Materializing Morality

Design Ethics and Technological Mediation

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During the past decade, the "script" concept, indicating how technologies prescribe human actions, has acquired a central place in STS. Until now, the concept has mainly functioned in descriptive settings. This article will deploy it in a normative setting. When technologies coshape human actions, they give material answers to the ethical question of how to act. This implies that engineers are doing "ethics by other means": they materialize morality. The article will explore the implications of this insight for engineering ethics. It first augments the script concept by developing the notion of technological mediation. After this, it investigates how the concept of mediation could be made fruitful for design ethics. It discusses how the ambition to design behavior-influencing technologies raises moral questions itself and elaborates two methods for anticipating technological mediation in the design process: performing mediation analyses and using an augmented version of constructive technology assessment.

Keywords: philosophy of technology; ethics; engineering ethics; technology assessment; design

Conceptualizing the Moral Dimension of Technologies

The ethics of engineering design aims to analyze the moral aspects of technology design in a systematic way. One of the things that should be taken into account in such analyses is the social impact that the technology in design will have as soon as it enters society. As recent research in science and technology studies and the philosophy of technology has shown, technologies profoundly influence the behavior and experiences of users. This charges the ethics of engineering design with the task to conceptualize this influence and to anticipate it in design.

A commonsense vision of the role of technologies in society is guided by the concept of functionality. Technologies are designed to function.

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They should solve a problem or fill a need. In this view, the criteria by which technologies are to be assessed primarily concern their ability to realize the ends to which they were designed. From this perspective, the focus of engineering ethics can concern only the normative aspects of the goals for which technologies are designed or the quality of the way in which the technologies function (risk assessment).

The script concept, as developed about a decade ago by Madeleine Akrich (1992) and Bruno Latour (1992), challenges this strictly functional vision of technology. Akrich and Latour introduced this concept to describe the manifold roles technological artifacts play in their use contexts. Like a theater play or a movie, they hold, technologies possess a "script" in the sense that they can prescribe the actions of the actors involved. Technologies are able to evoke certain kinds of behavior: a speed bump can invite drivers to drive slowly because of its ability to damage a car's shock absorbers, a car can demand from a driver that he or she wear the safety belt by refusing to start if the belt is not used, and a plastic coffee cup has the script "throw me away after use," whereas a porcelain cup "asks" to be cleaned and used again. Technological artifacts can influence human behavior, and this influence can be understood in terms of scripts.

Scripts, according to Akrich (1992) and Latour (1992), are the products of "inscriptions" by designers. Designers anticipate how users will interact with the product they are designing and, implicitly or explicitly, build pre-scriptions for use into the materiality of the product. Latour describes this inscription process in terms of "delegation": designers delegate specific responsibilities to artifacts, such as the responsibility to make sure nobody drives too fast, which is delegated to a speed bump.

Conceptualizing technological artifacts in terms of scripts shows that functionality is too limited a concept for engineering ethics. Scripts tran-scend functionality: they form a surplus to it, which occurs once the tech-nology is functioning. When technologies fulfill their functions, they also help to shape the actions of their users. For this reason, the script concept lays bare ethical questions regarding technology design that transcend the commonsense idea that technologies need to be morally evaluated only in terms of the goals for which they are designed or of the quality of their functioning. The script approach opens up a new way to morally assess technologies with respect to the role they play in their use contexts. In doing so, it also reveals a specific responsibility of the designer, who can be seen as the inscriber of scripts.

Until now, the script concept has mainly functioned in descriptive set-tings: in analyses of the role of technologies in their use contexts. In this

article, I investigate how the concept can be deployed in a normative setting. To cover all relevant aspects of the role of technological artifacts in their use contexts and to provide a vocabulary for describing these aspects, I will first develop the notion of technological mediation and show that scripts can be seen as a specific aspect of mediation. After this, I will investigate how the concept of mediation can be made fruitful for design ethics. The concept provides designers with an explicit link with the use context in which their products will be functioning, making it possible to identify and answer new normative questions during the design process.

Integrating mediation in engineering ethics is a complex task, however. First, the ambition to design technologies with the explicit aim to influence human actions raises moral questions itself. It is not self-evident, after all, that all attempts to steer human behavior are morally justified, and steering human beings with the help of technology raises associations with the totalitarian technocracy of Orwell's Big Brother. Second, if some forms of behavior-steering technologies can be seen as morally acceptable—and I think such technologies do exist—it is very complicated to design them since there is no linear connection between the activities of designers and the mediating role of the artifacts they are designing. As I will make clear, this mediating role also depends on the unpredictable ways in which the technologies are used. For this reason, I will suggest two ways to cope with this unpredictability.

