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ETHICAL THEORIES

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Introduction

Ethical theories analyze and justify what is morally right and wrong. Ethical theories, therefore, are *normative* theories that provide the systematic basis of arguments and viewpoints from which moral issues can be discussed. Within the context of engineering ethics education, Haws (2001, p. 226) claims that ethical theories "provide a more logical, systematic format for the resolution of ethical dilemmas." Martin and Schinzinger (2004, p. 81) define them as "attempts to provide clarity and consistency, systematic and comprehensive understanding, and helpful guidance in moral matters." Mastering at least the basics of important ethical theories is meant to enable students to reach the core aim of engineering ethics education, namely developing 'ethical competence,' that is, the ability to understand and solve ethical issues in the student's field of work based on well-reasoned ethical arguments and judgments as well as developing a corresponding personal ethical attitude for acting responsibly (Andersson et al., 2022; Franck, 2017) – although it should be noted that different conceptions of 'ethical competence' emphasize different components (Franck, 2017).

Although ethical theories provide a necessary normative framework to address moral questions, it is a matter of debate whether to use them in teaching engineering students. This debate is unfolding differently in different geographical regions and cultural traditions. In terms of engineering ethics education, the connection between cultural and ethical values (Alas, 2006) means that the degree to which ethical theories are adopted within different geographical regions depends upon various contextual factors, including educational systems and accreditation bodies. For example, within Great Britain, where the first professional engineering societies were formed, practitioners developed the first code of professional ethics, which was later used as a model for codes within the United States, and upon which the first US ethics textbooks were based (Didier, 2015). In comparison, "such codes are much less important in Europe than in North America" (Didier, 2015, p. 89). In Europe, engineering ethics is generally considered "an interdisciplinary reflection at the crossroads of professional ethics, the human and social sciences, and the philosophy of technology" (Didier, 2015, p. 87), and the development of engineering ethics was initially based on feelings of social responsibility, drawing upon insights from Science and Technology Studies (STS) (Polmear et al., 2019). Accordingly, engineers are placed within a complex system where technologies are developed in collaboration with other actors (Didier, 2015). Indeed, during their

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cultural comparison of macro-ethics teaching practices and perceptions in engineering, Polmear et al. (2019) found that US educators primarily taught codes of ethics, ethical design, and safety – and focused on an individualistic micro-ethical approach. Likewise, Hess and Fore (2018, p. 551) highlighted "that the most common methods for integrating ethics into engineering involved exposing students to codes/standards, utilizing case studies, and discussion activities." Although it should be noted that the consistent formulation and justification of professional codes still require a philosophical framework in terms of ethical theories, it is well worth asking if it is necessary to include this framework in teaching – or if referring to professional codes is already sufficient for students to develop ethical competence and an ethical attitude.

In this chapter, we will first provide an overview of the principal ethical theories used in engineering ethics education – namely *consequentialism*, *deontology*, and *virtue ethics* – before discussing contemporary aspects of the philosophical and ethical debates surrounding them. We will then provide a brief overview of several underrepresented ethical theories and approaches, including *contractarianism and contractualism*, *care ethics*, and *discourse ethics* (for an in-depth look at *non-Western ethics*, see Chapter 8) to paint a richer picture of how ethical theories could contribute to improving ethical competence among students. We will ultimately provide a summary of common problems or barriers that engineering students encounter when learning about ethical theories. The chapter concludes by discussing the need to use ethical theories when teaching engineering students, if one sees ethical competence as the primary learning goal. We begin by describing our shared perspective as authors.

Positionality

Two philosophers specializing in applied ethics (Michael and Rafaela) and two engineering academics with backgrounds in ethics (Natalie and Ester) authored this chapter. We share an interest in fostering responsible engineering in teaching. Based on influential ethics literature and years of experience teaching ethics to engineering students, we intend this chapter to provide an overview of ethical theories and their use within engineering ethics education for engineering teachers, students, and practitioners.

Ethical theories prominently used in engineering ethics education

Consequentialism and utilitarianism

Consequentialism is an ethical theory that places the consequences of an action at the center of ethical judgments. Every time we make a choice, we should choose the option that produces the best overall consequences, and only this option can be considered morally right or obligatory (Sinnott-Armstrong, 2022). *Utilitarianism* is considered a prime example of consequentialism. According to utilitarianism, an act is morally right only if its consequences create the most 'utility' (Driver, 2022). Note that the notion of 'utility,' including the idea of 'best' consequences, is not itself morally qualified but points to a *non-moral* understanding, for example, people's happiness or the maximum fulfillment of their particular interests or preferences.

