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Chapter 9

How Engineers Can Care from a Distance

Promoting Moral Sensitivity in Engineering Ethics Education

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Moral (or ethical) sensitivity is widely viewed as a foundational learning goal in engineering ethics education. A recent literature review of US-based engineering ethics interventions, for instance, found that twenty-five out of the twenty-six reviewed articles listed "'ethical sensitivity or awareness" as a learning goal (Hess and Fore 2018). One particularly prominent account of the nature of moral sensitivity and what **it** means for professionals to acquire and exhibit it arise in a series of articles by Kathryn Weaver and Carl Mitcham (Weaver et al. 2008; Weaver and Mitcham 2016). who focus on nurses but maintain that their account equally applies to engineers. They argue that engineers-much like nurses are engaged in an activity in which moral sensitivity plays a central role, namely an activity of *caring* for others. They readily acknowledge, however, that the target of care in the engineer ing context is crucially different from the target of care in the nursing con text. The nurse attempts to be sensitive to the particular needs of individual patients. We call this *parliculari:ed care.* The engineer, by contrast is tasked with designing and maintaining structures and systems that, ideally, help take care of society at large. Though Weaver and Mitcham acknowledge this contrast. it is drawn too quickly. We wager that fostering *care* within engineers-in-training requires that close attention be given to the phenom enological difference between ..the to-be-cared-for Other" in the world of the

engineer [the *engineers Other]* and the ·'to-be-cared-for Other" in the world of the nurse [the *nurses Other].* The phenomenological approach interrogates the manner in which the Other is experientially manifest in one's activities. As the phenomenological tradition has emphasized, our experience of other people is shaped by shared practical contexts. or worlds, which are textured by background practices, norms, and ideologies (see Gallagher 2007). By explicating the phenomenological specificity of the to-be-cared-for-Other in the world of the engineer, we can identify more precisely what kind of care we can expect from and help cultivate within engineers (in training).

We focus on two dimensions of the engineer's world that can have a for mative effect on how the engineer's Other is constituted. First, at a practical level, the relationship between the engineer and her Other is characterized by *distance,* which is unavoidably built into the engineer's practices and activities. This is contrasted with the nurse's Other, who is characterized by *proximity.* This contrast brings out a problem or challenge: what exactly does it mean to care for an Other who is marked by distance? Second, at an ideo logical level, the world of the engineer is prone to a particular discourse a particular way of understanding what engineering is, what it produces, and what it means to be a good engineer. This discourse is marked by an *ideology of neutrality,* an umbrella term we use to refer to several interconnected back ground commitments. When internalized, these background commitments exacerbate the distance between the engineer and her Other, complicating the engineering student's understanding of herself qua care-taker.

But engineering and design students can also be exposed to an alternative image of the engineer: as someone tasked with caring for society at large through thoroughly normative, value-laden activities. Yet while notions of care and care ethics have slowly penneated through scholarship (e.g.. Adam and Groves 2011; Vallor 2016; van Wynsberghe 2016), the explicit delinea tion of care-centered approaches in engineering ethics education is still rela tively novel (e.g., Russell and Vinsel 2019).

In this chapter, we aim to further develop such approaches by proposing that the pedagogical endeavor of cultivating moral sensitivity-via the notion of care-taking-should include two aims. It should dispel the ideology of neutrality while offering a *positive* image of what it means for an engineer to care for her Other. This requires that we take up the question of "What does it means to care for an Other who is marked by distance?"' Relatedly. we must ask what it means to promote such care through our educational endeavors. While the type of care characteristic of the nurse is particularized care, the two types of care relevant for the engineering context are what we call *generalized care* and *universalized care.* Generalized care refers to the practice of attending to the needs. concerns, emotions, and desires of those

who are affected by the products and activities of engineering by taking one or some individuals as representatives of a larger cohort of stakeholders. Universalized care is exhibited when engineering activities of design and maintenance reflect a responsiveness to a universally shared feature of the engineer's Other, namely her vulnerability as a technology-dependent being. While generalized care has received a fair amount of attention in engineering ethics education, both at our own institution and beyond, universalized care seems to have remained largely under the radar. Though our main contribution aims to be conceptual, we illustrate these different notions of care, and how they might be operationalized in engineering ethics education, via a recently developed pedagogical exercise, which we term a tinkering workshop.

MORAL SENSITIVITY: ITERATIVE MOVEMENT BETWEEN PERCEPTION, AFFECTIVITY, AND DIVIDING LOYALTIES

The notions of moral sensitivity and care are intimately related. Psychologist James R. Rest has developed an influential account of the idea that moral sensitivity involves an awareness of how others are affected by one's own actions which he argues makes moral sensitivity a foundational ethical competency for professionals like nurses and engineers. He presents moral sensitivity as the ability to ••interpret" or "perceive" a given situation in terms of how one·s own actions may or may not affect ·'the welfare of someone else either directly or indirectly" (1982, 29). Rest builds on research from the field of psychology to argue that, although basic, moral sensitivity is hardly automatic. Identifying salient ethical features of a situation and seeing it in terms of how one's own actions may affect both proximal and distant others are complicated by the fact that ··many people have difficulty in interpreting even relatively simple situations" and that '•individuals exhibit striking differences in their sensitivity to the needs and welfare of others" (29). We will expand on this idea, proposing in the next two sections that how one interprets "even relatively simple situations" and exhibits ••sensitivity to the needs and welfare of others" is, in professional contexts, partially determined by the practical and ideological ways in which one's professional world and one's role as a professional in that world are shaped.