Technological Mediation[1]

For analyzing the role of technologies in the daily lives of human beings, the concept of technological mediation is a helpful tool, especially in the way it was developed in postphenomenological philosophy of technology (cf. Verbeek 2005). Phenomenology—in my elementary definition—is the philosophical analysis of the structure of the relations between humans and their life-world. From such a phenomenological perspective, the influence of technology on human behavior can be analyzed systematically, in terms of the role technology plays in human-world relations. Technological mediation then concerns the role of technology in human action (conceived as the ways in which human beings are present in their world) and human experience (conceived as the ways in which their world is present to them).

Human-Technology Relationships

A good starting point for understanding technological mediation is Martin Heidegger's (1927) classical analysis of the role of tools in the

everyday relation between humans and their world. According to Heidegger, tools should be understood as connections or linkages between humans and reality. Heidegger indicated the way in which tools are present to human beings when they are used as "readiness-to-hand." Tools that are used for doing something typically withdraw from people's attention; the attention of, for example, a person who drives a nail into a wall is not directed at the hammer but at the nail. A person's involvement with reality takes place through the ready-to-hand artifact. Only when it breaks down does it ask attention for itself again. The artifact is then, in Heidegger's words, "present-at-hand" and is not able to facilitate a relationship between a user and his or her world anymore.

Although ready-to-hand artifacts withdraw from people's attention, they do play a constitutive role in the human-world relation that arises around them. When a technological artifact is used, it facilitates people's involvement with reality, and in doing so, it coshapes how humans can be present in their world and their world for them. In this sense, things-in-use can be understood as mediators of human-world relationships. Technological artifacts are not neutral intermediaries but actively coshape people's being in the world: their perceptions and actions, experience, and existence.

The positions of the North American philosopher Don Ihde and the French philosopher and anthropologist Bruno Latour offer concepts for building a vocabulary to gain a closer understanding of this mediating role of technologies. To build this vocabulary, I discern two perspectives of mediation: one that focuses on perception and another one on praxis. Each of these perspectives approaches the human-world relationship from a different side. The hermeneutic or experience-oriented perspective starts from the side of world and directs itself at the ways reality can be interpreted and present for people. The main category here is perception. The pragmatic or praxis-oriented perspective approached human-world relations from the human side. Its central question is how human beings act in their world and shape their existence. The main category here is action.

Mediation of Perception

The central hermeneutic question for a philosophy of mediation is how artifacts mediate human experiences and interpretations of reality. Don Ihde's (1990) philosophy of technology is a good starting point for answering this question because of its focus on the technological mediation of perception. Ihde elaborated Heidegger's tool analysis into an analysis of the

relationships between humans and technological artifacts. He discerned several relationships human beings can have with technologies. Two of these can be indicated as relations of mediation.[2]

First, Ihde discerns the embodiment relation, which is his equivalent to Heidegger's readiness-to-hand. In the embodiment relation, technologies are incorporated by their users, establishing a relationship between humans and their world through the technological artifact. This embodiment relation, for instance, occurs when looking through a pair of glasses; the artifact is not perceived itself, but it helps to perceive the environment. Technological artifacts become extensions of the human body here, as it were. Second, Ihde discerns the hermeneutic relation. In this relation, technologies do not provide access to reality because they are incorporated but because they provide a representation of reality, which requires interpretation (hence the name "hermeneutic relation"). A thermometer, for instance, establishes a relationship between humans and reality in terms of temperature. Reading off a thermometer does not result in a direct sensation of heat or cold but gives a value that requires interpretation to tell something about reality.

Ihde shows that technologies, when mediating our sensory relationship with reality, transform what we perceive. According to Ihde, the transformation of perception always has a structure of amplification and reduction. Mediating technologies amplify specific aspects of reality while reducing other aspects. When looking at a tree with an infrared camera, for instance, most aspects of the tree that are visible to the naked eye get lost, but at the same time, a new aspect of the tree becomes visible: one can now see whether it is healthy. Ihde calls this transforming capacity of technology "technological intentionality": technologies have "intentions," they are not neutral instruments but play an active role in the relationship between humans and their world.

