in science and science education, who could provide an outside perspective on the field notes for the observer to account for in her subsequent observations. These combined insider and outsider perspectives contributed to a nuancing and a strengthening of the emerging data.

The teacher was an experienced university lecturer with a background in engineering. Seven EMP students (all men) were video-recorded during their project work; 1 group with 4 students and 1 with 3 students (these were all the students who volunteered to take part in the research project, from a class of in total 26 students, all male). The seven students also recorded video-diaries on three occasions during the module. The video-diaries were guided by interview guides where they were asked to talk about the project work and what they had been doing the past week. They were also asked to reflect on following themes: (1) the students’ backgrounds, their experiences of living and studying in University Town and what a typical week in the EMP looking like; (2) the EMP and what characterizes the program; (3) their future career directions. Interviews were conducted with the seven students. The video-diaries were used as starting points for the semi-structured interviews (30–60 minutes), in which the themes of the video-diaries were explored further. Having acquainted ourselves with the students and the educational context through the observations and the video-diaries meant that we in the individual interviews could progress to a more in-depth exploration of the students’ identities and aspirations, thereby contributing to the quality of the empirical data. The interviews were carried out by the three Swedish authors, all of whom drew on their own backgrounds in science and/or engineering during the interviews. This manuscript mainly makes use of the video-diaries and interviews, whereas the recordings and observations of teaching mainly serve as a contextualization of the interview data.
One group of four students was chosen as a case for this manuscript; we chose to focus on this group because the students all shared similar characteristics (working-class background, similar age, Swedish background). This helped us to elicit a more nuanced understanding of their identity negotiations than if we had focused on the more diverse group of three students. This group’s chosen project concerned the construction of a sheet metal cutter. Based on their parents’ professions all four students can be defined as having a working-class background (Arvid: administrator and small-scale entrepreneur; Björn: nurse’s aides; Calle: electrician and carpenter; Danne: carpenter and not stated). The four students are in their early twenties and have moved from different parts of Sweden in order to attend this particular EMP; Arvid and Björn are a couple of years older than Calle and Danne, who both have continued directly from upper secondary school to higher education. Arvid was briefly enrolled in a different engineering education prior to starting Engineering Mechanics and also did some unskilled work (not related to engineering) for a period. Björn has worked as an industrial mechanic prior to starting the engineering mechanics program. All four interviewed students were native Swedish speakers and, thus, the interviews were conducted in Swedish. The audio-recorded interviews and the video-diaries were transcribed verbatim, but with little additional detail (laughter and longer pauses were marked). In the analysis, we have worked with the Swedish transcripts, and excerpts included in the manuscript have been translated to English following the analysis. The translations seek to preserve the meaning of statements, rather than being literal translation. The excerpts included in the manuscript have been gently edited for readability to exclude, for example, stutters and false starts. The participating students and teacher have given written consent to participate in the research project. All participants were assigned pseudonyms, and the description of the university has been kept vague to preserve anonymity. The project adheres to the ethical guidelines of the Swedish Research Council.

**Analytical process**

The analysis commenced by repeated readings of the entire data set (transcriptions of all interviews and video-diaries as well as field notes from observations), with a broad focus on how the students talked about engineering mechanics (both the education program and the field of engineering mechanics generally). This reading was guided by a broad interest in the students’ identity negotiations, so we paid attention to language that signaled how they positioned themselves relative to the education program and their classmates. The initial coding was largely inductive, creating a diverse set of codes for aspects in the empirical data that were salient to the students (examples of codes include: project – simple, project – advanced, theoretical and practical, taking pride in the product). In the first step of the coding, we also took notes on biographical information about the students from the interviews and video-diaries (such as, where they grew up and their parents’ occupations). We then looked for patterns among the initial codes in order to merge them into more overarching themes. At the end of this analytical stage, our initial codes had been grouped into the themes ‘Engineering education’, ‘Engineering student culture’, and ‘Engineering trajectories’. This empirically driven analytical stage was followed by a more theoretically focused one, guided by a performative understanding of identity as well as the concepts ‘cultural
models’ and trajectories. Following Holland and Quinn we apply an understanding of cultural models as presupposed, taken-for-granted models of the world that are widely shared (although not necessarily to the exclusion of other alternative models) by the members of a society and that play an enormous role in their understanding of that world and their behavior in it.

The broad themes were refined as we paid attention to aspects of student talk that were salient to their construction of engineering mechanics (both the program and the field). In doing so, we identified cultural models of engineering mechanics that students drew on in their talk, which resulted in four further refined themes: ‘Engineering as a natural choice’; ‘Balancing the valuing of theoretical and practical aspects’; ‘Becoming an engineer in the context of project work’ (focused on the project work as a resource for identity work); and ‘Engineering student culture – and the resistance to it’. In a final iteration of analysis, the four students’ emerging engineering identities were analyzed in terms of trajectories, with a focus on how each of the four identified themes played into the individual students’ identity constitutions. Here, following Wenger, we made use of a distinction of trajectories as inbound, peripheral, and outbound, but also further nuanced this characterization by discussing the trajectories as troubled or untroubled. We paid attention to the ways that students’ trajectories were shaped by the cultural models identified in each of the above themes, and whether these contributed to troubling of identity trajectories.