While engaging with Rest's influential proposal, Mitcham et al. propose their own model of moral sensitivity. This model, which they develop via an engagement with the professional nursing context, consists of three interconnected moments: *moral perception, ajfectivity,* and *dividing loyalties* (Weaver et al. 2008, 8; see also Weaver and Mitcham 2016).

1. *Moral perception* is defined as an '•intuitive discrimination of cues and patterns;• that awakens a professional to -client and situational needs." Phenomenologically speaking, they wager that moral perception is experienced as ··a gut level •jolt"' in response to "some cue" that some thing in one·s routine activities-often performed unreflectively and habitually-warrants immediate anention (Weaver et al. 2008. 609).
2. *Ajfectivity* bears a strong conceptual similarity to empathy. It offers a ·•vivid rendering of what it means to be human ... based on the pro fessional puning of oneself in the place of clients." which ••increases responsiveness and preserves client dignity and caring" (609).
3. The act of *dividing loyalties* captures the importance of adopting "strat egies of interpretation. justification. and reflection" (609) in order to arrive at different perspectives on a relevant issue-which includes perspectives held by relevant stakeholders as well as those articulated in textual '·sources of knowledge (e.g.• expert opinions. policies and pro fessional conduct codes)." The act of dividing loyalties has the potential to "expose assumptions and privileges•· through "critical scrutiny of the larger social system." and to detach "from privileged relationships and the immediacy of the situation long enough to distinguish personal biases and assumptions·· (609 I0). As we will later suggest. a key '"bias and assumption" that must be targeted pedagogically in the fostering of moral sensitivity in engineers-in-training is the ideology of neutrality.

Weaver et al. (2008) believe each of these three components is a necessary condition for genuine moral sensitivity. A nurse must possess an openness to letting unreflective routine actions be interrupted by ·'a gut-level jolt:· the sense that something or someone in her perceptual environment requires an immediate response. But. by itself. moral perception falls short of moral sen sitivity. After all, Weaver et al. note, ·'spontaneous recognition of the moral issue can be inadequate or misleading" (610). Similarly. atfectivity, though crucial for a nurse's empathic grasp of her patient's humanity, can be ··sub ject to personal motives and misunderstanding." Think. for instance. of the evidence that implicit biases in health care providers can suppress moral per ception of and affectivity toward Black women during pregnancy, labor. and the postpartum period (Roeder 2019). A wider reflective perspective. through which a nurse can "solicit breadth and depth" about these issues, for instance by talking to advocacy groups or learning about the nature of implicit biases and their pernicious consequences. can circle back into moral perception and affectivity, thus widening the scope of her moral sensitivity. At the same time. Weaver and Mitcham wam that the sources professionals tum to in the pro cess of dividing loyalties can also be capable of--uphold[ing] the hierarchy of

more powerful stakeholders" or of"address[ing] only issues prior to code or policy development" (2016, 610). Hence. engaging in dividing loyalties with out perceptual and affective anunement to situational demands will fall short of establishing robust moral sensitivity. As Weaver and Mitcham conclude: ..When combined. the individual limitations of the attributes are overcome. In moving back and forth between moral perception. atTectivity and dividing loyalties. the professional modulates a situation through interpretive under standing and evaluation.. (6 I0).

THE WORLD OF NURSING AND THE WORLD OF ENGINEERING

The iterative nature of this view of moral sensitivity serves as the founda tion for the argument we make, namely that the specific world in which a professional is embedded-in our case the world of engineering-shapes how that professional can morally perceive and affectively respond to her to-be-cared-for Other. In homing in on the world of engineering and how moral sensitivity can be enacted there, we are critically examining Weaver and Mitcham's claim that their account of moral sensitivity, though devel oped in the nursing context, can be extended to the engineering context. As mentioned. Weaver and Mitcham (2016) and Weaver et al. (2008) invoke a care analogy between the profe ional life of the nurse and that of the engi neer. In both instances. they suggest. proper care is dependent on the three moments of moral sensitivity they have identified:

> Through moral perception, the professional distinguishes and appreciates the client's unique situation amid its complex context. Affected by the encounter, the professional is motivated to anticipate and alleviate the suffering {in nurs ing) or protect safety and welfare (engineering). To inform a reasoned and appropriate course of action, the professional explores and interprets the often divided perspectives and competing demands of involved stakeholders which can include clients. social institutions, and the public. (Weaver and Mitcham 2016, 6-7)

Note how Mitcham and Weaver focus on the engineer's relation to the *client* in establishing an analogy between moral perception in nursing and engineer ing contexts. But this move is problematic. For as they readily acknowledge. ··Engineers need to practice ethical sensitivity ... not just with regard to their immediate clients or employers but also with respect to all those who may be affected by their work" (14). This, then, raises the question: *What does it mean to care not only for the welfare of a particular individual client with*

whom one stands in an in-person dyadic relationship, but also, perhaps first and foremost, to care for the welfare of "all those who may be affected" by ones activities? When we talk about the engineer's Other, it is precisely the other in this sense ("all those who may be affected by their work") that inter ests us. From here on it is this Other that we refer to when we use the tenn *the engineers Other.* We now argue that there are important phenomenological differences between "the to-be-cared-for Other" in the world of the engineer (i.e., the *engineer:.· Other)* and the "to-be-cared-for Other" in the world of the nurse **(i.e.,** the *nurses Other).* We believe one must pay close attention to these differences in order to identify fruitful ways of promoting moral sensi tivity in engineers-in-training.

