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Conceptual disruption and 21st century technologies: A framework

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ABSTRACT

Modern technologies like artificial intelligence, robotics, geo-engineering, social media, or next-generation genomics have been and will continue to be *socially* (culturally, economically, legally, etc.) *disruptive*. Several philosophers of technology have noted that technology is not only *socially* but also *conceptually disruptive*. Technologies do not only change the way we live together. They also challenge the way we conceptualize or classify ourselves and the world around us. However, it is not clear what it means for technology to disrupt our concepts, as the very idea of conceptual disruption and its relation to conceptual and social change remain opaque. In what way can technologies disrupt our concepts and how we can overcome such disruptions? This paper proposes a framework for studying technology-induced conceptual disruptions that draws both on mediation theory and recent work on conceptual engineering.

1. Introduction

Modern technologies like machine learning, robotics, large language models, geo-engineering, social media, or next-generation genomics have been and will continue to be *socially disruptive* [1,2]. Several philosophers have expressed concern that such *disruptive innovations* [3,4] will lead to significant disruption of established beliefs, social norms and practices, and beliefs [5–12]. For example, the replacement of a human workforce with robots arguably disrupts established business and production models as well as interpersonal norms, social roles, and personal career paths [13]. Similarly, the advent of social media has arguably disrupted social practices and norms pertaining to sharing personal information and the legal right to privacy [14].[1]

Many of the paradigmatic examples of social disruptions are non-conceptual, including the case studies presented in [8] or the report by the WTO and WCO mentioned in the first footnote. However, philosophers of technology have long stressed that new technologies do not only challenge our social institutions and relations but that they disrupt our most fundamental moral and scientific concepts, i.e., the basic entities or abilities that we rely on to think and talk about ourselves and the world. The idea that technologies can disrupt or even change the way we classify the world work goes back to the beginnings of 20th century philosophy of technology with authors like [15–18] or [19]. Already in the 19th century, German poet Heinrich Heine argued that the railway challenges and changes our most basic concepts of time and space [20] (see [1] for a similar claim on the disruption of the concept of space). Around the beginning of the 21st century, [21] argued that the invention of the obstetric ultrasound – an imaging technology that produces visual representations of the embryo or fetus within a pregnant woman – has given the parents not only new options for action but led them to conceptualize the fetus as detached from the mother.

In more recent years, the idea that new technologies disrupt not just our social practices and norms but even our most basic moral concepts has found new proponents and applications to 21st century technologies with a focus on AI and synthetic biology. For example, [22] argued that the advent of modern and future intelligent robots may not just challenge our social practices and norms regarding trust but challenge or even change our conception of trust. While we used to apply the concept of trust only to people we know well or at least members of the same social group, we may soon apply it even to robots and other intelligent non-human systems. [23] argued that the advent of sex robots will put pressure on or even change our concept of consent, especially if such

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[1] A review of different socially disruptive technologies can be found for example in a recent report by World Customs Organization (WCO) and the World Trade Organization (WTO), which includes a number of interesting case studies. https://www.wto.org/english/res_e/publications_e/wco-wto22_e.htm.

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robots will be conceptualized as "legal persons" [24]. [11] argued that AI will disrupt the concept of personal identity while [25] argued that synthetic biology might change our current concept of life.[2]

While the notions of disruptive innovations and technology-induced social disruptions are currently being discussed in detail (see [12,7]; and [2] for reviews), the notion of technology-induced *conceptual* disruption is not being explored to the same extent. Despite the wealth of examples of the way technology impacts our concepts, it remains unclear what exactly the notion of conceptual disruption amounts to, how it arises from technological innovations, and how it relates to the concept of conceptual change. The purpose of this paper is to begin answering these questions. Building on [2,13], *mediation theory* [26], and the thriving literature on conceptual engineering [27–29], I first engineer a broad notion of conceptual disruption. This broad notion will be sharpened by a number of further distinctions and by comparing it to the notions of conceptual application and conceptual change. Finally, I propose a model of how technology generates conceptual disruptions and how these disruptions can be studied and potentially dissolved. I hope that this conceptual framework will stimulate and guide empirical and philosophical research on the impact of new technologies on our moral and other fundamental concepts.

2. Engineering "conceptual disruption"

2.1. A guiding example

In the British version of the Swedish TV show *Real Humans*, one of the main characters, Joe, a married father of two, has sex with the humanoid service robot, Anita. For this to be possible, he only has to enable the robot's "adult" function. Anita is conscious and happens to be attracted to Joe. However, at the time of the incident, Joe has no reason to think that Anita is anything but a non-sentient mildly intelligent machine, i.e., a machine without any feelings and with the purpose of serving him and his family. Thus, he classifies his action – intercourse with Anita – as masturbation with a sex toy rather than sex with a person. Even though Joe is trying to hide the fact that he had intercourse with Anita, he does not conceptualize himself as having acted wrongly. He tries to hide his action not because he considers it unethical or wrong but because he feels embarrassed. He feels shame rather than guilt. He thinks that he did nothing wrong but still does not want his action to become public for non-moral and merely social reasons. He does not want others to think of him in association with a private and perhaps even stigmatized sexual activity.