These intentionalities are not fixed properties of artifacts, however. They get shape within the relationship humans have with these artifacts. Within different relationships, technologies can have a different identity. The telephone and the typewriter, for instance, were not developed as communication and writing technologies but as equipment for the blind and the hard of hearing to help those individuals hear and write. In their use contexts, they were interpreted quite differently, however. This phenomenon is what Ihde calls "multistability": a technology can have several stabilities, depending on the way it is embedded in a use context. Technological intentionalities, therefore, are always dependent on the specific stabilities that come about.

Ihde's analysis of the transformation of perception has important hermeneutic implications. In fact, it shows that mediating artifacts help to determine how reality can be present for and interpreted by people. Technologies help to shape what counts as "real." This hermeneutic role of things has important ethical consequences since it implies that technologies can actively contribute to the moral decisions human beings make. Medical imaging technologies, such as magnetic resonance imaging and ultrasound, are good examples of this. Such technologies make visible parts of the human body, or of a living fetus in the womb, that cannot be seen without them. But the specific way in which these technologies represent what they "see" helps to shape how the body or a fetus is perceived and interpreted and what decisions are made. In this way, technologies fundamentally shape people's experience of disease, pregnancy, or their unborn children. Ultrasound, for instance, makes it quite easy to determine the thickness of the nape of the neck of a fetus, which gives an indication of the risk that the unborn child will suffer from Down's syndrome. The very fact of having an ultrasound scan made, therefore, lets the fetus be present in terms of health and disease and in terms of our ability to prevent children with this disease from being born (cf. Verbeek 2002).

Mediation of Action

Within the praxis perspective, the central question is how artifacts mediate people's actions and the way they live their lives. While perception, from a phenomenological point of view, consists in the way the world is present for humans, praxis can be seen as the way humans are present in their world. The work of Bruno Latour offers many interesting concepts for analyzing how artifacts mediate action (cf. Latour 1992, 1994). Latour pointed out that what humans do is in many cases coshaped by the things they use. Actions are the result not only of individual intentions and the social structures in which human beings find themselves (the classical agency-structure dichotomy) but also of people's material environment. The concept introduced by Latour and Akrich to describe the influence of artifacts on human actions is "script." Like the script of a movie or a theater play, artifacts prescribe their users how to act when they use them. A speed bump, for instance, has the script "slow down when you approach me" and a plastic coffee cup "throw me away after use."

This influence of artifacts on human actions is of a specific nature. When scripts are at work, things mediate action as material things, not as immaterial

signs. A traffic sign makes people slow down because of what it signifies, not because of its material presence in the relation between humans and world. And we do not discard a plastic coffee cup because its user's manual tells us to do so but because it simply is physically not able to survive being cleaned several times. The influence of technological artifacts on human actions can be of a nonlingual kind. Things are able to exert influence as material things, not only as signs or carriers of meaning.

As is the case with perception, in the mediation of action, transformations occur. Following Latour, within the domain of action, these transformations can be indicated as "translations" of "programs of action." Latour attributed programs of actions to all entities, human and nonhuman. When an entity enters a relationship with another entity, the original programs of action of both are translated into a new one. When somebody's action program is to "prepare meals quickly," and this program is added to that of a microwave oven ("heating food quickly"), the action program of the resulting, composite actor might be "regularly eating instant meals individually."

In the translation of action, a similar structure can be discerned as in the transformation of perception. Just as in the mediation of perception, some aspects of reality are amplified and others are reduced, in the mediation of action, one could say that specific actions are invited while others are inhibited. The scripts of artifacts suggest specific actions and discourage others.

The nature of this invitation-inhibition structure is as context dependent as the amplification-reduction structure of perception. Ihde's concept of multistability also applies within the context of the mediation of action. The telephone has had a major influence on the separation of people's geographical and social context, by making it possible to maintain social relationships outside our immediate living environment. But it could have this influence only because it is used as a communication technology, not as the hearing aid it was originally supposed to be.

An important difference with respect to the mediation of perception, however, is the way in which action-mediating artifacts are present. Artifacts mediate action not only from a ready-to-hand position but also from a present-at-hand position. A gun, to mention an unpleasant example, mediates action from a ready-to-hand position, translating "express my anger" or "take revenge" into "kill that person." A speed bump, however, cannot be embodied. It will never be ready-to-hand; it exerts influence on people's actions from a present-at-hand position.