The Other in the Practical World of Nursing

As we saw, Rest maintained that moral sensitivity is hard to achieve, with "many people" finding it difficult to "interpre[t) even relatively simple situations" (1982, 29). Of course, one could ask what counts as a relatively simple situation, particularly in complex professional settings? As Weaver and Mitcham note, "The comprehensive recognition of ethical issues is dif ficult because such issues are almost always embedded in webs of social custom, personal and relational histories, and competing needs and interests of professional practice" (2016, 12). Perhaps it is better to say, then, that the difficulty of moral sensitivity lies not merely in the difficulty of •'interpreting even relatively simple situations;· but also in the complexity of situations themselves-where situations that have the appearance of simplicity are in fact multilayered and framed by a variety of relationships, norms, beliefs, institutional practices, demands, and ideologies. Ideological assumptions are the topic of the next section. In this section we look at the worlds of nursing and engineering from a practical point of view, as enacted through the practi cal day-to-day goals and activities of its professionals.

Mari Skancke Bjerknes and Ida Torunn Bjork's ethnographic sketch, derived from a study of newly qualified nurses, provides an entry into the practical world of nursing and how the nurse's Other is manifested as a target of care in this world. The study contains the following vignette of Tina, a nurse who just started working at a Norwegian university hospital:

> In one room, a young woman lay with her eyes c l o s e d . . . . Tina quietly approached the bedside and bent down, whispering: "Are you awake? Can I get you something to drink?" The patient only grunted in reply and did not open her eyes. Her face was pale and she had a kidney bowl on her chest holding some absorbent tissue. While looking at the intravenous catheter and checking the intravenous injection, Tina kept an eye on the patient's face. She stood there

for some minutes. After a period of silence, the patient replied, "'My mouth is dry, so perhaps just a swallow." A glass of fresh water was on the bedside table, and Tina carefully supported the patient and helped her take a small mouthful. The patient swallowed some water and spat out the rest. "Just a small swallow, yes, that's good," Tina said. After helping the patient into a comfortable posi tion, Tina said that she would be back again soon. On the way out. I noticed a soft light in the single room, a glow from the lamp beside the bed, positioned in such a way that it would not bother the patient. I asked Tina about this patient afterwards, and she told me that the patient had a serious disease, hyperemesis gravidarum, which meant that she was constantly sick with nausea and vomit ing. The patient would have to stay in bed for months or possibly for her entire pregnancy, and she was not supposed 10 have anything to drink or eat. "I really feel sorry for this patient, so young and being so sick day after day," she said. Later in the afternoon. and in between phone calls and her responsibilities for other patients, Tina slipped in to see the young pregnant woman. "I must not disturb her," she whispered to me. "I have to follow upand see if she is all right, and whether she has vomited." She helped the patient and offered her a special moisture stick in a glass of iced water to cleanse her mouth, which would give her a sense of tasting water. Tina's caring and sensitive attitude when taking care of the patient was in marked contrast with her much more determined and brisk manner of walking as soon as she was back in the corridor. (Bjerknes and Bj0rk 2012. 3)

Tina's actions reflect both the capacity of putting her acquired professional medical and technical knowledge into practice and of providing fine-grained, context-sensitive care for her patient's particular needs, reflected in embod ied and linguistic registers. In adjusting her movements and the volume of her voice to accommodate her patient's condition, and in offering words of encouragement ("just a small swallow, yes, that's good"). Tina exhibits a ·•vivid rendering'" of her patient's particular needs and experiences. Some would argue that providing such care. which we have termed *particu/ar i::ed care,* is interwoven with the telos of nursing, with nurses-in-training typically referring to the care-providing component of their profession as the main motivation for pursuing this line of work (Bjerknes and Bj0rk 2012: Halperin and Mashiach-Eizenberg 2014). Of course. as already noted, pro viding uch patient-centered care is not the only responsibility of a nurse. Nurses operate in complex socio-technical systems shaped by different medi cal. technical. organizational. bureaucratic, social. and temporal demands. As such. we can understand nursing as involving a constant balancing-act of internalizing, implementing. and abiding by third-person professional norms and knowledge and exhibiting a continual responsiveness to the first-person experiential point of view of the patient, of attending to her expressed needs and emotions. weighing what these might mean and the best response given

the larger context of the patient's medical predicament. Despite the asym metrical epistemic relationship between the nurse and her Other. with the nurse possessing a body of professional knowledge about the patient's medi cal situation that the patient does not have, the nurse must simultaneously possess a readiness to take the patient's verbal and bodily expressions as capable of being authoritative and of determining the appropriate course of action in providing particularized care. This balancing act typically involves being able to "provide the technical aspects of practice *in an* [often] *unreflec tive manner"* while also allowing for this to be ••interrupted by some cue." The "awakening" to this cue, which Weaver, Morse, and Mitcham character ized as moral perception, is said to be experienced by nurses as ·'a gut-level jolt ... or worry." We propose that if *anyone* can bring about such a gut-level jolt, disrupting absorption in habitually executed professional activities, it is a concrete particular human person, visible, present, and capable of changing the course of any routine interaction.

The Other in the Practical World of Engineering

In the practical world of engineers, a to-be-cared-for Other rarely plays this "jolt-producing" role because in-person interactions between engineers and their Other are far more restricted, and the kind of care engineers provide is almost never particularized. The activities of engineers in general are not aimed at the needs of particular others and a ·'vivid rendering" of their humanity, but at society at large or large cohorts within it. One cannot build or maintain a bridge by ·'awakening [to] and particularizing" the ·•situational needs" of everyone who will be crossing it or who will be otherwise affected by its presence. It seems, then, that Weaver, Morse, and Mitcham 's character izations of moral perception and affectivity miss the mark here. *We posit that seeing the Other as a particular person and meeting that person - particular needs is antithetical to the activity of engineering.* Maintaining and design ing products made for mass-scale use or mass-scale reproduction requires, by definition, that one treats the needs of the Other in a more homogenous uniform way. As such, we propose that where the nurse's relation to her Other is characterized by *proximity,* the engineer's relation to her Other is marked by *distance* (see figure 9.1).