Findings

The findings section is divided into two parts. The first explores salient themes in the students’ constitution of the engineering mechanics program, while the second part gives an account of how each of the students negotiate their emerging engineering identities, with a focus on their identity trajectories.

Part I: the engineering mechanics program

Engineering as a ‘natural choice’: The four men all described engineering education as a ‘natural’ choice, contrasting the choice of the EMP program to other engineering programs. Arvid, Björn and Danne all connected their chosen engineering education to their upbringing. Danne related his choice of engineering to his father’s work with construction of vehicle parts and explained: ‘it just felt natural to do the same in a way’. Arvid said:

I grow up outside of [town in Northern Sweden], so it’s always been lots of machinery and such. I’ve had jobs during the summer holidays where I’ve been driving heavy vehicles and such. And that in combination with sort of an interest in how things work, so ... I’ve chosen to study mechanical engineering. (Arvid, video diary 1)

Björn had previous experience of industrial work and constructed a strong connection between this experience and the engineering education:

Yes, I’ve been doing some welding for their project. Because I have [some experience] from before I started studying I worked as an industrial mechanic in [the Industry], and I did some welding there. And then I got to use my skills here in the school too, which I enjoy, I enjoyed helping them. (Björn, interview)
Björn was thus able to create a continuity between his working-class background and his current education. This is not to say that welding can be considered a core part of the studied engineering education, but for Björn welding nonetheless functions as a bridge between his previous experiences and current education.

An assumed interest in and passion for technology was also constructed during lectures. The teacher often assumed that the students had heard of the different inventors, inventions and mechanisms he mentions, and sometimes students were observed to nod in agreement. This assumed familiarity was identified in field notes:

The teacher thinks it’s stupid that we don’t use the Wankel engine [a type of internal combustion engine, previously used in some sports cars] today. The students are now joining the conversation without being invited. Someone mentions a make of car that uses the Wankel engine. Someone claims that it’s only good at certain engine speeds. Someone says that there are probably reasons as to why it’s not so popular. A fourth student says that it would have been cheaper and more developed had everyone chosen to use it. The teacher listens to everyone’s opinions without disagreeing with anyone. [. . .] He says: ‘It would be fun if someone did a project with a Wankel engine. If you do, I will sponsor you so that you can buy an old engine. Come and talk to me’. (Field notes, lesson 2)

Many of the students here contribute willingly to the discussion about the Wankel engine, creating a sense of belonging for the students who showed passion and interest in a topic that the lecturer is passionate about. For the students, the choice of an engineering education in a sense became a non-choice. The choice as a non-choice was also manifested in how all the students construct EMP as a ‘wide education’, that is, one that is not limiting in terms of perceived possible futures. Arvid explained that it was difficult to choose which kind of engineering to go into, and he ultimately went for what he perceived to be the widest education. Danne found it difficult to talk about why he chose to study engineering and said: ‘I’ve never really had a goal in life, so it just felt right at the moment. Right now, I’m very happy with [my choice of education] so there’s not that much more to say’ (Danne, interview).

This is in line with Holth’s work which shows that many Swedish men in engineering education begin their engineering studies very soon after graduating from high school; whereas the choice of engineering is less self-evident for women, their paths into engineering typically are more winding, and they begin engineering educations later in life.

Negotiating the valuing of theoretical and practical aspects: In the interviews, the operation of different kinds of machinery figured repeatedly, both in their descriptions of experiences prior to the engineering education, and in relation to the workshop the students have access to at this specific university program (e.g. laser cutter and welding tools). The students stressed that they enjoyed this practical aspect of the education:

I would stress what I said about handling problems, you really get to learn lots of fun technology. For example, the CNC-machine, CAD, lathing, welding. I feel that this education has taught me how to do things I make use of in my everyday life and it can be sort of anything: a wall mounting, who knows. (Calle, interview)

Thus, the students cite a cultural model of engineering as a practical occupation. However, Arvid and Björn strongly and repeatedly stressed the theoretical aspects of the education. Arvid, for example, pointed out that we as researchers might not have got a correct impression of the education from the very practically oriented module we had observed. Thus, for Arvid it was important to challenge the cultural model of engineering as a practical occupation.
occupation by pointing out that the bachelor EMP is in fact also theoretically oriented program. In that sense, he authored himself as both theoretically and practically inclined. Yet, a ‘too theoretical’ engineering education was not seen as desirable either, in that it is not connected to the perceived future profession:

It gives you a bigger picture of what you are actually going to work with in the future, and that it is actually useful, and that it’s not just a lot of numbers on paper that you don’t know what they are for. Instead you actually get to see that this is what a certain part can take, for example, this bolt will cope with this much [. . . ]. (Björn, video diary 2)

Thus, the students were constantly balancing the valuing of theoretical and practical aspects when they made sense of their trajectory through the EMP. The need for a similar balancing act between the valuing of theory and practice in the context of male working-class physics students who had been able to use their practical skills and experiences of industrial work as a gateway into physics has been described by Danielsson.61

This connection between being ‘a real engineer’ and the ability to do actual construction work was also reproduced by the teacher. We observed the teacher using the white board to solve a problem with a four-bar mechanism (one theoretical concept presented in this course), when he contextualized the problem with example of a garage door:

I’m building a garage with an overhead garage door. ‘I want to construct the door myself, because I’m a mechanical engineer’ (students are giggling). I want there to be light coming in. And then I treat myself to an expensive lamp (puts the lamp into the drawing). (Field notes, lesson 2)

When the teacher says that he wanted to construct the garage door himself because he is a mechanical engineer, he does this in a joking fashion, which was also perceived as a joke by the giggling students. Hence, the teacher was playing with the norm of engineer as someone focused on technical constructions, in and out of professional contexts, and by doing so used humor to create a sense of belonging among those students who could recognize themselves in this interpretation of engineering (and a potential exclusion of those who do not).62

While a reoccurring theme in all the students’ talk about the bachelor EMP was how the program balances theoretical and practical aspects of engineering, it was the practical aspects that are presented as most fundamental to engineering. Calle exemplified that as Bachelor Engineers they learn when different bearings are appropriate to use, but they do not need to know about the research behind these bearings. While the positioning of practical aspects as most fundamental to engineering is not surprising in an engineering education focus on design, production, and operation of machinery, the valuing of practical skills also has a symbolic value. Robinson and McIlwee found that male engineers often valued and displayed practical skills also in engineering contexts where these were less relevant.63 Arguably, the cultural models discussed in this section present rather overarching characterizations of engineering; next we zoom in on how cultural models of engineering are played out in the students’ descriptions of their participation in the actual project work.

**Becoming an engineer in the context of project work**

One of the goals of the module we observed was for the groups to design and construct a model that made use of a four-bar mechanism. The group consisting of the four interviewed
students chose to construct a model of a metal sheet cutter. In comparison to projects chosen by some of the other groups, this one was considered ‘easy’. During interviews and video-diaries group members mentioned the low difficulty level of their chosen project. However, the students approached this perceived simplicity in different ways. Calle was very adamant that he would have wanted to do something ‘cooler’, like a clock, for example, and says he lost motivation because of the time constraints:

It’s, like, what happens when you feel that . . . We were just ‘we will just aim to get a pass’, when you feel that ‘we don’t have time to do something fun, we don’t have time to do something fancy’. But then it just happens, you lose motivation. (Interview)

Calle further elaborated that the expectation from the teacher was simply that the group were to construct a functional model that fulfilled the basic requirements of the assignment. A very similar description was given by Danne, who also explained that the group did not want to work around the clock, but just do enough to pass the assignment. When asked how the project work could have been improved Danne explained that they could have divided the different parts of the project between themselves in the group and, thus, made the working process more efficient. Both to settle for passing the project assignment with the minimum requirements and to divide the different parts of the project to enhance the effectiveness can be understood as the enactment of an instrumental approach to education; where the aim is to get the assignment done as effortlessly as possible.64 So, while adhering to a cultural model of engineering as a practical occupation – and constructing this as ‘fun’ – this is not sustained in the context of the actual engineering project.

Arvid and Björn also talked about their chosen project as easy. But, in contrast to Calle and Danne, Arvid talked with passion about working with the laser cutter they made use of in the construction of the sheet metal cutter model, and the laser cutter was also described as a complicated tool. Björn also showed a fascination with the laser cutter and talked about being able to use this tool in their project:

And, when we learnt how to do it, then I thought that the laser is amazingly . . . precise in . . . that it prints exactly like you want it and it is very nicely done. To be able to use such a thing just makes things even better. (Video diary 2)

During the interview, Arvid described the instance when the group introduced their suggested project to the teacher:

We had a picture we showed him [the teacher] and then he said ‘you should do something you’re proud of, something you think looks good’. And that connects to . . . like the approach to this project also connects to how it’s supposed to be interesting and fun. That you should still try to perform well, and now the metal cutter turned out damn well too, even if it pales in comparison to other [projects]. (Interview)

We note that Arvid describes his metal cutter turning out ‘damn well’, and also the teacher stresses that it is important to make something they are proud of, and that is aesthetically pleasing. On the same note, Arvid also shared with pride how the teacher had complimented the group on their metal cutter and thought it was nice-looking enough to be placed in a display cabinet. During the lectures, the teacher also repeatedly made aesthetic judgements about mechanisms (for example, how they are elegant and clever). Hence, the focus on the aesthetics of mechanisms adds another dimension to the cultural models of engineering practice (potentially applied to both practical and theoretical aspects, but here mostly focused on the practical). This modification of a cultural model of engineering
as a practical enterprise to foreground aesthetical aspects provides an avenue for students to renegotiate a comparatively simple project as an integral part of their engineering trajectories.