When referred to in engineering ethics education, utilitarianism is typically taught based on the first two of its three classical authors as identified by van de Poel and Royakkers (2011, pp. 78–89): Jeremy Bentham (1748–1832) (Bentham, 1789); John Stuart Mill (1806–1873) (Mill, 1861); and Henry Sidgwick (1838–1900) (Sidgwick, 1909). Classic utilitarianism's *axiology*, that is, the notion of goodness that is supposed to be maximized, is *happiness*. Hence, the classic utilitarian slogan: 'The greatest happiness for the greatest number.' Happiness is, in turn, defined in

hedonistic terms of *feelings of pleasure*, as opposed to pain. Bentham thought pleasure and pain can be measured quantitatively, for example,concerning their intensity or duration. Mill rejected this claim and argued for a qualitative distinction between higher and lower pleasures, asserting that higher pleasures (e.g., engaging intellect, moral reasoning, or aesthetic appreciation) are necessary and preferable to lower ones (e.g., bodily sensations or sensory gratification) concerning human happiness. In any case, if happiness could be measured, it would be possible to determine the morally 'right' choice using an approach similar to a cost–benefit or risk–benefit analysis (Pantazidou & Nair, 1999, p. 206).

Yet, things are not that simple. For instance, the idea of maximizing goodness fails to address the question of how pleasure and pain should be distributed among different people, which is why utilitarianism has been criticized for failing to include a convincing notion of (distributive) justice (van de Poel & Royakkers, 2011, p. 86f). Moreover, calculating the consequences of each action individually – which would be *act utilitarianism* – easily leads to counterintuitive results. For instance, it would imply that it is *morally obligatory* to kill an innocent person if doing so avoids a worse outcome (Smart & Williams, 1973, p. 98f). In comparison, *rule utilitarianism* is intended to avoid such counterintuitive implications, as it focuses not on individual decisions or actions but on rules and the consequences of their general adoption. Accordingly, a rule that allows killing innocent persons for the greater good cannot be considered as producing the best consequences because no one could feel safe anymore. Therefore, what we morally ought to do depends on whether an option falls under a rule that, when generally adopted, produces the best overall consequences.

Deontology

In contrast to consequentialism, *deontology* rejects the moral importance of consequences. According to the most influential deontological author, Immanuel Kant (1724–1804), consequences do not matter morally at all (Kant, 1785, 1797). The moral quality of an action is instead a question of the action's inherent quality and our good 'will,' that is, our intention, which, in turn, is determined by whether we could think of, or could want, this course of action being taken up by everyone in similar circumstances. In Kant's famous words of the first formula of the categorical imperative: "act only according to that maxim through which you can at the same time will that it become a universal law" (Kant, 1785, p. 71). Put simply, the question is: '*What if everyone did this?'* Note that this question is not meant to invoke consideration for the actual consequences if everyone acted accordingly but whether the respective principle of action (*maxim*) is reasonably acceptable to everyone.

To illustrate the categorical imperative, Kant discussed the moral permissibility of lying. Imagine if one were to ask themselves whether it is morally permissible for them to lie to avoid an uncomfortable situation. If everyone were morally allowed to lie, successful lying would be impossible because lying exploits (and, therefore, depends on) honesty. Only if people assume honesty as morally required (i.e., precisely presupposing a moral obligation *not* to lie) can one successfully lure people into believing one's lie. Hence, the maxim to be allowed to lie implies both the permissibility to lie ('I want lies to be allowed') and its *im*permissibility ('I want people to believe me, so I want lies *not* to be allowed') – a logical contradiction, which is why the maxim does not stand Kant's test of the categorical imperative, and lying is, therefore, morally wrong.

Kant's ethics is typically taught with a focus on the first two formulas of the categorical imperative (van de Poel & Royakkers, 2011, pp. 89–95), where the second formula emphasizes respect for people's autonomy: "So act that you use humanity, in your own person as well as in the person

of any other, always at the same time as an end, never merely as a means" (Kant, 1785, p. 87). The crucial point here is to understand that instrumentalizing others is not morally impermissible *as such* but only if it is done without respecting the others' autonomy ("*merely* as a means"). Put simply, and relating to the first formula, the question is whether everyone can autonomously (i.e., freely and reasonably) agree to the underlying principle that defines the particular social interaction (more currently, Rawls's (1971) *contractualism* has Kantian roots; see below). For instance, instrumentalizing others in the workplace is morally unproblematic as long as everyone freely and reasonably agrees to the particular conditions of working together – which is why forced labor and unfavorable working conditions that take advantage of someone's dire situation are morally wrong. Respecting people's autonomy, thus, provides an additional important aspect when applying Kant's ethics in engineering practice.

However, like utilitarianism, Kant's ethics may lead to counterintuitive results. For instance: *Would it not be morally required to lie to save an innocent person from a potential murderer?*

Consequentialism/utilitarianism and deontology revisited

When it comes to using ethical theories in teaching engineering students, referring only to their classical versions is somewhat problematic. In the case of utilitarianism, practically all its features have been subject to criticism and substantial revision (Sinnott-Armstrong, 2022). First, classic utilitarianism's *hedonism* has been criticized because feelings of pleasure and pain are notoriously hard to measure, especially for interpersonal comparison. Newer suggestions for utilitarianism's axiology propose *desire fulfillment*, *interest realization*, or *preference satisfaction*. Each of these suggestions has different implications for maximizing *goodness*. For instance, a person might *want* ice cream but would *prefer* not to gain weight, while eating a salad would be in their best *interest*.