The distance between the engineer and her Other can be brought out more concretely by taking a look at an ethnographic sketch of the engineer, involved in her day-to-day activities. In the following scene, described by Louis L. Bucciarelli, we ask you to trace to what extent the engineer's Other becomes manifest. is attended to and cared for, throughout the engineer's day-to-day practical activities:

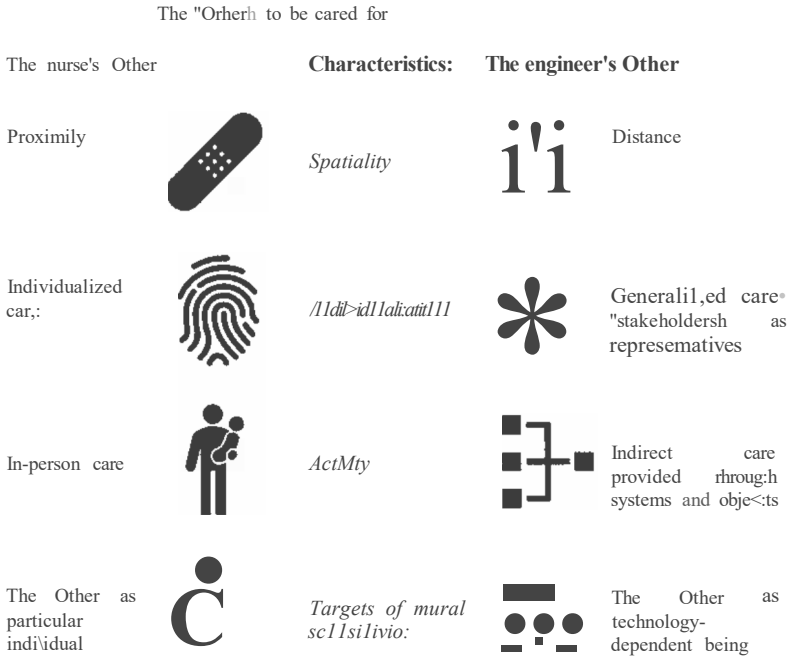

Figure 9.1. **The Nurse's Other and the Engineer's Other**

I observe members of the finn engaged in a variety of activities. Some of these are solitary: sketching at the board, running a computer analysis at the terminal, putting a prototype sub-system through its paces down in the lab, phoning a subcontractor back in the office, checking out codes in the library, conceptualiz ing, dreaming, detailing, cost-estimating, cursing, etc. Others are collaborative: sitting in on a design review in the board room, leading a meeting in the project manager's office, consulting with purchasing or production, advising the new hire, celebrating the shipment of the new product, negotiating time on the next design task, laughing, bantering, bickering, cursing, etc. (1988, 162)

The engineer's Other is nowhere to be found here. Much, though not all, of what the engineer attends to is what Bucciarelli tenns her ..object-world":

The mechanical engineer, designing a structure to hold the plates used to col limate an X-ray beam, moves within an object world of beams, of steel, of geo metric constraints, of stress levels, of close tolerances, of bearing surfaces, of positioning errors, of fasteners, and of metal machining practice. The electrical engineer designing a photo voltaic module works in tenns of voltage potentials,

> and of current flows. He sketches networks with special symbols for diodes and current sources, resistive elements, all within a meaningful topology. These are two different worlds. The project manager casts out schedules and milestones, worries about manpower allocation and development cost trends. speaks of interface constraints and critical paths: another object world. (162)

From these brief sketches, one can see that an engineer's proximal other is not in any immediate sense the to-be-cared for Other, but her colleagues with whom she collaborates, her direct clients, and the technological artifacts to be maintained or designed through her activities.

But the emphatic distance between the engineer and her to-be-cared-for Other is not just a result of the world of engineering understood in a day-to-day practical sense. The challenge of promoting a self-conception of the engineer as care-taker in engineering students is exacerbated by an ideology of neutrality that often circulates in the world of engineering and engineering education. Although the degree to which the ideology of neutral ity is internalized by students will depend on cultural and institutional varia tions, we maintain that traces of it are typically found at technical universities around the globe.

IDEOLOGICAL MECHANISMS SHAPING THE WORLD OF ENGINEERING

As we sketched in the previous section, being a good nurse involves a bal ancing act between internalizing and applying third-person expert knowledge (knowledge of clinical technology, diseases and bodily processes, institu tional rules and protocols) and taking seriously a patient's first-person reports and expressions of their needs, feelings, and sensations. Of course. individual nurses may fail in perfonning this difficult balancing act. For instance, moral perception and affectivity may be hindered by an overreliance on a third-person medical-technical apprehension of a situation and an undervalu ing of a patient's first-person reports.[3] We already mentioned. for instance, that the first-person reports of pregnant, birthing. or postpartum Black women are disregarded at a disproportionate and deadly rate (Roeder 2019). Crucially, though, we categorize these occurrences *as* failures. We think something has gone wrong in how the nurse executes precisely their role *as* a nurse. A good nurse, a nurse who performs their role well. is typically understood as someone who exhibits not only the practical medical-technical know-how characteristic of their field, but also as someone who is responsive to the humanity in their patients. someone who puts themself•'in the place of clients" with the aim of preserving '•client dignity and caring" (Weaver et al.

2008. 609). Attunement to a patient's expressed needs. feelings and emotions is as much a part of being a good nurse as exhibiting the required medical and technical knowledge.

