Chapter 4: The Social Shaping of Ethics in Life Science Engineering

Abstract: Engineers and scientists don't work as solitary individuals alone on an island and unconnected to the wider world. Typically they work in teams and organisations which have their own rules, norms, and practices. Organisations also have taken for granted assumptions that are part of their culture, as well as 'narratives' or stories that people tell which help them to explain (to themselves and others) why they do what they do. Organisations also have (both formal and informal) power structures which impact upon what decisions people feel they can make.

Case Study: Time Sharing Space

Ramona is an intern at an up-and-coming power electronics startup. On her first day of work, she was shown around a laboratory where she would complete most of her projects. During this time, she was also introduced to nine male interns who would be sharing the same lab space. Since the lab could only accommodate five interns at a time, a vote was held to determine who would work in the lab during the day (e.g. 8am to 4pm) and who would work at night (e.g. 4pm to 12am) during certain days of the week. The morning shift was a popular option for a majority of the interns; Ramona was fortunate to be selected for four (out of five) morning shifts.

Weeks passed. Ramona had been enjoying her work and almost completed one of her projects. However, one day, a fellow intern asked how she was doing. Ramona commented that she was "good but tired." The intern replied that Ramona had "no reason to be tired because [she was] working mostly day shifts." Ramona was offended, but chose to ignore his comment. The next day, she ran into several interns, one of whom was the one she encountered the previous day. At some point in group's conversation, the same intern made a remark about how Ramona "always got her way [in the workplace] because she was a girl." Ramona was upset; however, because she did not want to cause a scene, chose again to ignore his remark. During the following weeks, Ramona tried to avoid the intern who made the inappropriate comments. However, certain settings forced her to interact with him and, in those times, he made a point to make Ramona feel guilty and trivial. Because she did not observe him behave condescendingly towards the other interns, Ramona speculated that her colleague held a prejudice towards female engineers.

Questions:

1. Try to identify the range of different people which are directly or indirectly involved in this case: (going beyond the people immediately present). How might each describe this situation from their perspective? What emotions might they experience if made aware of this situation?
2. Who needs care in this situation (there can be more than one)?

3. Are there particular (social) competences that you expect professionals to bring to a situation like this?
4. Ramona has other roles she plays in her life (friend, employee, citizen…). What are these roles and which ones might be relevant in this situation?
5. Which parts of the situation is Ramona responsible for addressing? Are there others who bear some responsibility to resolve/address the situation?
6. What different actions (by Ramona, by managers, by other interns) might ensure that all those who need care in this situation are supported?

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Introduction

In the last few chapters we have looked at how individual psychological factors impacts on ethical decision making. We have looked a little at how the presences of other people can affect this (such as with bystander effects) but up to this point 'other people' have been largely absent from the discussion. This chapter looks in more detail at the social context in which engineering ethical decisions are made. In particular it looks at how (a) the teams that we are part of and (b) the organisations in which we work, can be relevant in terms of engineering ethics decisions.

In this chapter we look at this social context of ethics in two ways:

1. How people are ethical in their interaction with others in their immediate social environment, in particular whether or not people in our immediate social environment are discriminated against, harassed, assaulted or otherwise subject to unethical interactions.
2. How the distribution of power, the rules in place, and the processes for decision making makes it more or less likely that ethics issues or issues of human or environmental impact are taken seriously in a team or in an organisation.

We start by looking at the idea that engineering problems require interdisciplinary teams, and we then move on to look at how power is distributed in interdisciplinary engineering teams. To do this I introduce the idea of 'discourse' as a way of thinking about 'invisible' power. We then look at how the organisational culture can make it more or less likely that human impact or ethics issues are raised.

If particular patterns of interaction exist in industry it is, in part, because people learn them in university. We will therefore then turn our attention to patterns of interaction in teams and classes in engineering education. Part of this involves looking at data on sexual harassment and assault in university.

Please note that, because of the topics it covers, this chapter describes experiences that can be upsetting and may raise issues which may have personal implications for you. Please take care of yourself in making your decision as to how to read this chapter.

Interdisciplinary teams in engineering

In university, students are most of the time assessed as individuals on their own personal learning. This can give an unrealistic picture of how professional life actually functions: engineers rarely work as individuals, but usually as part of teams in which it is the success of the team that is important. This reflects the fact that real-world problems are often complex which involve an understanding of social and economic factors alongside technical factors.