Second, the notion of consequences needs refinement. *How much into the future should one consider the consequences of one's actions?* Moreover, the kind of consequences that one needs to consider should also be specified. As the *actual* consequences are not yet known, we can question whether to consider *intended* consequences, consequences that a person can *foresee*, or those that may be regarded as *reasonably foreseeable*.

Third, the idea of *maximizing* good consequences has also been contested. Given the complex challenges of measuring and predicting the consequences of one's actions: *Why not opt for consequences that are taken to be good enough?* Accordingly, some newer versions of utilitarianism opt for a *satisficing* principle.

Hence, following the current ethical debate, consequentialism/utilitarianism is not *one* clearly defined ethical theory but, rather, allows for a wide variety of different versions – each differing in their specification of core claims and accompanying arguments. Yet, engineering students rarely get to know this lively debate – with its intricate arguments and specifications – and are usually left with an outdated understanding.

Such shortcoming is also visible in the case of deontology. Concerning Kant's ethics, questions have been raised if there can be really no moral dilemmas, that is, conflicting moral duties without a moral solution, as Kant claimed (Kant, 1797, p. 50; McConnell, 2022). This has led to the concept of *prima facie duties* (van de Poel & Royakkers, 2011, pp. 93–95; Ross, 1930), which are weighed against each other to determine one's *actual* moral duty. The discussion of moral dilemmas is regularly used in teaching ethics and has also, for example, spun a public debate about how autonomous cars should behave in so-called *trolley cases*, in which a decision needs to be made as to who should be killed if there is no option to save everybody (Foot, 2003, p. 23; Thomson, 1986, p. 80f). Discussions in class and public debates are then usually focused on determining the

'right solution.' However, if *trolley cases* are *real* moral dilemmas, then there is, per definition, no single correct solution. Yet, it should be emphasized that *trolley cases* are used for a very different purpose in philosophical debate. Instead of seeking the 'right solution,' the philosophical goal is to analyze which aspects bear how much weight, if any, in moral analysis. For instance: *Does it make a difference in moral judgment if trolley cases involve actively killing someone or letting a person die?* The philosophical aim here is to make progress in analyzing the conceptual difference and moral weight of actions in comparison to omissions – not in finding the 'right solution.' Hence, the way these cases are typically discussed in public debate and engineering classes is misguided.

Moreover, Kant's ethics raises questions about how exactly the categorical imperative works as a universalizability test in practice, e.g., whether different specifications of one's maxim may already lead to different results (Korsgaard, 1996; O'Neill, 1989). For instance, it makes a difference if I characterize my maxim as 'I lie if it suits my needs' or rather as 'I lie if I consider the situation as socially unbearable.'

Finally, Kant had a narrow understanding of autonomy solely regarding *moral autonomy*, i.e., our ability to give ourselves a *moral law* of action. Current ethical debate has broadened the notion – now referring to *personal autonomy* – to emphasize that *respecting people's autonomy* is not confined to respecting their ability to act from a universalizable moral principle but also encompasses respecting their ability to make autonomous choices in their personal life (Christman, 2020). Most prominently, this Kantian idea has been introduced as one of four ethical principles in biomedical ethics and further explained in terms of patients needing to give their *informed consent* based on their own individual perspectives and personal values (Beauchamp & Childress, 2019, ch. 4). All these elaborated current discussions about Kant's ethics draw a much more fine-grained picture of deontological ethics than merely explaining Kant's categorical imperative.

The outcome is that engineering students typically fail to learn how critical ethical reflection and argumentation contribute to making ethical progress – both within one strand of ethical theorizing and concerning the controversy between different ethical theories. Yet, this capability of engaging in ethical argumentation and forming well-considered ethical judgments based on state-of-the-art insights is a crucial aspect of ethical competence. Accordingly, including current versions of ethical theories and debates in teaching engineering students would enable students to better understand critical ethical thinking and, thus, improve their ethical competence.

Virtue ethics

Deontological and consequentialist ethical theories share one fundamental assumption: morally right and wrong are distinguished by judging *actions*, whether these are subject to specific general standards (deontology) or based on their consequences (consequentialism). In everyday life, we often use moral judgments differently: instead of actions, we judge the acting *person*. So-called *virtue ethics* takes this as a starting point and focuses on the acting subject, that is, the person who is morally responsible. Virtue ethics is primarily concerned with the question of cultivating moral character. Its focus is on how to be a *good person* and less on defining morally *right* (or *wrong*) *actions*. Apart from care ethics (see below), other ethical theories discussed here focus on the latter. Virtue ethics thus provides a different approach to teaching engineering ethics. Its basic idea when looking at actions is that one reliably acts morally right or good once one has acquired a moral character: a person who *is* good *acts* well.