Table 1
A Vocabulary for Technological Mediation

Experience	Praxis
Mediation of perception	Mediation of action
Technological intentionality	Script
Transformation of perception	Translation of action
Amplification and reduction	Invitation and inhibition
Delegation: deliberate inscription of scripts and intentionalities	
Multistability: context dependency of scripts and intentionalities	

Vocabulary

The STS concept of scripts, indicating the influence of technological artifacts on human actions, can be seen as part of a more encompassing framework for understanding the role of technologies in the relation between humans and reality. The main concepts of this framework together form a vocabulary for technological mediation (see Table 1), which could be helpful to analyze the role of technologies in their use contexts. Artifacts mediate perception by means of technological intentionalities: the active and intentional influence of technologies. They mediate action by means of scripts, which prescribe how to act when using the artifact. This latter form of mediation is most important for the ethics of engineering design since it concerns human actions whereas ethics is about the moral question of how to act. Technological mediation appears to be context dependent and always entails a translation of action and a transformation of perception. The translation of action has a structure of invitation and inhibition, the transformation of perception a structure of amplification and reduction.

Mediation and Engineering Ethics

The phenomenon of technological mediation creates a specific responsibility for designers. The brief overview of technical mediation in the previous section in fact shows that engineering design is an inherently moral activity. The fact that technologies-in-use inevitably play a constitutive

role in the actions of their users places mediation at the heart of ethics. Ethics, after all, is about the question of how to act, and technologies appear to give material answers to this question. Ethical questions regarding the design of technologies are thus not limited to questions about the goals for which technologies are designed and applied or to the quality of their functioning.

When technologies are inherently moral entities, this implies that designers are doing "ethics by other means": they materialize morality. Usually, this "doing ethics" happens in an implicit way. Engineers design a new technology with specific functionalities in mind, without explicitly aiming to influence the actions and behavior of users. The question, therefore, is how considerations regarding the mediating role that the technology-in-design will eventually play in society could be integrated in the design process.

There are two possible ways to take technological mediation into account during the design process. A first, minimal option is that designers try to assess whether the product they are designing will have undesirable mediating capacities. A second possibility goes much further: designers could also explicitly try to build in specific forms of mediation, which are considered desirable. Morality then, in a sense, becomes part of the functionality of the product.

Moralizing Technologies

The latter direction was taken by the Dutch philosopher Hans Achterhuis (1995, 1998), who translated Latour's analysis of scripts into a plea for an explicit "moralization of technology." Instead of moralizing only other people ("do not shower too long," "buy a ticket before you enter the subway"), humans should also moralize their material environment. To a water-saving showerhead, the task could be delegated to see to it that not too much water is used when showering, and to a turnstile, the task to make sure that only people with a ticket can enter the train.

Achterhuis's plea for a moralization of technology received severe criticism (cf. Achterhuis 1998, 28-31). In the debate that arose around this issue in the Netherlands, two types of arguments were brought in against his ideas. First, human freedom was thought to be attacked when human actions are explicitly and consciously steered with the help of technology. This reduction of human freedom was even perceived as a threat to human dignity; if human actions are not a result of deliberate decisions but of steering technologies, then people were thought to be deprived of what makes them human. Moreover, if they are not acting in freedom, their

actions cannot be called moral. Human beings then simply show a type of behavior that was desired by the designers of the technology, rather than explicitly choosing to act this way. Second, Achterhuis was accused of jettisoning the democratic principles of our society because his plea for developing behavior-steering technology was considered an implicit propagation of technocracy. When moral issues are solved by the technological activities of designers instead of democratic activities of politicians, these critics hold, not humans but technology will be in control.

These arguments can be countered, though. Anticipating the mediating role of technologies during the design process—either to assess possible undesired forms of mediation or to explicitly moralize technologies—does not need to be as immoral as it might seem to be. First, human dignity is not necessarily attacked when limitations of freedom occur. Our legal constitution implies a major limitation of freedom, after all, but this does not make it a threat to our dignity. Human behavior is determined in many ways, and human freedom is limited in many ways. Few people will protest against the legal prohibition of murder, so why protest to the material inhibition imposed by a speed bump to drive too fast at places where children are often playing on the pavement?

Second, the analysis of technological mediation above shows that technologies always help to shape human actions. Seen from this perspective, paying explicit attention to the mediating role of technologies should be seen as taking the responsibility that the analysis of technological mediation implies. When technologies are always influencing human actions, we had better try to give this influence a desirable form. Besides, as will become clear below in the example of a Dutch industrial design initiative, the moralizing role of technologies does not necessarily have the form of exerting force on human beings to act in specific ways. Technologies can also seduce people to do certain things; they can invite specific actions without forcefully exacting them.