**Engineering student culture – and the resistance to it**

As shown by Ottemo and Tonso, contexts outside of formal education are also highly important for engineering students’ discipline-specific identity work and the formation of the concomitant engineering student culture.\(^\text{65}\) When asked about their well-being as students, Björn, Calle and Danne described themselves as well-integrated into the EMP student community and talked in appreciative terms about their class mates and the social climate. During the interview, Björn elaborated on hanging out with other engineering students during the weekends:

A typical week: to get up early in time for the lecture, if that’s what on the schedule, after the lecture, group work – sit down together with the group. We’ve been reasoning about all sorts of things. Lots of studying Monday to Friday. Lunch break. Chat with others. You’ve always got friends [around] so to speak. (Video diary 1)

Likewise, Danne stressed the good social climate in the group and how he hung out with the group members also outside of the university:

I think it been a darn good atmosphere [in the group], or a really easy-going atmosphere. We know each other, I hang out a lot with Björn, both during school, outside of school and such. So, we have lots to talk about and the same with Arvid, he also has a lot to add and Calle, I talked to Calle yesterday and we just . . . you see each other a lot, so you do talk a lot. (Interview)

Further, Danne talked at length about how he often prioritized extra-curricular activities and partying above the studying, and Calle called this approach a ‘normal student life’. During the interview, Calle elaborated further on how time-consuming these extra-curricular activities were and how exhausted they made him. To be involved in student activities – many of which are specific to engineering students – is constructed by both Calle and Danne as integral to their participation in the engineering education.

In contrast to the other students, Arvid made a clear distinction between the education context and who he hung out with outside of his studies. Arvid says that he does not fit in with the EMP students:

I don’t hang out a lot with the engineering students now actually. I, eh, it’s more that I hang with the medical students I live with and other groups of people . . . Eh, it’s like, it’s a nice group of people on EMP, it is. It’s sort of laddish, lots of focus on alcohol, like, that doesn’t really suit me, but I, well, I have hung out with them more and more. They are nice, too. (Video diary 1)

Arvid used the word ‘laddish’ to describe the EMP students, thereby constructing them as performing a certain masculinity that he does not identify with.\(^\text{66}\)

When asked during the interview to describe the typical students on the EMP in terms of interests and background he searched for words carefully and said:

Like that was one of my first impressions when I got here, it was lots of snow-mobiles and such. Those kinds of interests, like . . . lots of engines, moto-cross and such. Then it’s kind of a boyish, yeah, I would still choose to call it boyish aura or niche or what it’s called? Jargon, that’s what it is call, sort of a boyish jargon. So, because of that I haven’t been hanging out a lot with the EMP students. It’s a lot of like the drunkest wins and your-mum-jokes, kind of. (Interview)
The laddishness Arvid described his classmates as enacting, thus, involves both more general markers of laddishness such as alcohol consumption and sexist jargon, but also as connected to particular technological interests, centered around engines and snow-moblies. For Arvid, the laddishness was largely a negative thing and when he did talk about certain aspects of it in a more positive manor, this was still done with a distance, as something he recognized as a particular way of being and could to a certain extent move in and out of, but did not identify with.

**Part II: students’ emerging engineering identities and engineering trajectories**

**Arvid**

Arvid displayed many of the hallmarks of a desirable engineering student. Balancing the theoretical with the practical; a nuanced appreciation for his project; interest in sustainability; interest in the social aspects of engineering. He also possessed important aspects of ‘engineering capital’ through his previous experiences of operating heavy machinery and three older sisters who are engineers. Taken together, this made Arvid’s trajectory into the EMP an untroubled one and the choice of this education relatively straightforward. Authoring himself as inclined to and interested in both theoretical and practical aspects of engineering contributed to his academically inbound trajectory (a trajectory leading to becoming a full participant). This inbound trajectory was also sustained through the project work, which Arvid constructed as relevant to his engineering trajectory through a focus on the model metal cutter as aesthetically pleasing and well-functioning. However, Arvid’s inbound trajectory was troubled by expectations for laddish behavior, expectations that not only have to do with more generic aspects of laddishness (such as alcohol consumption), but that also reach into content related aspects of the engineering education.