Virtue ethics approaches were popular in antiquity (with philosophers such as Plato and Aristotle) and throughout the centuries in non-Western thought (particularly in Confucian and Buddhist traditions). While virtue ethics took a backseat to other ethical theories in Western phi-

losophy after the Enlightenment, this changed in the mid-twentieth century with influential publications by, for example, Anscombe (1958), MacIntyre (1981), and Hursthouse (1999). Virtue ethics has proven itself as a theoretical alternative to deontology and consequentialism and plays an increasing role in applied ethics. For medical, care, or business applications, virtue ethics seems to be a fairly well-established alternative to address moral questions (Oakley & Cocking, 2001). In comparison, in engineering ethics and ethics of technology, virtue-based approaches have only gained prominence more recently (Frigo et al., 2021; Steen, 2013; Vallor, 2016) and remain less utilized than utilitarian or deontological positions (Pierrakos et al., 2019).

In virtue ethics, notions like the 'good' or 'virtuous' engineer are central (Harris, 2008). Virtues refer to the characteristics of a (moral) character and are character traits in the sense of deeply rooted dispositions to direct one's actions and thoughts in a certain way. They can be trained and cultivated. Thus, a virtuous character trait develops gradually from a full study and exercise of 'right' actions. The virtues are excellences of character in their own right. Their value is not measured solely by the fact that they serve to implement the right actions. Instead, they are intrinsically valuable to those who cultivate them. It is this latter point that distinguishes virtue ethics from other ethical theories. Admittedly, all ethical theories may include the idea of virtues in the simple sense of good character traits, just like including references to consequences or rules (Hursthouse & Pettigrove, 2022). However, when utilitarianism or deontology refer to virtues, these are merely of instrumental value in ensuring that people act morally. Only virtue ethics places virtues front and center.

Virtue ethics is primarily concerned with the *how* of the morally right or good, not primarily with the *what*. Aristotle, a classic virtue ethicist, saw the highest human goal in realizing *eudaimonia*, often translated as happiness or well-being but referring to a more encompassing idea of flourishing as a human being. Similarly, in Confucian and Buddhist traditions, a full human life is tied to possessing and cultivating particular virtues. Hence, training the virtuous engineer or spelling out any virtues must give some account of a well-lived human life. Although concrete manifestations of virtues (as well as the incorporation and exercise of virtues) may change with the context, virtue ethics is rooted in a conception of human nature or human flourishing and is, therefore, decidedly non-relativistic. It is universal at its core (Vallor, 2016, p. 50).

All versions of virtue ethics involve a concept like the 'Aristotelian mean' that emphasizes the right measure for certain things. The virtuous state is an intermediate ground between two extremes, a 'golden mean' (Aristotle, EN, pp. 1106a26–b28). For instance, the classic virtue of courage lies between cowardice and rashness. Where exactly this intermediate between the two bad extremes lies depends on many contextual factors. To become virtuous, it is necessary to repeatedly identify the 'golden mean' in different situations and act accordingly. The virtuous person can do so reliably through another virtue, which Aristotle called *phronesis*, that is, a learned practical wisdom to judge situations and determine the required action correctly. Such practical wisdom also helps deal with the uncertainties of the threats and promises of technological developments (Frigo et al., 2021; Hillerbrand & Roeser, 2016).

The fact that virtue ethics must presuppose some account of a good human life is often seen as a challenge, especially in modern societies with their multitude of different ways of life and values. This presents a particular challenge for the ethics of technology when, in principle, an ethical account needs to bind present and future generations with very different cultural backgrounds all over the globe. Contemporary virtue ethicists like Vallor (2016) answer this challenge by drawing on both Western and non-Western accounts of the good life. Vallor suggests a list of technomoral virtues: *honesty*, *self-control*, *humility*, *justice*, *courage*, *empathy*, *care*, *civility*, *flexibility*, *perspective*, *magnanimity*, and *technomoral wisdom.* Before Vallor, non-anthropocentric environ-

mental ethicists suggested virtue ethics to deal with the negative impacts of modern technologies (Sandler & Cafaro, 2005). Many of these ecological virtue ethics build on Aldo Leopold's and Henry David Thoreau's *land ethics* and have rather far-reaching implications; they are grounded in assumptions concerning the good human life (Wensveen, 2000). An anthropocentric virtue ethics for the technology era was suggested by Höffe (1993) in his synthesis of Kantian and Aristotelian approaches. Next to classical Aristotelian virtues, Höffe advocates two ecological virtues to deal with the ecological threats that modern technologies may pose:

1. The virtue of *ecological serenity* as intermediate between human hubris, which sees nature as entirely amenable for human interests, on the one side, and an acquiescence of natural threats and hazards, on the other.
2. The virtue of *ecological prudence* as an intermediate between humility and the wish for the fulfillment of each and every need.