These counterarguments, however, do not take away the anxiety that a technocracy would come about when technologies are explicitly moralized. It might be true that technologies do not differ from laws in limiting human freedom, but laws come about in a democratic way, and the moralization of technology does not. Yet this does not justify the conclusion that it is better to refrain from paying explicit attention to technological mediation during the design process. If technologies are not moralized explicitly, after all, the responsibility for technological mediation is left to the designers only. Precisely, this would amount to a form of technocracy. A better conclusion

would be that it is important to find a democratic way to moralize technology. In the following, I will elaborate a way to do this.
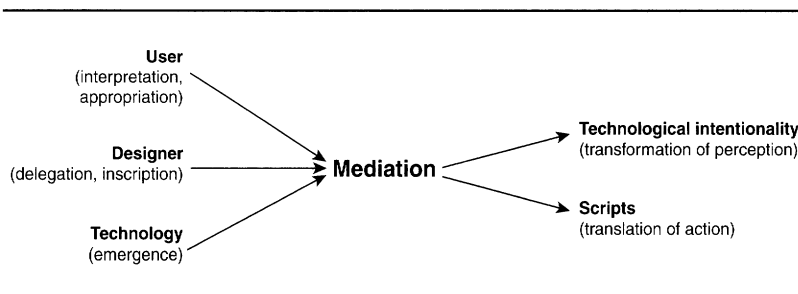
Designing Mediations

The moral impediments to the moralization of technology can be countered much more easily than the practical impediments. The moralization of technological artifacts is not as easy as it might seem to be. To build in specific forms of mediation in technologies, designers need to anticipate the future mediating role of the technologies they are designing. And this is a complex task since there is no direct relationship between the activities of designers and the mediating role of the technologies they are designing. As became clear above, the mediating role of technologies comes about in a complex interplay between technologies and their users.

Technologies are multistable, as Ihde calls it. They have no fixed identity but get defined only in their context of use. Technologies have to be interpreted and appropriated by their users to be more than just objects lying around. Only when human beings use them, artifacts become artifacts for doing something. And this "for doing something" is determined not entirely by the properties of the artifact itself but also by the ways users deal with them, as became clear in the example of the telephone that was originally designed as a hearing aid. If this were not the case, accepting the idea of technological mediation would take us back to technological determinism; technologies would then be able to determine the behavior of their users all by themselves instead of being part of a sociotechnical network.

This multistability of technologies makes it very difficult to predict the ways in which technologies will influence human actions and accordingly to evaluate this influence in ethical terms. Technologies can be used in unforeseen ways and therefore have an unforeseen influence on human actions. Besides this, unforeseen forms of mediation can also emerge when technologies are indeed used as the designer intended. Revolving doors, for example, were designed to make it possible to enter a building while keeping the draught outside. Once they were used, they also appeared to inhibit people in a wheelchair to enter a building.

Designers thus help to shape the mediating roles of technologies, but these roles also depend on the ways in which the technologies are used and on the ways in which the technologies in question allow unforeseen mediations to emerge. The suggestion that scripts are a result of inscriptions (Akrich) or delegations (Latour) therefore does not do enough justice to the

Figure 1
Sources of Mediation

complex way in which mediation comes about. Designers cannot simply inscribe a desired form of morality into an artifact. The mediating role of technologies is not only the result of the activities of the designers, who inscribe scripts or delegate responsibilities, but also depends on the users, who interpret and appropriate technologies, and on the technologies themselves, which can evoke emergent forms of mediation. Figure 1 draws together these factors in the coming about of mediation.

To cope with this complexity, designers should try to establish a connection between the context of design and the context of use. Designers could try to formulate product specifications not only on the basis of the desired functionality of the product but also on the basis of an informed prediction of its future mediating role and a moral assessment of this role. Such a prediction could be indicated as a mediation analysis: an analysis of the future role of the technology-in-design in terms of the vocabulary that was elaborated in the Technological Mediation section.

Mediation analyses could be carried out in two different ways. The first is simply prediction by the imagination of the designer. Imagination can create a link between the designer and the technology in its future use context. When designers attempt to imagine what mediating role the technology they are designing might play in the behavior of its users, they could feed these anticipations back into the design process. As an example of this approach, I will briefly discuss the work done by the Dutch industrial designers collective Eternally Yours. A second way to formulate an informed prediction of the future mediating role of technologies is a more systematic one. It consists in an augmentation of the existing design methodology of constructive technology assessment in such a way that

it becomes an instrument for a democratically organized moralization of technology.