To take an example, during the COVID pandemic, contact tracing apps (which identified whether or not a person's mobile phone had recently been in proximity to the mobile phone of a person who subsequently tested positive for COVID) had a potential to reduce the spread of the disease. In some US states, however, uptake accounted for only 3% or 4% of the adult population (in September 2020, Nevada had more than 10,000 new COVID cases but a total of zero exposures notified via their app) (De la Garza, 2020). In Europe uptake rates were higher than in the US with an average uptake of 23% - as high as 51% in Finland and 45% in Ireland but as low as 4% in Poland and 2% in Croatia. Uptake depended on factors such as age, gender, education level, existence of comorbid illnesses, trust in government, level and nature of concerns about privacy, coherence of public health messages, the user interface and features of the app, and level of comfort with using smartphone apps (Kahnback et al, 2021). Developing an effective COVD tracing app, then, required not just technical engineering expertise, but also an understanding of the privacy and trust concerns in wider society, the diversity of potential users and their prior knowledge and habits, the mechanisms of effective public communication, as well as the design of effective user interfaces. Solving a problem like this requires a multidisciplinary team in which everyone's expertise is taken seriously as contributing to the solution. The same is likely to be true for many other dimensions of the COVID pandemic response (multiple social and health effects of lockdowns, vaccine uptake, the dynamics of interactions in elderly-care homes etc.). Recent analyses of research, however, indicates that interdisciplinarity was not a notable feature of COVID research at the time the pandemic was ongoing (Seidlmayer et al., 2024).

If research team diversity is important (and often missing) in responding to complex problems, it may also be important in good decision making in other ways. Sommers (2006) found that socially diverse teams (his research focused on ethic/'racial' diversity) tend to discuss in more detail, to have fewer inaccuracies in discussions and to be more successful at correcting inaccurate statements when compared to less diverse teams. Diverse teams may feel less comfortable for participants, but the discomfort may be functional in reducing the risk of 'groupthink'. In another example, Diaz-Garcia et al. (2013) looked at the relationship between gender diversity in R&D teams and the success of these teams in bringing new innovations to the market. Drawing on a dataset of 4,277 companies, they found that, while factors like firm size and the sector of the economy had no impact on success of radical innovation, increased gender diversity in R&D teams did (see also Østergaard, 2011).

Given that both social and disciplinary diversity has been found to contribute to good decision making in so many ways, it is perhaps not surprising, then, that the public discussion about solving complex problems refers to interdisciplinary work and uses language like integration, mutuality, reciprocity, exchange and shared solutions (Callard and Fitzgerald, 2015: 100). One of the features of teamwork, however, is the way in which power can impact on the functioning of the team. This chapter will look at some of the ways in which power can impact on engineering teams, and the implications of this for engineering ethics.

Power in words and stories

One of the ways that social scientists look at power in social groups (such as teams) is to look at how language and power interacts through looking at the use of words and stories. This is particularly important in looking at invisible power (the concept of invisible power will be discussed below). A key idea is that, in addition to the obvious meaning of any given word or phrase, there are also often a set of hidden or implicit meanings. An example is provided by Bruzzone and Gherardi (2025) who describe the development of technology to forecast and prevent wildfires in the Mediterranean region. They describe how the term 'wildfire' ends up having quite different implicit meanings for the different groups involved in the project. For the foresters who seek to manage and fight wildfires, an unstated assumption is that the fires are typically caused by arson. The engineers who are developing forecasting models do not share this assumption. For the forecasters, providing information about the level of risk of wildfire in a given area is useful in helping the general public to take responsible actions to reduce the risk of fire as well as enabling them to avoid potential danger, while for the foresters, providing the public with information about the level of fire risk is seen as potentially aiding criminals in planning for making their arson more devastating. They, therefore, approach forecasting as primarily providing information for policing purposes and not for distribution to the general public. In this case, the term 'fire' – which is used by both the foresters and forecasters – has two different meanings. These meanings are implicit; they are so taken for granted by each of the two groups that they hardly feel the need to explain the implications of the term. These different meanings are likely to be underpinned by the different stories each group tells (e.g. stories about arson vs stories about someone who was able to take preventative action because they had good forecasting information).