Due to their context-sensitivity and their focus on the moral subject (i.e., the engineer, those regulating the development and use of technology, or those using technological artifacts), virtue ethics adds substantially to developing and improving ethical competence among engineering students.

Care ethics

Nair (2005, p. 695) describes *care ethics* as highlighting "the importance of responsibility, concern, and relationship over consequences (utilitarianism) or rules (deontology)." Although responsibility is central in engineering ethics, it was not until recently that care ethics was taken up in (teaching) engineering ethics and ethics of technology (Campbell et al., 2012; Frigo et al., 2023; Pantazidou & Nair, 1999).

Originally developed as an alternative to traditional Western ethical approaches by psychologist C. Gilligan and philosopher N. Noddings, contemporary care ethicists like Tronto (1993) see care ethics more as an augmentation of classical approaches. However, all versions of care ethics share a critique of traditional (Western) ethical reasoning with its focus on generalizations and abstract moral objects and subordinate elements as (at least partially) incomplete; they build on an unwarranted assumption about the nature of moral relations, namely equality. Care ethics asserts that moral relations extend beyond interactions among equals to encompass relationships between individuals with unequal power or circumstances, often involving parties who did not voluntarily enter these relationships. For instance, children find themselves with parents they did not choose. Similarly, individuals such as workers in coal mines may be dependent on their employers and industry in ways they have not autonomously chosen (Groves et al., 2021).

Care ethics takes concrete human relationships and their asymmetries as a starting point. Consequently, the moral subject "is conceived as a *relational* self, one that is constituted in part by relationships important to a person's identity" (Kittay, 2011, p. 53). Moreover, care ethicists share a sensitivity to the context-dependent features of the situation, which renders some parts of ethical reasoning *irreducibly particular* and *non-universalizable*. Every person comes with their own context and their very own specific history and identity. Care ethics contends that moral deliberation requires not reason alone but also *empathy*, *emotional responsiveness*, and *perceptual attentiveness*.

One line of integrating care ethics into the ethics of technology is via technological design. While van Wynsberghe (2013) explores the role of care in the design of robots, more recent work considers energy ethics (Frigo et al., 2023) as well. Van Wynsberghe and Frigo et al. suggest care

ethics as a normative framework for *Value Sensitive Design* (VSD) (for more on VSD, see Chapter 22). Michelfelder et al. (2017) explore the concept of *Caring Design* (Flower & Hamington, 2022). Other lines of reasoning have explored the role of care ethics in *Responsible Research and Innovation* (RRI) (Pellé, 2016). Groves (2014) links responsibility to care in intergenerational perspectives, while others approach the link between care and engineering responsibility broadly (Campbell et al., 2012) and care as a guiding principle for (teaching) engineering ethics per se (Kardon, 2005; Pantazidou & Nair, 1999).

Ethics of care has been criticized for being limited in its moral scope as it seems confined to intimate settings and close-kind relationships (or at least between human beings who interact directly). However, within environmental ethics, care ethics has been shown to extend to other sentient beings (Warren, 2000). Tronto (2013), and others have argued that care ethics can tread into areas such as the political realm, especially where practices of justice are inadequate to cover a situation's contextual and narrative complexities.

Contractarianism and contractualism

A general challenge for ethical theories is that they often include controversial assumptions. For instance, utilitarianism must defend its axiology, that is, what should count as goodness. Likewise, virtue ethics must defend its account of what may count as a good human life. In contrast, *contractarianism* is an ethical theory that explicitly tries to avoid controversial assumptions and merely takes rational self-interest and bargaining power as its starting point (Cudd & Eftekhari, 2021). The classic example is Thomas Hobbes's (1588–1679) *Leviathan* (Gauthier, 1986; Hobbes, 1651). The basic idea is that only those social norms that are in the rational self-interest of individuals may be regarded as justified and, thus, morally legitimate. For instance, people have a rational interest in not getting killed against their will. To ensure that one can live safely, it is more efficient to have a social norm in place that generally forbids murder than to take care of one's protection individually. Of course, it must be ensured that everyone adheres to the norm, which is why Hobbes has added the figure of Leviathan, a supreme ruler with absolute power to guarantee people's compliance. Thinking about what is morally obligatory or permissible, then, boils down to analyzing whether one's options fall under a norm that is in people's rational self-interest and that can be sufficiently enforced. As a result, contractarianism only comprises a few basic norms that can be backed up by people's bargaining power, like prohibitions against killing and harming others at will.