Out of the four students, Arvid was the only one that commented on the actual themes of the projects and said that their decision to build a tool was not typical for the student group at large. As he explained: ‘I know that there are some groups that have made like a kind of golf ball canon. Lots of weapons, they’ve made, the lads’ (Arvid, interview). Here, Arvid explicitly distanced himself from the classmates focus on weapon-construction, and by using the colloquial term ‘the lads’ to describe them, connected the focus on weaponry as part of the enactment of a non-desirable somewhat childish masculinity. This positioning of himself as constructing a more mature masculinity is also present above, when referring to the classmates as ‘boyish’. The case of Arvid demonstrates that inbound trajectories are not straightforward, even when all the elements for success are there.

**Björn**

Björn grew up in a community where few young people continue to higher education, yet he narrates his trajectory into the engineering education as untroubled; he explained that he has always wanted to go on to higher education and strongly connected his choice of engineering to his previous experience of working as an industrial mechanic. Remaining in his childhood industrial community was not a future Björn imagined for himself. He elaborated:

Yes, it’s kind of been like that. I’ve always felt that I don’t want . . . because when you work in [home town], it’s so much that you put your trust in get a job in the [Industry] or a sub-contractor that works for [the Industry]. And I felt that it’s not me, I don’t want that. (Björn, interview)
He was on an inbound trajectory into the engineering community that was helped by his orientation to the practical aspects of the program. He was also aided by his ability to see beyond the simplicity of his group project, perceiving it instead as elegant (and something to take pride in). In terms of his trajectory through his education, he – like Arvid – sought to balance the theoretical and practical aspects. He was, in a very concrete manner, able to make use of skills developed as an industrial mechanic and get recognized for those skills by his course mates. Further, Björn gave the most specific and detailed account of an imagined future. His experiences of working in the Industry provided him with a distinct vision of how a future as engineer in the same industry might play out, and he could imagine returning there in a different position:

And then it had been kind of nice, actually, to return as a trained constructor and give directions to your old colleagues. That hadn’t been boring at all, it would have been kind of great. But you got to dream a little too. (Björn, interview)

His future goals seemed to draw on and build on his working-class background in a way that presented his trajectory as ‘natural’, even though he might be exceptional as someone who comes from his community (as indicated by the reference to ‘dream a little too’). While Björn talked relatively sparsely about extra-curricular (engineering) student activities, and hence did not portray these as central to his identity trajectory, he presented a strong sense of belonging to the engineering student group. As such, Björn was to be able to balance the social expectations on him as an engineering student, with the desire to focus on his studies, and seems to have the most untroubled inbound trajectory of the four students.

**Calle**

Calle constructed the choice of engineering as natural choice in that he had always been interested in technology. He suggests that he would have preferred to become an architect, but his grades were not good enough. Despite Calle’s working-class background (both his parents are craftsmen), continuing to higher education was an obvious choice, but mostly out of necessity: ‘There is absolutely nothing in [City] that you can do that is fun, without education. So then I only felt “oh, just as good to get it over” so I started to study straight away’ (Interview).

Calle was strongly focused on the practical aspects of the engineering education; he stressed that he enjoys tinkering and considered himself as more well-suited for the Bachelor of Engineering Program than a Master of Engineering Program, given that he was much more interested in the practical than the theoretical aspects of engineering. Despite authoring himself as passionate about technology, he did not construe the project work as integral to his engineering trajectory. Calle was on a peripheral trajectory academically (a trajectory that does not lead to full participation); he said that he has been labeled as unambitious by his course mates, due to a high absenteeism and his disengagement with the project work, something he explained as due to ‘bad luck’. Calle also deviated from the desirable engineering student by his single-minded focus on the practical aspects of engineering. Perhaps most importantly, though, it was his unclear vision of the future that contributed to his peripheral trajectory. He stressed the good possibilities for employment and how it would make a comfortable 8 to 5 lifestyle possible. He did, however, briefly mention a ‘dream job’ in the interview: he was interested in working with constructing prosthetics, but said that he does not know how to make this dream a reality and did not appear to
be particularly invested in finding it out (‘But I’ll have to see if I slip in there somehow or if I even do it’). However, he had a strong sense of belonging in the engineering education community, which contributed to keeping him on a peripheral rather than outbound trajectory. In particular, his engineering student identity was centered around laddish behavior (partying, staying out late, sleeping in) and a bookish behavior would put this identity to risk. Notably, Calle was simultaneously motivated to pass his courses since he noted that he otherwise could not afford his living costs nor finish the program so that he can have the comfortable lifestyle he is after. Hence, while Calle’s peripheral engineering trajectory was troubled by the perceived risks involved in being associated with ‘too much’ studying and the lack vision for his future, he didn’t need to deviate so much from the desirable engineering student that he ended up on an outbound trajectory.