Anticipation by Imagination: Eternally Yours

An interesting example of anticipating mediation by imagination is the work of the Dutch industrial designers collective Eternally Yours. Eternally Yours is engaged in ecodesign but in an unorthodox way (cf. van Hinte 1997; Verbeek 2005). It does not want to address the issue of sustainability in only the usual terms of reducing pollution in production, consumption, and waste. The actual problem, Eternally Yours holds, is that most of our products are thrown away far before actually being worn out. Meeting this problem could be much more effective than reducing pollution in the different stages of products' life cycles. For this reason, Eternally Yours focuses on developing ways to create product longevity. It does so by investigating how the coming about of attachment between products and their users could be stimulated and enhanced.

To stimulate longevity, Eternally Yours seeks to design things that invite people to use and cherish them as long as possible. "It is time for a new generation of products, that can age slowly and in a dignified way, that can become our partners in life and support our memories," as Eternally Yours approvingly quoted the Italian designer Ezio Manzini in its letterhead. Eternally Yours investigates what characteristics of products are able to evoke a bond with their users. According to Eternally Yours, three dimensions can be discerned in the life span of products. Things have a technical, an economical, and a psychological life span. Products can turn into waste because they simply are broken and cannot be repaired anymore, because they are outdated by newer models that have appeared in the market, and because they no longer fit people's preferences and taste. For Eternally Yours, the psychological life span is the most important. The crucial question for sustainable design is therefore, How can the psychological lifetime of products be prolonged?

Eternally Yours developed many ideas to answer this question. For instance, it searched for forms and materials that could stimulate longevity. Materials were investigated that do not get unattractive when aging but have "quality of wear." Leather, for instance, is mostly found more beautiful when it has been used for some time, whereas a shiny polished chromium surface looks worn out with the first scratch. An interesting example of a design in this context is the upholstery of a couch that was

designed by Sigrid Smits. In the velour that was used for it, a pattern was stitched that is initially invisible. When the couch has been used for a while, the pattern gradually becomes visible. Instead of aging in an unattractive way, this couch renews itself when getting old. Eternally Yours not only pays attention to materials and product surfaces, however. It also investigated the ways in which services around products can influence their life span. The availability of repair and upgrading services can prevent people from discarding products prematurely.

The most important way to stimulate longevity that should be mentioned in the context of this article, however, consists in designing products that evoke a bond with their users by engaging users in their functioning. Most technologies ask as little attention for themselves as possible when people are using them. Technologies, after all, are often designed to disburden people: a central heating system liberates us from the necessity to gather wood, chop it, fill the hearth, clean it, and so forth. We need only to switch a button and our house gets warm. But this disburdening character also creates a loss of engagement with technological products. Ever fewer interactions are needed to use them (cf. Borgmann 1992). One of the downsides of this development is that this also affects the attachment between human beings and technological products. The product as a material entity has become less important than the function it fulfills. In many cases, human beings are not invited to interact with the technological artifact they are using but only to consume the commodity it procures.

The work of Eternally Yours shows that this loss of engagement can be countered in a playful way. Technological products could invite users to interact with them without being so demanding that nobody would be prepared to use them. An interesting example in this direction is an engaging electric/ceramic heater that was designed by Sven Adolph. It consists of a heating element with several concentric, cylindrically shaped ceramic shells of different height around it, which all have a vertical aperture. The shells can be arranged in several ways, so that they radiate their warmth in specific directions. This artifact is not a purely functional heater that withdraws into pure functionality like common radiators, which are hidden under the windowsill and are only turned on and off. It is an engaging product that asks for attention and involvement in its functioning, much like a campfire. You cannot hide it under the windowsill but have to put it in the middle of the room. You cannot escape it if you need warmth: you have to sit around it. Its shells have to be arranged if you want it to function. Simply turning the heater on and off is not enough: you actually have to be involved in its functioning if you want it to work.

The activities of Eternally Yours can be seen as a form of anticipating mediation by imagination. Sigrid Smits's couch and Sven Adolph's heater were designed explicitly from the perspective of their possible mediating role in the interactions and affective relationships their owners will have with them. They mediate the behavior of their users in such a way that the users are likely to get attached more to these artifacts than to other couches or heaters. These products were designed not only as functional objects but also as artifacts that actively mediate the behavior of their users. The products of Eternally Yours embody an environmental ethics: they seduce their users to cherish them rather than throwing them away prematurely.