Contractualism also refers to rational self-interest and includes the idea of ensuring a *reasonable* or *fair* outcome (Ashford & Mulgan, 2018). Most prominently, John Rawls (1921–2002) developed this idea regarding what constitutes a just society (Rawls, 1971, 2001). The primary (Kantian) idea is that rational, self-interested people must decide on the basic structure of society without knowing their place in it or anything about their own person (e.g., their interests, capabilities, or personal values). They must deliberate behind a *veil of ignorance* (Rawls, 1971, pp. 12–19), which ensures a fair outcome. Accordingly, moral contractualism (Scanlon, 2000) involves thinking about whether any option of how to act may fall under a *fair* (moral) rule and, thus, cannot be *reasonably* rejected.

The contractarian and contractualist ideas of *rational self-interest*, *fairness*, and the possibility of *reasonable rejection* add further aspects for engaging in critical thinking about ethical questions. Any engineering project implies drafting a 'contract' where each of the elements to be developed are perfectly defined; contractarianism and contractualism emphasize not only the importance of the contract itself, but also the importance of why it has been drafted and the conditions under which it has been drafted.

Discourse ethics

Discourse ethics may be depicted as a variant of deontology. The term refers to ethical theories that determine morally right arguments by whether they adhere to specific rules of rational discourse. Discourse ethics originated in the German-speaking world (Apel, 1990, 1999; Habermas, 1983). Both Apel and Habermas viewed discourse ethics as a shift away from Kant's philosophy of the subject, that is, of the constituents of ourselves as individual human persons, resulting in an ethics of individual conviction, towards an ethics of responsibility toward others and the world as a whole. This transition, exemplified by Jonas (1979) and increasingly influential in the ethics of technology, emphasizes the ethical implications of human actions and decision-making. Internationally, discourse ethics is best known as *argumentation ethics* (Hoppe, 1988).

Habermas (1990) formulated two core principles of discourse ethics:

> *Discourse principle (D)*: norms are only valid if they meet (or could meet) the agreement of all affected who, as such, are participants in a practical discourse.
>
> *Principle of universalization (U)*: "*All* affected can accept the consequences and the side effects its [the norm's] *general* observance can be anticipated to have for the satisfaction of *everyone's* interests (and these consequences are preferred to those of known alternative possibilities for regulation)".
>
> *(Habermas, 1990, p. 65)*

With these principles, those who participate in the discourse can, in an ideal case, determine what is morally right or wrong. Ethically permissible communication following *(D)* and *(U)* must be symmetrical; only sound arguments are allowed in this communication, and hierarchies and authorities have no place if they prevent rational communication in the form of critical arguments. As Nickel and Spahn (2012, p. 38) wrote, "The purpose and outcome of the discourse are open in a strong sense, because any party to the communication could be convinced by the other parties to change their behavior or their moral beliefs."

Nickel and Spahn (2012, p. 38) applied discourse ethics to engineering design, particularly the design of persuasive technologies, and argued that the typical *a priori* method of incorporating moral values into the design cannot fulfill the communicative standards set by discourse ethics. To achieve symmetrical communication, there must be room for those who use, or are affected by, the technology not only to co-design its technical features but also to co-design the moral values in the technological design process. The reciprocity of perspective necessitates incorporating the perspective of the other into the norm and, thereby, impartiality. In this regard, discourse ethics does without a counterfactual construction such as Rawls's *veil of ignorance* (Rawls, 1971, pp. 12–19). Though this is often cited as an advantage of discourse ethics, it is unclear how a symmetrical dialogue with future generations can be realized, even in principle, to determine principles of sustainability and intergenerational justice. This may be one reason why, despite some applications to the information technologies (Mingers & Walsham, 2010; Yetim, 2011), discourse ethics is rarely referred to explicitly in the ethics of engineering and technology. However, it plays a vital role in both the practice and teaching of engineering ethics in the guise of stakeholder discussions, deliberative technology assessments, role plays, and so on (Lennerfors, 2019). Still, engineering students could benefit from learning discourse ethics explicitly by imagining themselves in the shoes of various stakeholders and reflecting on how each stakeholder would argue in an idealized version of symmetrical communication.

Typical problems, errors, and barriers in student learning

Despite their appeal, ethical theories and their use within engineering education are not without issues. Many engineering students and educators fail to differentiate personal values from ethics, leading to a barrier in teaching ethics. Thus, they fail to grasp how ethics 'works' and what gaining 'ethical competence' means, namely the ability to understand and reflect on ethical issues based on coherent ethical arguments and principles, not subjective personal preferences. This problem is perhaps linked to faculty members' observed resistance to teaching ethics. Haws (2001, p. 227) suggests that the claim by engineering educators that "the theoretical aspect of engineering ethics is beyond our expertise" undoubtedly has consequences for both the confidence and enthusiasm with which such theories are communicated to students.