Social scientists refer to these different implicit meanings and stories as 'discourses'. The term 'discourse' refers to a set of (often implicit) meanings that help to organise the way people see the world. Discourses do not simply exist in the world, they are created by people in interaction with each other. But, once created, they can shape how people think and the things they see as possible or desirable. A feature of discourse is that different groups may well tell different stories and have different implicit meanings attached to words, and interaction between them is often focused on whose meanings get accepted as true or 'common-sense'. In the case described by Bruzzone and Gherardi (2025), the foresters tended to be more successful in having their understanding of the term 'wildfire' accepted in public policy. As a result, the potential of the forecasting technology to reduce the risk and impact of fires (as it is conceived by the forecasters) was not fully realised because the engineer's conception of what fire is and how to prevent it is at odds with the implicit meanings of those who are leading the response in this specific situation.

There are a few important implications of this idea of 'discourse'.

- First, language and implicit meaning are seen as important, not just in *describing* reality but also in shaping how people *view* the world, and consequently how they act in the world (some people go further and say that how people *see* reality *is* reality, but one does not have to accept this idea to see value in the concept of discourse).
- Second, when there are different implicit meanings (discourses), part of the way power operates is by one group managing to have their implicit meanings accepted as being the true or common-sense meaning.

- Third, because these important meanings are implicit and accepted as 'common-sense', it can be difficult to discuss them because it is easy to dismiss any attempt to discuss them as pedantic or lacking in 'common-sense'.

Engineering in teams

In project teams that include engineers, one of the factors that can impact on whose stories and meanings become 'common-sense' is 'expert' status. Those who are recognised as 'experts' are often assumed to know what they are talking about. They will often also use language and means of communication (particular types of charts, graphics, quantitative results etc.) that are not widely understood by those who are non-experts (or who are experts in a different discipline). This can make it less likely that 'experts' are questioned or challenged.

In many project teams, the distinction is not just between 'expert' and 'non-expert' but also between different groups of 'experts'. Some disciplines may have greater social status or economic power than others. As the researchers Callard and Fitzgerald, who researched collaboration between neuroscientists and social scientists state "interdisciplinarity is entangled in much thicker structures of power than either its promoters or its practitioners are willing to recognise" (2015: 98):

> Go to the bar at any science and technology studies conference, and it won't take too many drinks before social scientists start telling you about how their research is often understood as 'public engagement'; how they consistently have to justify their expertise to their collaborators; how they have to translate (or sometimes give up on) their conceptual language in a way that is not always reciprocated, and so on. This doesn't mean that life scientists in collaborations are especially power-hungry; or that they behave badly (no doubt most would be surprised and taken aback to learn that their collaborators would narrate their experience in such ways). But it *is* to say that when a group of people collaborate within institutional structures that end up placing the more highly valued epistemological frameworks, as well as financial resources, largely on one side, then asymmetries result (2015: 97).

Callard and Fitzgerald identify a number of dimensions to this power imbalance:

1. *Higher social status of natural sciences:* They note that technical and natural sciences are afforded higher status in society (and thus are more likely to have their implicit meanings accepted as 'reality'). This can be seen in how technical schools (like MIT or EPFL) are regarded as more elite than those doing social or humanities research, in the differences in funding which is awarded to different disciplines, as well as in less tangible things like to visibility of different disciplines in the media (Gauchat & Andrews, 2018). Gauchat and Andrews found that, in the US, while only 0.1% of respondents had never heard of the academic discipline of 'Medicine', and 1.7% had never heard of 'Biology', 11.9% had never heard of 'Sociology'. Medicine was regarded as 'very scientific' by 82.8% of respondents, Biology by 71%, and Sociology by 9.5%. The word 'scientific' here is not simply a description of a reality but rather a term that carries with it implicit meanings (a discourse) which tend to imply that 'scientific' is better and more high status than 'non-scientific'.
2. *Epistemological hierarchies:* 'Epistemology' refers to the way in which people come to know things. Different disciplines typically have different epistemologies, different ways of coming to know. This includes different ways of asking questions (framing hypotheses vs asking more open research questions), differences in the methods used to answer those questions (quantitative and experimental methods being more common in natural sciences or psychology, while social and human sciences have greater use of qualitative data and non-experimental data), and ways of thinking about generalisability (with natural sciences more often focused on things which are 'always true' and social sciences more often focused on findings which depend on multiple contextual factors). In public discourse, the epistemologies of natural scientists and engineers are then described using terms like 'rigorous', 'exciting' and 'providing

solutions', while social scientists are more likely to be described as non-rigorous, boring and irrelevant (Lélé & Norgaard 2005: 971–972). Gardner, who researched interdisciplinary collaboration in sustainability projects found social sciences were described using terms like 'squishy', and that natural scientists interviewed wondered "Where were the hypotheses? How much data were gathered? Where are the statistics?", while another said "I have … walked away wondering what the point was" (Gardner 2012: 248). Again, terms like 'rigorous' here do not only have a formal meaning but also carry an implicit meaning: since rigorous is 'good', automatically assuming that natural sciences is rigorous without needing to question they ways in which a different methodology might also be rigorous shows the discourse in operation.