Engineers and engineers-in-training are judged in strikingly different terms. Despite the fact that nearly every professional code of conduct for engineers characterizes engineering as an activity that ··must be dedicated to the protection of the public health. safety. and welfare·· and that "has a direct and vital impact on the quality of life for all people." the idea that engineers are *at their very core* in the business of care-taking is largely absent from the engineer-in-training's self-conception.[4] Anecdotally. when we ask TU Delft students what it means to be a good engineer. the answers we typically receive contain references to technical, scientific, and managerial skills. Being a good engineer in the care-taking ethical sense of the word tends to be seen as a separate category from being a good engineer in the functional sense of the word: it is of course viewed as commendable ifan engineer falls into both categories at once. but concerning oneself with the ethical care providing dimensions and consequences ofone's line of work is generally not seen as *constiflltive* of what it means to be a good (well-performing) engineer.

These anecdotal observations about how engineering students understand "the good engineer" are confirmed by engineering ethics educators at institu ions across the globe. In a focus group in 2019, we discussed the challenges of teaching ethics to engineering with thirteen engineering ethics lecturers and professors from a variety of institutions in Europe, Australia, and the United States.sOne of the main findings was that "'simply" getting students to see ethical issue as deeply intertwined with their practice (i.e., getting them to see how their technical activities might impact on the well-being of di tant others) was widely seen as a primary marker of success in teaching ethics to engineering students. ven at institutions that explicitly foreground ethics in their engineering curricula, the idea that engineers are *at heart* involved in an irreducibly ethical endeavor of caring for direct and indirect stakeholders does not seem to feature prominently among students.

We believe this is true in part because engineering students either explicitly or implicitly accept an ideology of neutrality. or one or more of the back ground assumptions of which this ideology consists (see also Cech 2013).[6] We take this ideology to consist of the following views:

1. The *neutrality thesis* of technology
2. The *applied-science-view* of engineering
3. The *rationalistic view* of engineering-relevant knowledge
4. The *technocratic view* of the engineer as social actor

According to the neutrality thesis of technological artifacts, a technology's ability to promote or undennine human welfare is detennined by the inten tions of its users. Indeed, facial recognition technology, nuclear energy, and social media platforms are all products of engineering that can be used in ways that are good or bad for human beings and the planet at large. But the neutrality thesis states that there is nothing about these technologies *them selves-nothing* in their "nuts and bolts" to use Langdon Winner's phrase (1980, 28)-that undermines or promotes well-being.7 As such. the designing of technological artifacts too is deemed to be neutral with respect to ethics.

The idea that technological objects are value-neutral is related to a way of understanding the domain or activity of engineering itself, namely as the prac tical application of rigorous scientific theorizing. As Vermaas et al. explain, this '"applied-science-view cannot be separated from the way in which engi neers perceived themselves. From the dawn of the Industrial Revolution until far into the last century, traditional engineering disciplines such as civil and mechanical engineering shifted increasingly from continuations of practical and traditional craftsmanship to the scientific end of the spectrum" (2011, 55-56). As they further point out, this shift directly impacted on the educa tion of engineers: "engineering curricula were organized in such a way that students were taught, above all else, just how to apply the theories gained from applied scientific research" (56).

If students are taught that engineering is an activity that takes "pure" descriptive scientific knowledge and chums that knowledge into value-neutral artifacts, this will inform students' conception of what it is to perform that activity well, what it means to become a good engineer. Good engineers are seen as

> no-nonsense problem solvers, guided by scientific rationality and an eye for invention, Efficiency and practicality are the buzzwords. Emotional bias and ungrounded action are anathemas. Give them a problem to solve, specify the boundary conditions, and let them go at it free of external influence (and responsibility). If problems should arise beyond the work bench or factory floor, these are better left to management or (heaven forbid) to politicians. (Herkert 2001,410)

Exhibiting care for and moral sensitivity toward the well-being of others is quite clearly not an integral part of the way in which the world of the engi neer and the engineer's role in the world at large are framed here. Although the applied-science-view of engineering has come under pressure in recent decades (see Vincenti 1990), and although countless engineering curricula have adopted a broader perspective on what it means to be a good engineer,

the effects of this view still continue to reverberate through the world in o which engineers-in-training are enculturated.

Sabine Roeser (2012) has challenged the view of engineers "as the arche type of people who make decisions in a rational and quantitative *way:·* Instead, she argues that what we need is "a new understanding of the com petencies of engineers: they should not be unemotional calculators; quite the opposite, they should work to cultivate their moral emotions and sensitivity·• (I 03). Attempts to cultivate this in engineers-in-training may be met with some reluctance. As an engineering ethics professor from TU Eindhoven pointed out in our focus group: "the students have this rationalistic view of ·these are the facts' and the things besides the facts are emotions and are irrelevant. We bring something else and there is resistance" (Marin, van Grunsven. and Stone 2022).

One way to tackle this is by confronting students with the questionable theoretical assumption that rationality and emotions are antithetical notions. This view rests on an oversimplified view of emotions that fails to take into account how emotions often help bring out morally salient features of a situation. To *feel* indignation when discovering that your children and you have been knowingly. avoidably, or even purposely exposed to dangerous toxic waste or psychologically damaging technologies is to exhibit a *rational* response to the morally salient features of those situations; it is a way of getting things right, in a moral sense, about what should or should not have occurred here. By contrast, someone who doesn't feel indignation is having a different cognitive understanding of the situation. an understanding that misses part of what is morally relevant: ·"By caring about certain things we are able to perceive evaluative aspects of the world that we would otherwise not be able to be aware of' (Roeser 2012, 106).