Another, perhaps more pragmatic issues associated with extensive discussion of moral theories in engineering ethics education are the amount of study needed to fully appreciate ethical theories and the limited time allocated for their teaching. Teaching ethical theories, Lawlor (2007) claims, can thus result in two undesirable consequences: either that students fail to process the nuances and complexities of each theory or that theories are simplified to the degree that they become of little use. This can cause students to dismiss their use and that of philosophical reasoning altogether. Lawlor further claims that teaching students this way can lead them to believe that ethics consists of simply picking a theory and applying it to a specific case by following it to its end.

Ironically, the problem with using ethical theories correctly is emphasized by students' familiarity with the use of *empirical* or *descriptive* theories. Such theories are meant to accurately describe and explain 'states of the world', that is, the theories need to 'fit' the world and be revised if they do not. In assuming that *normative* ethical theories can be applied in the same way, students risk erroneously choosing an ethical theory to *fit* the concrete ethical problem, for example, choosing utilitarianism because the ethical problem appears concerned with undesirable consequences. However, the 'direction of fit' of ethical theories works precisely the other way around (Anscombe, 1963; Searle, 2001). Ethical theories depict states of the world that are *not* (yet) the case but *ought* to be. Hence, if an ethical theory's content does not 'fit' the relevant 'state of the world,' it is the world that needs to change – brought about by our moral actions. What we ought to do then relies on the respective theory's ethical criteria, like maximizing utility in the case of utilitarianism or the universalizability of one's maxim in the case of deontology. Accordingly, referring to apparently undesirable consequences does not qualify as a reason to choose any ethical theory. So, the main problem for students in working with ethical theories is understanding – in direct opposition to what they know from working with empirical or descriptive theories – *not* to put the (worldly) cart before the (ethical) horse.

A related problem occurs when students commonly integrate theoretical elements of different ethical theories without being aware of the (theoretical) inconsistencies that arise by doing so. For example, utilitarianism explicitly claims that overall consequences are *all* that matters for ethical judgments. This sometimes clashes with individual rights when these are seen from a deontological perspective. Often, students, in arguing explicitly from a utilitarian standpoint, simply want to solve this by 'adding Kantian deontology' for dealing with individual rights, that is,safeguarding individual rights against a utilitarian calculation. What such students fail to see is that Kantian deontology rejects utilitarian calculation *completely* and that, therefore, they cannot hold both ethical positions at the same time without contradicting themselves. Those students thus show a lack of ethical competence and fail to reach a consistent and well-argued judgment. Such competence would consist in realizing that if one wanted to uphold a utilitarian judgment, this would imply that any individual right could only be justified as a result of a utilitarian calculation, for example, because implementing individual rights would lead to overall better consequences. Accordingly,

safeguarding individual rights would only be possible against this background and would always be limited. If, on the contrary, one wanted *strictly* to uphold individual rights from a deontological perspective, this would imply dropping one's previous utilitarian standpoint that consequences are *all* that matters ethically.

To equip students with the ability to consistently justify their decisions by integrating ethical theories, it is also recommended that students actively apply their ethical competence in their daily activities. In many universities, there are possibilities for co-curricular activities outside the strict curriculum, which can increase their knowledge in this area. For example, industrial lecturers can be invited to share real-life ethical challenges and case studies with students through group discussions or short reflection papers. There are also many students involved in service-learning activities. It would be advisable for this type of work to seek a link with engineering so that the development of ethics and, in particular, the ethical behavior component could be promoted through coursework. However, such additional and partially non-mandatory activities take up students' time, adding to the challenge of how successful engineering ethics education can be integrated into student activities.

This last problem leads to the general question of how best to incorporate ethics teaching into the curricula, including teaching ethical theories. A study carried out by Walczak et al. (2010) identified five common problems in engineering schools that hinder the incorporation of ethics in students' training. In addition to the problems mentioned above (i.e., the overcrowded curricula, the limited space for ethics education, and educators needing more training for teaching ethics), two further problems were noted: inconsistency in policies and academic dishonesty.

The challenges that engineering students face when it comes to integrating ethics into their decision-making processes during the design and development of products present their flipside when it comes to *assessing* students' ethical competence. Engineering schools need to determine whether, or how well, graduates have acquired this competence. While various helpful approaches to acquiring ethical competence for future engineers can be found in the literature, the question of how to assess students' ethical competence remains a particular challenge. Some schools offer compulsory subjects within the curriculum that deal with ethics in engineering; others opt for a transversal integration with different approaches. To evaluate the effectiveness of such approaches, it would be necessary to carry out respective studies (Barry & Ohland, 2012). In any case, even if knowledge of ethical theories proved to be conducive to developing ethical competence, such knowledge alone would not guarantee that students will display an ethical attitude when making decisions related to their professional work. In other words, *knowing* what is right does not guarantee *doing* what is right. (For more on the assessment of competencies, see Chapter 26.)

From ethical theories to ethical competence?