These differences in power between disciplines are perhaps more difficult to identify in part because they rely on taken for granted assumptions. That is, the idea that some types of question and some research methods are 'better' than others is simply not questioned – it becomes "common-sense". Cullen et al., writing about interdisciplinary work in agro-sciences distinguish between three types of power:

- *Visible* power refers to formal decision-making processes, such as who is in charge when meetings take place, who controls the budget and who has the final say.
- *Hidden* power, focuses on how organisations work in ways that are unquestioned, such who decides what questions get discussed in the first place, how some issues become important to solve (often technical issues) while other issues (such as issues to do with users of technology or those impacted by it) are identified as second order questions, and the ways in which some people get to participate in discussions while others are left outside.

- *Invisible* power, focuses on how power is embedded in "common-sense" discourses, that is in the ideas, values customs and ways of doing things that are so taken for granted as being superior that this assumption becomes invisible.

Cullen et al., studied interdisciplinary work in crop breeding, in which biophysical scientists (often in Western countries), collaborated with social scientists to develop new crop varieties that would be tested in countries like Uganda, Haiti, Costa Rica, Senegal, Malawi, and used in Kenya, Tanzania, Mozambique, Burkina Faso and Niger (these countries are quite different from each other and have a range of different social settings in which the crop varieties would be used).

They found that biophysical scientists had *visible* power over their social science collaborators in a number of ways. While biophysical scientists set the agenda as to what work would be done (including framing of project proposals, research questions, budget allocations and methodological approaches), social scientists were seen as 'service providers' who undertook work assigned to them. This work often focused on diffusing innovations that had been developed by biophysical scientists. If they were involved in the conceptualisation stage of the project it was to add some nuance to already framed questions (such as suggesting a focus on gender and youth in crop adoption studies). Few social scientists became managers and so they had limited formal decision-making roles (of the 21 people involved in the project management, 17 were biophysical scientists). Differences in visible power were not only disciplinary: nine of the twelve project leads were men, and the women were often co-leads rather than leading alone. The people identified as the 'big names' on the project were all men. The country of origin of the person was also a factor in visible power in that those working in African settings in the project had less formal authority: as one woman scientist in the project stated: "We do not have the same voice, or if we propose something it's never really that important… if you propose something in a meeting… and then it [the same idea] comes from somebody in the West suddenly it's like whoa, yeah, that's a really great idea'".

Cullen et al. identified *hidden* power as operating in the way in which some agendas and participants were excluded from decision making. Since the biophysical scientists were responsible for framing of project proposals, research questions, budget allocations and methodological approaches, they decide when social and economic data becomes part of the analysis. The role of the social scientist is often seen to be an intermediary between the biophysical scientist and the end users (typically farmers in African countries). The job of the social scientist is to understand both farmers and bio-scientists: there is no reciprocal expectation that the bio-scientists will need to understand social scientific methods or questions (Callard and Fitzgerald, [2015] note the same in their study of social scientist-neuroscientist collaboration – and the same thing is evident in the natural scientist quoted by Garnder [2012], above). One impact of this is that the social scientific component of the project becomes set up in ways that guarantee that it will not be able to make a contribution to the project. In the crop breeding project, social scientists were to interact with farmers to help identify what crop traits should be targeted. Insufficient time was allocated to this work, as the biophysical scientists needed to begin work on breeding straight away. Hence the design of the project was such that the biophysical scientists needed to begin work without actually understanding the needs. More than that, the focus on the farmers and their needs became perceived as a blockage to successful delivery of the project. As one person remarked, the biophysical scientists "are frustrated … They think we are delaying their outputs". Again, these differences in hidden power were not only linked to discipline. The project goals prioritised some traits (yield) over others (nutrition, or multiple uses of different crop parts, such as using leaves for fodder). Such decisions can have important impacts on relationships and inequalities within communities affected by these technological change. In developing countries, new technologies can widen disparities between comparatively well-off farmers who have access to land and credit, and poorer farmers who often have insecure ownership and tenancy, and a lack of access to credit or technology. This means that new technologies can bypass poorer farmers. Similarly, women farmers and households headed by women have been found by researchers to gain less than their male counterparts from technological developments in agriculture (Pingali, 2012), sometimes because such developments tend to focus on developments focused on selling crops rather than on crops being used by families. Prioritising one outcome (yield) over others (such as nutrition or the use of leaves as fodder) can have unintended consequences when dropped into specific social environments which are poorly understood.