Our Ethics and Philosophy of Technology Section at TU Delft invites its engineering students to explicitly reflect on the value-neutrality thesis and the applied-science-view of technology (see van Grunsven et al. 2021). To give a simple example. by explicating the difference between descriptive versus normative statements and by asking students to categorize common engineering-statements, such as '·this high-frequency switch is *safe,"* or ··this is a *good* high-frequency switch." students begin to attend to the ineluctably normative-evaluative judgments that they make all the time. in a manner that problematizes the "applied science view" of engineering. And by asking students to use the value-neutrality thesis in order to make sense of com monplace innovations and artifacts such as the speed bump or hostile design (e.g., park benches designed so as to prevent homeless people from sleeping on them) (see Rosenberger 2020; Verbeek 2011), students become aware of the limits of the value-neutrality thesis and the ways in which technological

innovations profoundly shape the possibilities for action, the values, and the social infrastructure of society.

One reason why it is particularly important to challenge engineering stu dents' often unexamined dichotomous view of rationality versus emotions is that this view, when left in place, can exacerbate the already distant relation between the engineer and her Other. In the previous section, we argued that the moments when individual nurses prioritize third-personal knowledge wholly at the expense of a perceptual affective attunement to the needs and the emotions of her patients are moments of failure and believe that the nurse has failed in her role qua nurse. In the context of engineering, the ideo logical tenets we have identified can enact a world in which the engineer's Other's feelings and emotions tend to not just be improperly cared for but purposefully sidelined, as the emotionally charged responses of laypersons to technological innovations and interventions are discredited for reflecting a "non-rational" ill-infonned stance. As mentioned, we can invite students to question the legitimacy of this *technocratic* outlook by challenging the theo retical separation between rationality and emotion. Role-play activities, for example, in the fonn of stakeholder meetings, offer an embodied experiential way of trying to cross the distance that is created when engineers-in-training assume that her Other's emotional responses to a technology can be discred ited in virtue of their alleged irrationality. Weaver and Mitcham concur, pro posing that "Role taking opportunities ... help students identify blind spots that limit them from seeing others' perspectives" (2016, 7-8).

Indeed, without recognizing those other perspectives, engineers often incorporate their own assumptions and biases about what their users need into designs. To name just one of many examples: engineers and designers have been known to build augmentative and alternative communication (AAC) technologies for non-speaking children without actually consulting children in order to establish what symbols would optimally promote expressivity, thus unintentionally but effectively silencing a whole cohort of people whom they were precisely aiming to equip with effective expressive resources (Van Grunsven and Roeser 2022). This example illustrates that the link between being a good (well-functioning) engineer and being an engineer who cares for her stakeholder's needs, desires, and experiences is an intimate one, such that a failure to care in this sense is just a failure to do one's work well.

In a recently developed engineering ethics exercise, we encouraged stu dents to experience this link by asking them to redesign an existing techno logical health care artifact (Van Grunsven et al. 2022). These redesigns were meant to promote ethical values, particularly inclusivity, by considering first personal user-testimonials. In groups of four, students used scrap material to alter their selected artifact, explicating throughout the process how those material alterations bore on the needs and desires of their stakeholders. This

·'tinkering workshop" proved to be an effective hands-on way to challenge the ideology of neutrality and to bring out that a dimension of care for human persons was embedded within the activity of material tinkering. It facilitated reflection on the relationship between the specific needs and emotions of stakeholders and the designing of good technology in the functional sense. As one student, who altered a tricycle to improve mobility, put it:

> So we look at the tricycle.... We actually could move around with it and discuss with each other, like, what certain kind of situation would we be in or would this person be in. You can have more empathy.... We had to imagine that there was this person that had to use the tricycle to get up on a hill or something like that. That was the whole point. And we all were imagining how that would turn out.... Eventually just, we were all thinking ... what ifit was my grandma, how would she react? (Franssen 2022, interviewee 1, 6-10)

This passage highlights that the distance between the engineer and her Other can be partially overcome via exercises that connect concrete design choices with the expressed needs and desires of relevant cohorts of stakehold ers. However, the passage also exposes the challenges of care in this context. The students eventually tended toward particularized care, imagining the spe cific needs, desires, and challenges of their grandmothers. In reality, though, the engineer offers what can be labeled as *generali=ed care-care* that aims to close the distance between the engineer and her Other by taking seriously the needs, emotions, concerns, and desires of a group of stakeholders (e.g., aging adults with certain mobile disabilities, or non-speaking children who depend on AAC for their daily communication needs). Of course, by taking one or some individuals as representatives of a larger cohort, the engineer's efforts of providing generalized care, though undeniably essential, will at the same time fail to live up to the standards of care as identified by Weaver, Mitcham, and Morse. Generalized care by definition cannot exhibit the kind of particularized, situation-specific moral perception and affectivity toward persons that they have built into their account. The other in her particularity remains, to a degree, at a distance in engineering contexts.

If our phenomenological analysis is right in suggesting that distance is to some degree inevitably built into the engineer's relation to her Other, it questions the move to transpose a particularized notion of care (characteris• tic of the nursing context) into the engineering classroom. When contrasted with particularized care, the generalized care that we want to encourage in our engineering students may feel like a fundamentally flawed type of care (which in turn could de-motivate students from prioritizing such care). But perhaps there is an additional approach to introducing care into the engi neering education context. In addition to generalized care, we propose the

usefulness of what we call *universalized care.* This notion of care offers an alternative positive view of what it means to develop a sensitivity to an Other marked by an irreducible distance.