**Danne**

When explaining why he choose the EMP, Danne simply said that he ‘never had a goal in life’. Yet he did end up in engineering education, hence, his trajectory into engineering was so untroubled that it does not render an explanation. Later, he connected the choice to his father’s previous work with construction of vehicle parts and was thus able to narrate a trajectory from his working-class background to his current participation in higher education in engineering. Like Calle, Danne enjoyed the practical aspects of engineering, but was also unable to connect the project to his engineering trajectory. Danne did not participate in the final meeting with the project group, not because of sickness like Calle, but claiming that the whole group was not needed and that: ‘It was just for the looks of it, [the metal sheet cutter] was already finished’. Danne described their project as simple, but also said that he would not have wanted to do something complicated. For him, the key to the project was the completion of the task and how the efficiency of the task completion could have been increased by dividing the work. This can be interpreted as Danne refiguring the project to make it more aligned with an engineering practice, but it is also consistent with Danne’s relaxed, sometimes avoiding, attitude to studying. Talking about the group he said:

> Well, it’s a very relaxed attitude, it’s not like ‘now we have to’, that we were super serious, it was pretty relaxed and we do the project, but at the same time we talk about what happens during the weekend. (Interview)

Danne’s trajectory can be characterized as peripheral in that he so clearly struggles to articulate a vision for his future and authors himself as a disengaged student: sleeps in; does not participate in lectures (but often catches up later); prioritizes extra-curricular activities and partying over studying. However, the peripheral trajectory is largely untroubled; he fit in socially (‘everyone is so different that it’s difficult not to fit in, you can be however you like’) and did not express any doubts that he will (effortlessly) perform well enough to graduate. In contrast to Calle, Danne made the impression of being very satisfied with his trajectory.

**Discussion**

Despite the under-representation of students from working-class backgrounds in Swedish higher education, all four students in this study were able to construe their choice of engineering as ‘natural’, almost a non-decision. The choice of the engineering mechanics program thus emerged as unproblematic for these students. As discussed previously, the
men in this study perceived that the engineering mechanics program would permit them to return to their working-class communities; Björn could even reason in detail about kind of job the education would potentially make possible for him within that community. This reasoning was significant to the participants’ identity work, and emerged as important beyond work opportunities. These participants saw their educational trajectories as enabling the possibility to make themselves intelligible in their childhood communities. Their educational trajectories that ‘made sense’ in that they will enable, for example, a higher paid or less physically demanding vocation. Hence, we conclude that the vocationally focused engineering education program gave the students access to benefits of higher education, without the risk of ‘losing yourself’ as Reay has suggested can be the case for higher education students with working-class background. By construing the EMP as so closely aligned with their previous experiences and backgrounds, the men in this study seemed to be ‘able to hold onto a self rooted in a working-class past’.71 Further, consistent with findings from Reay and Ball et al. the choice of institution and education program was very much, at least for these four students, an educational choice that they perceived to be the appropriate choice for them.72 While not explicitly stated, the strong focus on a sense of belonging created by the social aspects of the EMP in Björn’s, Calle’s and Danne’s narratives suggested that their choice of education may also have been motivated by going to a university where people share their culture, in line with Ball.73

However, the trajectories of the men in this study suggested that movement through the engineering mechanics program could be troubled in spite of this perceived naturalness. We found that the production of localized masculinities in the program confronted men with troubled forms of identity work. In the following section, we discuss these masculinities, and the troubled identity trajectories that some of the students formed around them. Emerging in the findings were two different local masculinities that construct a natural association between men and engineering in the EMP. In particular, we highlight two emergent masculinities related to the professional (technical competence) and to the student (engineering laddishness).

Wacjman has suggested that technical competence is associated with a performance of masculinity that is ‘based on physical toughness and mechanical skills’.74 She has also pointed to machine-related skills and physical strength as being measures of masculine status. In this study, we also observed a professional masculinity that was associated with hands-on competence. The ‘real engineer’ was constructed as someone who has a passion for hands-on aspects of engineering, a norm that is also reproduced by the teacher, for example, in his focus on the mechanical engineer as someone engaged in technical constructions. This emphasis on technical competence is often naturally associated with men’s career choices, and all four men in this study unproblematically navigated this technicist masculinity in the engineering trajectories. In this respect, the homogeneity of the group becomes apparent; they come from similar backgrounds and they are also first year students. The latter could be of importance to the identification with the technicist masculinity; this is a cultural model readily available both within engineering and their childhood communities (cf. Mellström) and in their identity trajectories still are so strongly influenced by pre-university experiences.75 In Arvid’s case, however, we can see that even though he unproblematically identifies himself with this technicist masculinity, it is problematic for him that engineering mechanics is associated with this masculinity. Consequently, his negotiations around this masculinity more concerns the perceived
perception of the engineering mechanics program than whether he is able to identify with it.