Cullen et al. identify *hidden* power as being visible in the way in which a sense of inferiority had been internalised by the social scientists involved in the project. When asked about interdisciplinarity in the project, one social scientist said "interdisciplinarity is when there are social scientists working with *real* scientists". In contrast, a bio-physical scientist taking about the plant breeding field said "early in my career, the plant breeder was the king or queen of the domain, they could do whatever they want, they were all knowing". Cullen et al. note that these differences do not just emerge from within the project but reflect the prior beliefs, values and implicit attitudes that people learned in their university training as well as in wider society. As we have seen above, there are wider perceptions in society as to what constitutes 'rigour' and 'scientific' research. Much of the data collected by the social scientists from their work with farmers was qualitative ('qualitative' data refers to detailed, text-based, descriptions which are generally based on interviews and observations) rather than on the kinds of quantitative data that are socially accepted as ‘scientific’. Cullen et al. conclude:

> As approaches to collecting socially inclusive data are still being developed, this creates a sense of methodological inferiority, placing social scientists further on the back foot. This may also further reinforce perceptions about the inadequacy of social scientists (2023: 8).

This research work by Cullen et al. and Callard and Fitzgerald highlight that power dynamics in interdisciplinary teams can create situations in which different team members may have a greater ‘voice’ than others. It is important to note that both studies highlight that it is not a lack of goodwill or decency on behalf of the biophysical scientists that gives rise to these issues. Indeed, the biophysical scientists have actively chosen to be involved in interdisciplinary work. Rather it is the funding and organisational systems within which they operate, and the implicit meanings (discourses) which shape the understandings of everyone involved (natural scientists, social scientists and the wider public), which give rise to these issues.

Their work shows that these power differences can have different dimensions: disciplinary differences are prominent here, but so too are gender and country of origin. These power differentials impact on the ethics of bioengineering teams in two ways:

1. These power differentials can mean that questions about the impact of the research on the lives of others are deprioritised in bioengineering research. As we saw in chapter 1, one of the ways in which ‘ethics’ is sometimes understood is as ‘not-engineering’. If social scientific and philosophical questions are also seen as ‘squishy’, non-rigorous, boring and irrelevant, this can lead to a de-prioritisation of human impact or ethics questions. In Cullen et al.’s study, there were a number of implicit assumptions that underpinned the project, including that the focus should primarily be on yield

(irrespective of the identified needs of the communities in question), that the role of social scientists was to be intermediaries, and that some scientists are *real* scientists and others are not. These assumptions mean that some questions get deprioritised, including questions about the unintended consequences of the use of newly developed crops in diverse social settings which are unfamiliar to the biophysical researchers. One biophysical scientist quoted by Cullen et al. commented “the project is more of a crop improvement project, so our objectives are more important than other objectives” (2015:7).

2. These power differentials can be seen as an ethical issue in their own right. The IEEE is the largest professional organisation of technical and engineering disciplines. Its code of ethics (2020), for example, says members undertake “to treat all persons fairly and with respect, and to not engage in discrimination based on characteristics such as race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression” (as we have seen, the power differentials in the project were not only linked to discipline but also to gender and place of origin). The IEEE has, as one of its sub-bodies the Engineering Medicine & Biology Society (EMBS), specifically catering for Bioengineering. It’s Code of Ethics includes the principle: “Hold in high regard the inter-disciplinary nature of healthcare delivery and research. Foster collegial inter-disciplinary relationships. Respect, value, and acknowledge the contribution of others”.

Teams in organisations

The analysis of power dynamics in interdisciplinary teams up to this point have more or less assumed that these differences are present in all teams. But, clearly, we might expect some teams to have more power disparities than others and this might exacerbate the issues noted in the previous section.