Augmenting Constructive Technology Assessment

A second way to make an informed prediction about the mediating role of a technology-in-design is a more systematic one. To establish a connection between the context of use and the context of design, designers could also employ a method that was developed precisely for making such a connection: the method of constructive technology assessment (CTA; cf. Schot 1992; Rip, Misa, and Schot 1995). CTA creates a link between the contexts of design and use in a practical way: it aims to involve all relevant stakeholders in the design of technologies. To make use of the CTA methodology within the context of technological mediation, it needs to be augmented, though.

CTA is based on an evolutionary view of technology development. The process of technology development is seen as generating variations that are exposed to a selection environment, which is formed by entities such as the market and government regulations. In this selection environment, only the fittest variations will survive. There is an important difference between the generation of technologies and the generation of biological species, though. Contrary to biological evolution, in technology development, there is a connection or nexus between variation and selection. After all, designers can anticipate the selection environment when they are designing technologies, to prevent that much effort is put into developing technologies that will not be accepted by consumers or by government regulations.

CTA is a method to employ this nexus in a systematic way, by feeding back assessments of the technology-in-design by all relevant actors, such as users, pressure groups, designers, companies, and so forth, into the design process. It does so by organizing meetings of all relevant actors in which the aim is to reach consensus about the design of the technology that is constructively assessed. This form of technology assessment is called "constructive" because it does not assess technologies after they have been
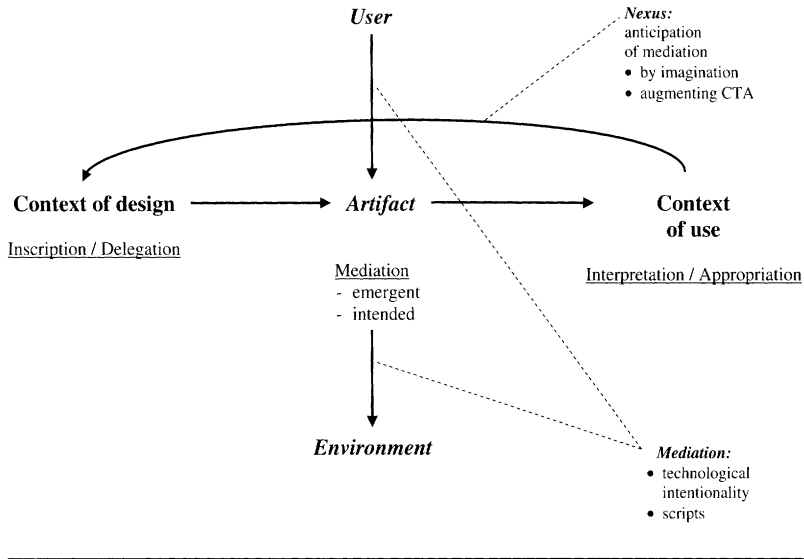
developed but during their development, so that these assessments can be used to modify the original design. Besides this, CTA can be seen as a democratization of the designing process. When a CTA design methodology is followed, not only designers determine what a technology will look like but all relevant social actors. Following this method, therefore, could take away the fear for technocracy that was discussed above.

Seen from the perspective of technological mediation, however, CTA also has limitations that need to be overcome. CTA primarily focuses on human actors and pays too little attention to the actively mediating role of the nonhuman actor that is at the center of all activity: the technology-in-design. CTA claims to open the black box of technology by analyzing the complex dynamics of technology development. It bases itself on the constructivist notion that technologies are not given but rather the outcome of a process in which many actors are involved. Other interactions between the actors might have resulted in a different technology. But by analyzing the dynamics of technology development, the black box of technology is opened only half way. It reveals how technologies emerge from their design context, but their role in their use context remains black boxed. Therefore, organizing a democratic, domination-free discussion between all relevant actors is not enough to lay bare all relevant aspects of the technology in question. The mediating role of the technology-in-design is likely to remain hidden during the entire CTA process if it is not put explicitly and systematically on the agenda.