Given not only the problems associated with teaching and learning ethical theories but also the question of whether knowing them is really necessary for students to develop ethical competence, one may argue that ethical theories could or should be entirely dismissed in teaching engineering ethics. Bouville (2008) proposes four possibilities regarding the treatment of ethical theories in teaching ethics to engineering students: (1) reject theories entirely, (2) use them without naming them, (3) mention them without justifying them, or (4) teach and justify them. Glagola et al. (1997, p. 475) thus encourage educators to "chuck out the jargon," indicating that students may feel they need to choose between ethical theories and that instead, "when we've got a moral problem, we should examine all the morally relevant considerations" (Glagola et al., 1997, p. 475). This view is "Pluralist – useful approaches may be drawn from a variety of ethical theories" (Derry & Green,

1989, p. 531). Bouville (2008) takes a similar approach, encouraging us to break ethical theories down into constituent parts and to emphasize fundamental dichotomies and elementary concepts, for example, consequences versus intentions or society as a whole versus individuals. An advantage of this, Bouville claims, is that the pairs are comparable, making it easier to find a middle ground through reasoning. Yet, doing so would only lead back to the general problem of ethical consistency we mentioned above if students came to some 'middle ground' in their ethical judgment without realizing its lack of coherent ethical justifiability. From a philosophical point of view, the uncritical suggestion of such a 'middle ground' as an implicit pluralist ethical framework is simply untenable. Accordingly, Haws (2004) suggests that the need to solve future, unprecedented ethical dilemmas indeed necessitates the inclusion of ethical theory, and that engineers who lack a foundation of strong theoretical knowledge will be unable to adapt. Such grounding is also required for engineers to justify their decisions to the broader community.

According to Newberry (2004), the purposes of teaching ethics in engineering can be classified into three categories: *particular knowledge*, *intellectual engagement*, and *emotional commitment*. Learning the main ethical theories would correspond to *particular knowledge* and would be the most easily attainable goal and the one that is often assessed in engineering schools. The second category, *intellectual engagement*, would be related to knowing how to make ethical decisions – the difficulties this presents have already been mentioned. Finally, *emotional commitment* or the desire to behave ethically would be most challenging to measure as an outcome within a curriculum – even if such an outcome would be desirable from the perspective of engineering ethics education.

Although the goal of personal ethical character building can neither be guaranteed nor properly assessed by 'merely' teaching ethics, developing an assessable ethical competence may very well be achievable by way of critically engaging with ethical theories, especially given the wide range of ethical theories with their different core ideas. If ethical competence is supposed to include the ability to reflect critically on different ethical aspects in the engineering realm, learning different ethical theories would equip students with relevant knowledge about different ethical aspects and their respective ethical roles in making well-justifiable decisions in practice. For instance, it makes a theoretical and practical difference when ethically thinking about a design problem in engineering from the perspective of, for example, utilitarianism, deontology, or care ethics, including their different ideas on how to justify ethical judgments and decisions. For example, deciding on the 'best' design of a bridge may differ if the decision is based on the overall consequences in terms of the most efficient travel connection (*utilitarianism*);or on relational aspects of the people who want to cross it using various means of transportation, including cars, bikes, and walking (*care ethics*); or on the bargaining power of those who have specific preferences for its design (*contractarianism*). Hence, students would not only gain *particular knowledge* when learning about different ethical theories but also show intellectual involvement via *critical engagement*, thereby becoming increasingly capable of justifying and critically re-evaluating their own particular ethical judgments and decisions consistently and coherently to others.

However, even if this line of argument is plausible and ethical theories may be considered conducive to developing ethical competence, one might still question whether they are necessary. Alternative teaching models encompass other factors affecting ethical decision-making and competence (Bairaktarova & Woodcock, 2017; Walczak et al., 2010). For example, Illingworth (2004) has outlined three different ways to teach applied ethics within higher education:

1. A pragmatic approach based on regulatory codes.
2. An embedded approach that makes use of reflection and role play.

3. A theoretical approach that "places an understanding of moral theory at the heart of ethics learning and teaching" and whereby "ethics of real-life or life-like situations are then presented in terms of application of that theory" (p. 10).

Conclusion

This chapter has provided an overview of the most important ethical theories as well as some theories that engineering ethics education has rather neglected. It briefly discussed whether teaching ethical theories is necessary to help students develop ethical competence – given that although knowing about ethical theories is conducive to developing ethical competence, knowledge of specific theories might not be necessary for sound engineering practice. For all practical intents and purposes, engineering ethics education may utilize other teaching models to achieve the levels of ethical awareness required (e.g., by accreditation bodies, as discussed in Chapters 32–36) – even though, from a philosophical point of view, ethical theories provide indispensable underlying frameworks for critical analysis and justification of ethical judgments. Understanding the theories discussed in this chapter can help educators and researchers achieve consistency and develop well-framed activities and materials. Understanding these seminal theories and their internal logic will also support understanding the other chapters of this handbook.

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