While differences in internal team dynamics can be a result of an individual's psychology (i.e., there are good bosses and bad bosses, good colleagues and bad colleagues), they can also be linked to the way in which organisations are set up. For example, studies of diversity and discrimination in research organisations have found that a number of organisational factors seem to be linked to increased risk of discrimination (Müller et al., 2022). These include:

- *Organisational diversity:* Organisations which have historically had lower levels of diversity (e.g. where women are historically under represented) are at risk of increased discrimination.
- *Power differentials: R*esearch organisations often have 'high value employees' who have very secure status (tenure), and who are embedded in a social network with managers, alongside other employees who are less valued by the organisation, who are less well connected to senior figures in the institution, and who are more insecure in their employment status. High power differentials are linked to increased risk of discrimination.
- *Isolation:* Situations in which people work in teams that are isolated from others in the organisation seems to increase the risk of discrimination.
- *Effective Organisational Policies:* Organisations that communicate effectively about discrimination and which make available working mechanisms for reporting and investigation seem to reduce the risk of discrimination.

While these risk factors are specifically linked to the ethical risk of discrimination in teams, similar sets of organisational characteristics come up in studies of other examples of antisocial behaviour in organisations, including sexual harassment and detrimental research practices (i.e. scientific misconduct).

Case Studies: Ethics of power in interaction in organisations

Here is a case you previously saw in Week 2:

Etienne is a Master student working on a semester project in a lab. The semester project is contributing to a bigger project that is being managed by a post doc and also has inputs from two PhD students.

When Etienne presents some of his collected data, the post doc in charge of the project suggests that a number of data points be removed from the analysis. These are outliers, they suggest, which have probably come from an error in data collection.

Etienne is a little uneasy about removing these outliers as it remains unclear to him how they arose. But the amount of data being removed is quite small, and no one else in the team raises any concerns about removing them.

Questions:

1. How might hidden or invisible power be impacting on the likelihood of different team members speaking in this case?
2. What kinds of things might a team do to ensure that all team members feel able to speak up if they have a question or a concern?

Here is a new case:
Sanna has just joined the lively start-up, *Company X*. They are struck by its casual yet energetic atmosphere. On their first day, they quickly notice that this isn't a typical office: tasks, teams, and even routine meetings all seem to have quirky, informal names. There's talk of "The Code Crackers," a team tasked with solving critical tech issues, and an upcoming "Think Tank Thursday," an all-hands brainstorming session where everyone gathers for a creative idea exchange. Throughout the day, colleagues mention grabbing a "glorp" (the team's quirky code for a coffee break), and you notice everyone seems to intuitively understand this insider lingo.

Questions:

1. How does the use of informal jargon and humorous language contribute to workplace culture?
2. What potential ethical issues might be reduced by such a workplace culture?
3. What potential ethical or practical concerns could arise from using jargon and humour in a professional setting?

Learning to be engineers in teams

(Please note that this section includes data on sexual harassment and assault in EPFL. They contain language that is discriminatory and describe experiences that can be upsetting. They can raise issues of which you may have personal experiences. Please take care of yourself in making your decision as to how to read this section).

Teams are not only a feature of engineering projects in industry; they are also a feature of learning to be an engineer in university. And these teams, can equally be sites of discrimination and power differentials. Kelly Cross and Marie Paretti (2015), for example, have found that interactions in student teams influenced how black students experienced coursework in engineering and work which my colleagues and I did with EPFL students (Aeby et al., 2019) found gender differences in experience in team projects.

The research carried out in EPFL focused on what happened with experienced students (those in 3rd year Bachelor or Masters) in project teams. In a survey, students were asked about the roles which they normally take in student team work. Women were more likely to be responsible for report writing ($p=0.023$), and far less likely to be responsible for technical aspects of the project such as coding, statistical work or mathematical proofs ($p<0.001$) (remember, these were all experienced students and so had all already shown their capability in the domain by passing multiple technical courses). Similar findings have been identified in international studies (Meadows and Sekaquaptewa, 2011) . Male students were more likely to be concerned that someone would not be able to handle technical aspects of a project when the task was to be assigned to a woman than when it was to be assigned to a man ($p=0.046$). Male students were more likely than female students say they are confident that their own opinions and suggestions would be valued by their fellow students ($p < 0.01$).