For this reason, participants in the CTA process should be invited not only to integrate assessments of users and pressure groups in product specifications but also to anticipate possible mediating roles of the technology-in-design. The vocabulary for analyzing mediation, as presented in the Technological Mediation section of this article, could be helpful for doing this. As Figure 2 illustrates, approaching the artifact-in-design in terms of mediation offers a perspective that can be used when creating a nexus between the contexts of design and use.

When the CTA method is augmented in this way, the method of anticipation by imagination is given a more systematic character. Creating space for all relevant stakeholders to anticipate the possible mediating role of the technology-in-design enhances the chance that as many mediating roles as possible are taken into account. To be sure, this augmentation of the CTA methodology does not guarantee that all mediating roles of the technology-in-design will be predicted. It creates a connection between the inscriptions within the context of design and the interpretations or appropriations within

Figure 2
Mediation and the Nexus between Design and Use

User

Nexus:
anticipation
of mediation
  • by imagination
  • augmenting CTA

Context of design ⟶ *Artifact* ⟶ **Context of use**

Inscription / Delegation

Mediation
- emergent
- intended

Interpretation / Appropriation

Environment

Mediation:
  • technological
    intentionality
  • scripts

the context of use, but this cannot possibly cover all emergent mediating roles of the technology. Yet it might be a fruitful way to give shape to the responsibility of designers that becomes visible from the analysis of technical mediation.

Conclusion

The analyses of technological mediation, which have been elaborated over the past years in STS and philosophy of technology, have major implications for the ethics of engineering design. The insight that technologies inevitably play a mediating role in the actions of users makes the work of designers an inherently moral activity. Ethics is about the question of how to act, and technologies appear to be able to give material answers to this question by inviting or even exacting specific forms of action when they are used. This implies that technological mediation could play an important role in the ethics of engineering design. Designers should focus not only on

the functionality of technologies but also on their mediating roles. The fact that technologies always mediate human actions charges designers with the responsibility to anticipate these mediating roles.

This anticipation is a complex task, however, since the mediating role of technologies is not entirely predictable. But even though the future cannot be predicted with full accuracy, ways do exist to develop well-informed and rationally grounded conjectures. To cope with the uncertainty regarding the future role of technologies in their use contexts, designers should try to bridge the gap between the context of use and the context of design.

One way to do so is by carrying out a mediation analysis with the help of the designer's imagination, which can be facilitated by the vocabulary developed in this article. Such an analysis will not allow designers to predict entirely how the technology they are designing will actually be used, but it will help to identify possible use practices and the forms of mediation that might emerge alongside it.

Designers could also make use of an augmented form of constructive technology assessment, in which the connection between design and use is made not only in imagination but also in practice. In this case, a mediation analysis is carried out not by the designer individually but by all stakeholders together, who engage in a democratically organized debate to decide how to feed back the outcomes of this analysis into the design process. Following this method could take away part of the fear that deliberately designing behavior-steering technology would lead to technocracy since the inevitable mediating role of technology is made subject to democratic decision making here.

To be sure, this anticipation of technological mediation introduces new complexities in the design process. Designers, for instance, might have to deal with trade-offs: in some cases, designing a product with specific desirable mediating characteristics might have negative consequences for the usefulness or attractiveness of the product. Introducing automatic speed influencing in cars will make sure that drivers keep to the speed limit but at the cost of the experience of freedom, which appears to be rather important to some car drivers, judging by the fierce societal resistance against speed-limiting measures. Also, when anticipating the mediating role of technologies, prototypes might be developed and rejected because they are likely to bring about undesirable mediations. Dealing with such trade-offs and undesirable spin-offs requires a separate moral decision-making process.

Technology design appears to entail more than inventing functional products. The perspective of technological mediation, which has been developed

in STS and in the philosophy of technology, reveals that designing should be regarded as a form of materializing morality. This implies that the ethics of engineering design should take more seriously the moral charge of technological products and rethink the moral responsibility of designers accordingly.

Notes

1. The text of this section is a reworked version of a section in P. P. Verbeek (forthcoming). It can be seen as a summary of the analysis of technological mediation as developed in Verbeek (2005).

2. Ihde (1990) also distinguished two relations that do not directly concern mediation. First, he identified the "alterity relation," in which technologies are the terminus of our experience. This relation, which mirrors Heidegger's "presence at hand," occurs when interacting with a device as if it were another living being, for instance, when buying a train ticket at an automatic ticket dispenser. Second, Ihde discerned the "background relation." In this relation, technologies play a role at the background of our experience, creating a context for it. An example of this relation is the automatic switching on and off of the refrigerator.

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