ENGINEERS AS MAINTAINERS AND THE NOTION OF UNIVERSALIZED CARE

In the previous section we cited Vermaas et al. (2011), who describe the historical shift away from engineering understood as a ··practical and tradi tional craftsmanship to the scientific end of the spectrum·• (56). This shift in the understanding of engineering points to the availability of an alternative discourse, a different way for thinking about what engineering is and what engineers (should) do. As Bucciarelli brings out, such an alternative is neces sary ifwe want to make sense ofa wide range of activities and judgments that do not fit in comfortably with the ideologized picture of the engineer as the applied scientist moving about in a pristine object-world:

> What engineers do, and are expected to do, includes much more than rational problem solving and constructing efficient means to reach desired, externally specified ends. In engineering practice, value judgements are made all the time, often not explicitly-about the user, about robustness, about quality, about responsibilities, safety. societal benefit, risks and cost. However. it is object-world work that is [often] seen as primary by engineering faculty-and consequently seen as such by our students. (Bucciarelli 2008, 143)

Here, then, is a sketch of the state of affairs as it pertains to engineering students being socialized into the world of engineering. There are at least two distinctly different discourses. two ways of framing what the world of engineering is like, what becoming a good engineer involves, what engineers in-training should practice and focus their attention on, what they should become sensitive to. One is the picture of the engineer as moving about in an ethically neutral world applying emotion-free scientific knowledge to pro duce value-neutral technical artifacts. The other is the picture of the engineer as essentially in the business of care. of attending (even if implicitly) to issues concerning a technology·s degrees of safety. risk. and ability to promote well-being in its users.

As Andrew Russell and Lee Vinsel have recently suggested, we can get a firm handle on the idea of engineering as a form of care via a realistic look at some of the ··basic facts of ordinary life with technology" and of the role that engineers play in maintaining this life (20 I 9. 256). *Maintaining* is the crucial notion here. For as Russell and Vinsel emphasize: ··Much of modem

life depends on well-functioning technological systems, and the vast majority of human work will always be aimed at maintaining them-that is. the labor is oriented towards taking care of the world and its inhabitants" (261). Indeed, over 70 percent of trained engineers dedicate their professional lives not to innovating and designing but to maintaining, to taking care of the technical systems that quietly support our daily functioning.[10] However, Russell and Vinsel note that in engineering education and "in most technology studies, maintenance, repair, and upkeep are largely ignored, rendered invisible" (256; see also Young 2021).

Russell and Vinsel draw a comparison between the quiet supporting role that women have traditionally played in maintaining the daily functioning of the family and engineers as quiet care-takers of the technical systems upon which we all depend. With this analogy, they present care ethics as the cen tral normative ethical theory to be incorporated into engineering education. For those familiar with care ethics, this suggestion may come as a surprise. After all, the emphasis in care ethics is typically on particularized care and ··the compelling moral salience of attending to and meeting the needs of the particular others for whom we take responsibility" (Held 2006. 10). Not sur prisingly. then. care ethics has played an important role in the education of nurses. It is perhaps fairly straightforward to imagine a positive role for care ethics in the evaluation of a particular subset of technological artifacts, such as care and service robots. which fulfill a central role in a dyadic relationship (see Van Wynsberghe 2016). But what Russell and Vinsel are proposing is that care ethics should be considered central for the education of engineers *tout court.* But. how can care ethics-as a theory that is in the first instance focused on dyadic, close personal relationships with and responsibilities to particular others-play such a central role?

We suggest that Russell and Vinsel's proposal. with its emphasis on maintenance, repair, upkeep, rehabilitation, and care for technical structures, opens up a positive approach to what it means to care *precisely* for a distant Other. Specifically. we propose that one important form of care in the world of engineering is what we call *universali=ed care.* Universalized care is care for the engineer's Other in her universally shared standing as a vulnerable technology-dependent being. as someone whose daily functioning and well being depends on well-functioning technological systems. Ensuring the safety of bridges and trains that support our daily travel. ensuring the availability and reliability of the digital infrastructures that increasingly enable many of our daily human activities and interactions, ensuring the integrity of pacemakers. wheel chairs, contraceptives and other health care technologies supporting our bodily health and autonomy-these activities can all be legitimately framed as ways of caring for people qua technology-dependent beings. Such care is perhaps most emphatically performed by maintaining. preserving, and

rehabilitating the technological structures that work well in quietly supporting our daily functioning. But it can also be exhibited, or precisely undermined, through the processes and products of innovation. Framing engineering as an activity of universalized care can underscore the profound moral failure of innovators who purposely exploit the ways in which human beings can become dependent on technologies. For instance, think of how engineers working for Facebook, lnstagram, and Apple intentionally operationalized such dependency in order to advance corporate financial interests, by build ing addictive properties into their innovations (Bhargava and Velasquez 2021; Wu 2017). By linking an in-class evaluation of these software engineers to a wider conception of engineering as care-taking, we can invite students to consider that, despite their technical skill in meeting design objectives, these engineers nevertheless fall short of being good engineers. Through the lens of the value-neutrality thesis, these engineers will likely be seen as good-that is, well-functioning-engineers who just happen to have morally bad inten tions. We propose a different take on the situation. Whereas the nurse fails in her role as a nurse when she lacks responsiveness to her Other's particular needs and well-being, we suggest that the engineers in this example fail in their role as engineers when they lack responsiveness to their Other by pur posely exploiting the universal human feature of technology-dependence to the detriment of their well-being.

We wager that the aforementioned tinkering workshop, though initially targeting generalized care, can also be utilized as a bridge toward reflecting on universalized care. Consider the following observation from one of the students who participated in the workshop:

> We don't want to just see how a tool can help people, but we want to also see how tools can be *embedded inside the life* of people....I didn't actually think about that before the project. I was just thinking that tools like this just help us, but its more than that. *Il's there to be a part of 011r lives.* If we have a certain disability, *you cannot do anything without that* [artifact]. (Franssen 2022, inter **viewee** 2, 2.62, italics added)

It is only a small step from here to encourage students to reflect on their own forms of technology dependency. After all, while technology depen dency is perhaps more obvious in contexts of illness and disability. we are all technology-dependent beings. The workshop, then, could be followed by a discussion in which students identify technological artifacts and systems in their own lives that highlight that dependency, exploring the different ethi cal implications thereof: do pervasively implemented lock-in technologies generate specific care duties to its technology-dependent users? What are the ways in which technology dependency has been purposely exploited and/

or unjustly distributed? And can we think of cases where technology depen dency has been tackled with care, be it through activities of maintaining or innovating the technological environment in which we all are embedded? Questions such as these could sensitize students to the dimension of univer salized care at stake in engineering endeavors.