Laddishness in the higher education context emerged in this study as a form of masculinity around which students do considerable identity work. Here, we saw it emerging as a focus on alcohol in social settings, and jocular behavior in the classroom, in line with Jackson and Dempster. Often, this behavior resulted in a disengagement from classroom learning (lateness, joking around in class) and disengagement in relation to group work (non-participation, or minimal participation). This construction of laddishness was appealing to some (Calle, Danne) but was troublesome for Arvid who did not participate in the social aspects of EMP culture. Jackson has described laddishness as a ‘self-worth protection strategy’, wherein self-worth is often tied up in notions of academic achievement. We saw this in Calle’s narrative, where his academic struggles were construed as a result of disengaging assignments. The laddish attitude to education (doing as little as possible regarding the project work, sleeping in, partying, etc.) displayed by Calle and Danne has been previously documented among male students, in secondary as well as tertiary education.

We noticed in our study that a laddish attitude prevailed in an educational context where the students claimed a passionate interest for the content. Ottemo has also shown how engineering students combined a passionate interest in technology with an instrumental approach to educational assignments. So it is unsurprising that some of the interviewed students were unable to enact this passion in the context of the project work despite a passionate interest in technology.

In a sense, an instrumental approach to the assignment was well-aligned with an authentic engineering practice, where dividing a task to increase efficiency often would be a preferred mode of work. As such, it is important to not just consider the display of ‘laziness’ during project work as an integral part of the doing of a laddish masculinity in an educational context, but also consider how it may be related to engineering practice; instrumental ‘goal-means-thinking’ can be seen as characteristic of technical thinking in itself. Yet, from a learning perspective, such an approach can be problematic, as pointed out by Kittleson and Southerland and Berge et al., in that the students focus on what they are already proficient at instead of engaging in an activity that is new to them. Hence, a divide and conquer approach to the project work is unlikely to challenge the students to develop new conceptual or procedural skills. An implication for engineering educations is that project work assignments need to balance the striving for authenticity (which in this case might imply the students dividing the labor so that everyone takes on the tasks they are already most proficient at) with challenging individual students.

In contrast to Calle and Danne, both Arvid and Björn were able to make sense of the project work as an integral part of their engineering trajectory, by focusing on executing the relatively simple project as elegantly as possible, with a high regard both for aesthetic appearance and function. This, however, took considerable ‘engineering capital’ (here understood as version of ‘science capital’ as conceptualized by Archer and colleagues) to achieve. In Arvid’s case engineering capital was collated through growing up around machinery, jobs where he has handled heavy machinery and three sisters who are all engineers. In Björn’s case engineering capital was accrued through prolonged experience of working as an industrial mechanic. Hence, our study shows that the implementation of
project work as a means of realizing better learning outcomes and/or socializing students into a contemporary, socially skilled engineering role is far from straightforward. In Engineering Mechanics the four interviewed working-class men have found a place in higher education that does not represent a traditional prestigious higher education institution/program (which has been found to sometimes alienate working-class students), but that still is construed as ‘prestigious to them’. It capitalizes on a technisist masculinity that is also recognizable in their childhood communities. Hence, skills and values from their childhood communities can be seen to function as capital in the EMP context, but also the other way around, skills and values developed during the EMP can function as capital in their childhood communities. Maybe this is how Danne is able to construct EMP as the most eminent of engineering educations: ‘The engineer of engineers, that’s mechanical engineering’ (Danne, video diary 2).