Other data on engineering student interaction patterns in teams comes from US research (Wolfe and Powell, 2009) which looked at how different forms of speech were perceived by engineering students. Forms of speech which were self-criticising (e.g., "Just so as you know, I don't know how to write a preface") or which were apologetic (e.g., "that's just me being picky") were viewed more negatively by male engineering students than they were by both female engineering students and by students in other disciplines. As compared to other students, male engineering students were significantly more likely to see the speaker as whining, ($p < 0.001$), incapable ($p < 0.01$), insecure ($p < 0.001$), wasting time ($p < 0.01$), and were less likely to want to be on a team with the speaker ($p < 0.05$). This seems to suggest that communication norms in engineering disciplines – at least among male students (who are often the majority) – tend not to accept self-critical or apologetic speech. The researchers conclude that "the consequences for displaying weakness may be much more negative in engineering settings than in other social environments" (2009: 13).

And, as in other organisations, it is not just the norms of interaction within the group but also the wider organisational cultural norms. Research in EPFL (Tormey, 2021) found notable differences in student experiences of harassment and discrimination. For example, when asked if they had have experienced derogatory or inappropriate comments based on their sex, 36.0% (±4.4%) of women students reported this happening 'sometimes', 'often' or 'very often', as compared to 1.3% of men student (the rate for students with a gender identity other than a binary man/woman was around 20%, but the number of such participants was so low as to make it hard to draw inferences from this data). Participants were also asked about unwanted physical contact (defined as someone placing their hand on your shoulder or back, pressing up against you, or stroking or pinching) and sexual assault (defined as any unwanted physical contact on the buttocks, genitals, breasts, mouth or between the thighs). For Female students in EPFL 33.0% (±4.3%) report having been victim of unwanted physical contact and 14.0% (±3.2%) report being the victim of a sexual assault during their work or studies at EPFL (including an exchange, internship or student social activities).

It is worth noting that such negative experiences do not always end when a person has completed their bachelor or master education. There are multiple studies which find similar patterns of behaviour in, for example, academic conferences (See National Academies of Sciences, Engineering, and Medicine, 2018; Custer, 2019).

Case study: Reducing the risk of harassment, assault and discrimination in engineering education

This testimony is from an EPFL Bachelor-level Architecture student. The testimony is in their own words and was given to a student association running a #MeToo campaign.

"It was in first year, in an room in CO [i.e. an empty classroom in the centre of campus] where I was doing my structure exercises one late afternoon on a Wednesday. A group of guys enters the room and sits down right behind me. They talk loudly enough so that I can hear everything they are saying since they're really close. They were constantly using really degrading terms by insulting each other of faggot, pansy, fairy. There was really not one sentence without a homophobic insult and they talked really aggressively. Even if these insults weren't directed at me, I was devastated to the extent that I did not feel safe and had to leave the room to go cry outside, because it was just too much".

1. Who are the different people implicated in cases of derogatory and inappropriate comments, or sexual assault in engineering education (going beyond those immediately involved…)?
2. How might each person describe such an incident from their perspective? What are the unspoken assumptions which may underpin different perspectives?
3. What emotions might each person feel in such circumstances? What are the likely thought-action consequences of those emotions?

4. Who in this situation needs care and who gives care?
5. Refer back to the features of organisations that are linked to increased risk of discrimination (Historical organisational diversity; Power differentials; Isolation; Effective Organisational Policies). How might someone use this information to reduce risks in an organisation?
6. How can an educational organization like EPFL act to maximise the chance that those who need and give care are supported?

Conclusion

Engineering Ethics is often thought of as if it refers to an individual person making difficult decisions about their work on their own. This differs from the reality in a number of ways. First, engineers generally work as part of teams and their goals are shared by a team. There are factors – such as power dynamics in interdisciplinary teams – that may affect the extent to which ethics questions, related to impacts on people or entities, are seen as being part of the work of the team. These power dynamics operate in terms of different disciplines but also operate in terms of other social factors like gender and place of origin. It is important to note that this is not simply a question of good and bad bosses and colleagues, but rather it is often a function of the culture, funding, and organisation of the team itself.

Interactions in teams are not only important in terms of how they affect the way a project focuses on who is impacted by the project and how: interaction with colleagues is itself an ethical issue. The Medicine & Biology Society of the IEEE, for example, includes in it's code of ethics that bioengineers "Hold in high regard the inter-disciplinary nature of healthcare delivery and research. Foster collegial inter-disciplinary relationships. Respect, value, and acknowledge the contribution of others". Doing this does not simply mean deciding as an individual to respect others, but it also means creating organisations that reduce the risk of discrimination and disrespectful relationships.

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