In sum. engineers are not in the business of caring for her Other as a unique individual with whom she stands in a close personal relationship. We sug gested that generalized gestures toward overcoming the distance between the engineer and her Other, for instance through exercises that explicate the link between stakeholder testimonies and material design choices, are undeniably important. This pertains both to making sure one's designs optimally fulfill the needs of cohorts of stakeholders (recall the AAC technology example). and for exposing engineers-in-training to the idea that they are in the care-taking business. However. we also added to this that care for the Other-in the context of engineering-involves recognition of a more universal feature of the engineer's Other, namely their deep dependency on the technological systems that engineers design, build, and maintain. Recognizing this is fully compatible with. and puts forth, a positive view of what it means to care for an Other in her distance.

As we have seen. Mitcham and his collaborators understand moral sensitivity as an iterative movement between moral perception, affectivity and divid ing loyalties. What we have argued in this paper is that this view of moral sensitivity cannot be readily transported from the nursing context to the engineering context on the basis of a care analogy. The particularized care characteristic of the nursing context is decisively different from the general ized and universalized forms of care characteristic of the engineering contex . That said, we agreed with Mitcham and his collaborators that care should be foregrounded as a central notion for engineering (ethics) education. As Russell and Vinsel furthermore suggest. this points to a key role for care eth ics in engineering (ethics) curricula. While we do not disagree with Russell and Vinsel, we want to conclude by making the tentative suggestion that a bottom-up approach might be desirable. particularly in the male-dominated engineering world, where insights from a feminist ethics of care might be met with significant resistance. Though we should of course never insulate students from ideas they might initially feel uncomfortable with, there seems to be a pedagogical advantage to gradually getting students to see care-related concepts as being central to rather than external to engineering itself. This can be achieved through a pedagogical exercise that we have termed a *linker ing workshop*. Through this workshop students can discover that improving. altering, fixing, and augmenting technology is hardly a descriptive move in a value-neutral world. but that it can instead be seen as an activity of

care-taking, both in its generalized and universalized fonns. We think that this active learning exercise in which students discover, on their own, the prevalence of care-dimensions in engineering has the potential to introduce notions of care in the ethics classroom, while "meeting students where they are," to speak in the tenns of Mary Sunderland (2014).

To harken back once more to the picture of moral sensitivity with which we started our analysis: by linking activities of care with choices regarding mate rial and design, the engineering student's moral sensitivity can be refined, opening up a perceptual awakening and affectivity toward the complex nature of the engineer's Other. This awakening is in part promoted through an understanding of the ideology of neutrality as a moment in the history of engineering. Becoming aware of this ideology *as* an ideology can then be seen as an activity of *dividing loyalties* that allows for a reflexive and critical view of the biases and presuppositions inherited within the world of engineer ing. This process of deepening the engineering student's moral sensitivity is perhaps as much a process of the student becoming aware of her professional world, how it shapes her understanding of herself, and what it means to be a good engineer.

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NOTES

I. We will use the terms moral sensitivity and ethical sensitivity interchangeably (see also Weaver et al. 2008).

2. Though one could argue that engineers do sometimes cater to the specific needs of others, for example, when catering to the needs of(often corporate) clients. Thanks to Glen Miller for pointing this out.

3. Of course, other factors come into play as well, such as bureaucracy-with nurses getting bogged down in institutional rules and protocols-or time-pressure and an overload of patients to care for. And the balancing act goes both ways. A nurse could overvalue the expressed experience of a patient at the expense of situation-relevant third-person knowledge and protocol.

4. https://www.nspe.org/resources/ethics/code-ethics.

5. Admittedly, the data gathered from our focus group may reflect a Western bias.

6. Cech speaks of an ideology of depoliticization, which refers to the assumption that engineering is a strictly "'technical" space where 'social' or 'political' issues such as inequality are tangential to engineer's work" (2013. 67).

7. Winner is emphatically critical of the value-neutrality thesis. For a thorough overview of this literature, see Byron Newberry's "An Engineer Considers Techno logical (Non)Neutrality: 'But Where Are the Values?,'" chapter 8 of this book.

8. These examples are taken from the course *Philosophy of Engineel'ing Science and Design,* taught by our colleague Maarten Franssen (for a more comprehensive picture of the Delft approach to philosophy and ethics of engineering teaching see https://www.tudelft.nl/ethics/).

9. One might even want to argue that there are three pictures: (I) the picture of engineering as it is framed from the perspective of the ideology of neutrality; (2) a picture that recognizes ethics as important for engineers and which focuses on those ethical theories most in line with some of the rationalistic, calculative postures built into the first picture (in other words, the emphasis in the second view is on rule-based ethical theories and how they can help engineers make better ethical decisions); and then (3) the picture that foregrounds the role of emotions and attitudes of care as central to engineering qua activity.

10. As Russell and Vinsel note, "Most civil engineers work on keeping up existing physical infrastructures, like roads and bridges. Even in 'cutting-edge' fields, like software, about 70% of budgets go into maintenance and upkeep, whereas only about 8% of budgets go into new design" (2019, 257).

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