Notes

1. Archer, DeWitt, and Willis, “Adolescent Boys’ Science Aspirations”; and Holmegaard et al., “To Choose or Not to Choose Science.”
2. Barnard et al., “They’re Not Girly Girls”; Cech, “Engineers and Engineeresses?”; Faulkner, “Becoming and Belonging”; Kvande, “In the Belly of the Beast”; and Tonso, “Engineering Identity.”
3. Holth, “Den Raka Och Den Krokiga Vägen” [The Straight and the Winding Road].
4. Adams et al., “Multiple Perspectives on Engaging Future Engineers.”
5. de Graaff and Kolmos, “History of Problem-Based and Project-Based Learning.”
6. Seron et al., “Persistence Is Cultural.”
7. Teknikföretagen, “Vilka ingenjörer behövs?” [What Engineers Are Needed?], 21.
8. Berge, Silfver, and Danielsson, “The New Engineer.”
9. Calabrese Barton et al., “Crafting a Future in Science.”
10. McIlwee and Robinson, Women in Engineering.
11. Wajcman, Feminism Confronts Technology, 144.
12. Mellström, “Machines and Masculine Subjectivity.”
13. Mellström, Engineering Lives.
14. McIlwee and Robinson, Women in Engineering.
15. Faulkner, “Nuts and Bolts and People’”, 346.
16. Du, “Gendered Practices of Constructing an Engineering Identity”; and Mellström, Engineering Lives.
17. Mellström, Engineering Lives.
18. Ball, “Classification’ and ‘Judgement’. “
19. Isopahkala-Bouret et al., “Access and Stratification in Nordic Higher Education,” 145.
20. Anderhag, “Students’ Choice of Post-Compulsory Science.”
21. Lehmann, “Habitus Transformation and Hidden Injuries”; and Reay, “Working Class Educational Transitions to University.”
22. Reay, “Finding or Losing Yourself?” 338.
23. Ball et al., “Classification’ and ‘Judgement’,” 2002, 52.
24. Börjesson et al., “Cultural Capital in the Elite Subfield.”
25. Thomasen, “Maintaining Inequality Effectively?”
26. Burke, “Men Accessing Education.”
27. Ibid., 419.
28. Ibid.; Jackson, “Laddishness’ as a Self-worth Protection Strategy,” 585.
29. Jackson and Nyström, “Smart Students Get Perfect Scores in Tests Without Studying Much’.”
30. Butler, Gender Trouble; and Hall, “Foucault: Power, Knowledge and Discourse.”
31. Calabrese Barton et al., “Crafting a Future in Science.”
32. Wenger, Communities of Practice.
33. Butler, Gender Trouble.
34. Hall, “Foucault: Power, Knowledge and Discourse.”
35. Butler, Gender Trouble.
36. Carlone and Johnson, “Understanding the Science Experiences of Successful Women of Color,” 2007.
37. Archer, “Social Class and Higher Education.”
38. Halberstam, Female Masculinity.
39. Connell and Messerschmidt, “Hegemonic Masculinity.”
40. Carlone, Johnson, and Scott, “Agency Amidst Formidable Structures”; and Jackson and Seiler, “Science Identity Trajectories of Latecomers.”
41. Jackson and Seiler, “Science Identity Trajectories of Latecomers,” 831.
42. Wenger, Communities of Practice.
43. Butler, Gender Trouble.
44. Jackson and Seiler, “Science Identity Trajectories of Latecomers,” 850.
45. Hallström, Hultén, and Lövheim, “The Study of Technology as a Field of Knowledge.”
46. Bergwik et al., “Inledning” [Introduction].
47. Berge, Silfver, and Danielsson, “The New Engineer.”
48. Universitetskanslersämbetet and SCB, “Higher Education.”
49. Osborne, Rimmer, and Houston, “Adult Access to Higher Education.”
50. Isopahkala-Bouret et al., “Access and Stratification in Nordic Higher Education.”
51. Börjesson et al., “Cultural Capital in the Elite Subfield”; and Thunborg and Bron, “Higher Education and Lifelong Learning in Sweden.”
52. Universitetskanslersämbetet and SCB, “Higher Education.”
53. Davis, “Voices of Gender Role Conflict.”
54. Noyes, “Video Diary,” 2004.
55. Kvale and Brinkmann, Interviews, 2009.
56. Butler, Gender Trouble; Holland and Quinn, Cultural Models in Language and Thought; and Wenger, Communities of Practice.
57. Holland and Quinn, Cultural Models in Language and Thought, 126.
58. Jackson and Seiler, “Science Identity Trajectories of Latecomers,” 831; and Wenger, Communities of Practice.
59. Wenger, Communities of Practice.
60. Holth, “Den raka och den krokiga vägen” [The Straight and the Winding Road].
61. Danielsson, “In the Physics Class.”
62. Riesch, “Why Did the Proton Cross the Road.”
63. McIlwee and Robinson, Women in Engineering.
64. Ottemo, “Kön, kropp, begär och teknik” [Gender, Body, Desire, and Technology].
65. Ibid.; Tonso, “Student Engineers and Engineer Identity.”
66. Ottemo, “Kön, kropp, begär och teknik” [Gender, Body, Desire, and Technology]; and Jackson, Dempster, and Pollard, “They Just Don’t Seem to Really Care’.”
67. Jackson, Dempster, and Pollard, “They Just Don’t Seem to Really Care’.”
68. Berge, Silfver, and Danielsson, “The New Engineer.”
69. Archer et al., “Science Capital.”
70. Here it can be noted that the original Swedish ‘grabbar’ does not carry as strongly classed connotations as the English ‘lads’.
71. Reay, “Finding or Losing Yourself?” 338.
72. Ibid.; Ball et al., “Classification’ and ‘Judgement’.”
73. Ball et al., “Classification’ and ‘Judgement’.”
74. Wajcman, Feminism Confronts Technology, 143.
75. Mellström, Engineering Lives.
76. Jackson and Dempster, “I Sat Back on My Computer . . . ‘.”
77. Jackson, “Laddishness as a Self-worth Protection Strategy,” 585.
78. Jackson and Nyström, “Smart Students Get Perfect Scores in Tests Without Studying Much”; and “I Sat Back on My Computer . . . ‘.”
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ORCID

Anna T. Danielsson http://orcid.org/0000-0002-3407-9007
Maria Berge http://orcid.org/0000-0003-3614-1692

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