When Joe's action is revealed to the family (by the company that sold Anita), Joe's wife, Laura, considers it not masturbation but adultery. Joe is surprised by this classification and provides reasons against it. He argues that Anita is just a machine and that intercourse with a machine is not the same as adultery. Adultery, he argues, requires a sentient person with whom one could start another family or build an emotional relationship, both of which would interfere with Joe's monogamous commitments. Again, at this point, nobody in the family knows that Anita is sentient. He could also argue that the historical function of the term *adultery* has been to regulate society by means of strict norms regarding reproduction. Since Anita cannot bear children, this means that the concept does not apply here. Eventually, however, Joe loses the classificatory battle against his wife and is asked to move out for a while. Nevertheless, whether or not he committed adultery likely remains a controversial issue in the community. The community, too, will have to decide about the moral significance of Joe's action. The community is *forced* to make a classificatory decision about the application conditions of concepts like *masturbation, adultery,* and *person* as well as their inferential relations to other concepts, i.e., what follows from being classified as an adulterer.

2.2. Socially disruptive technologies

The service robot Anita is a paradigmatic kind of what can be called a *socially disruptive technology*. In the context of philosophy of technology and theoretical economics, the notion of disruption has been introduced under the labels of "disruptive technologies" and "disruptive innovations" and is mostly associated with the work of the economist Clayton Christensen [30,31]. Disruptive innovations are innovations or technologies that "cause a stir" in existing market structures [7,31]. They are more than technological improvements on existing structures and may at first even be less competitive within existing structures. An example of a disruptive business model is Amazon. The company began as a rather small and hardly competitive online bookshop. Nevertheless, its business model was disruptive enough to change the market to its advantage, such that more established bookshops perished.

While Christensen and his colleagues and commentators [7] have focused on a kind of social disruption pertaining to the economy, one can identify other kinds of technologically induced social disruptions. In fact, given that the economy is part of our social world, we might say that Christensen was merely interested in a subset of technologically induced social disruptions. Because the notion of a technological disruption promises to be useful and fruitful for other social domains, the concept has been broadened to include examples beyond the world of business, such as social structures, social norms, and social kinds (e.g., *marriage, family, etc.*). According to [2](p. 4), for example, social disruption "manifests itself in the overturning of stably entrenched [social] norms [and] practices". Social disruptions in general are then events that generate cracks or ripples in the fabric of society. They generate interruptions of some expected course of events or challenges to a certain societal equilibrium [6,9,10]. This disruption often leads to changes in social norms or practices, although this is not necessarily the case.

2.3. Conceptual disruption

As the example of Joe and Anita shows, technology can be socially disruptive not only in the sense of "overturning stably entrenched norms of conduct", as [2] calls it. It is not just that inventions like Anita change the way we clean our houses, take care of our children, or wash our bikes. The example shows that a particularly important and deep kind or instance of social disruption is classificatory, i.e., a disruption or challenge of our established classificatory norms and practices.[3] It is a challenge or disruption of conceptual pairs like *masturbation* versus *adultery* or *person* versus *object*. Moreover, it is a disruption pertaining to other concepts that are inferentially related. If we classify Joe's action as adultery, this does not only change our use or practice with respect to the word *adultery*. It also puts pressure on related concepts like *person, object,* and *emotional connection*. This has moral and social consequences. Once we change these pairs, we also change our more practical norms and behaviors with respect to the respective new technology.

Following Hopster's analysis of socially disruptive technologies, I take it that we can consider an action, event, or artifact *socially* disruptive if it challenges or prompts an overturning of stably entrenched norms and practices. An action, event, or artifact would then be *conceptually* disruptive, following this characterization, if it

[2] There are many more examples that would overburden the main text: It has been argued that social media challenge the concept *friend* [20], that robots may put pressure on our concept *respect* [51] and *right* [24], that neuroimaging methods exert pressure on the concept *free will* [52], that Digital Twins have the potential to challenge the concepts of health and disease [5], that an artificial womb may challenge the concept *fetus* [40], that computer technologies change our concept of assault (54) and that de-extinction technologies challenge the concept of extinction [10].

[3] For examples of legal classifications see [9, 10].

challenges or prompts an overturning of entrenched *conceptual* or *classificatory* norms and practices, i.e., practices pertaining to language and thought. In other words, an action, event, or artifact is conceptually disruptive if it prevents a certain classificatory equilibrium or typical classificatory practices from continuing as planned or expected. We can say that Anita's human-like qualities, especially her sexual functionality, put pressure not only on our established social relationships and institutions [23] but on our established classificatory norms and practices. Anita's existence challenges the way we currently apply our concepts of robot, sex toy, object, person, adultery, and masturbation. I would like to propose the following characterization of the phenomenon as a starting point.

> A conceptual disruption is any intentional or unintentional challenge or interruption of the ways in which an individual or group has intuitively classified individuals, properties, actions, situations, or events, leading to a classificatory conflict or uncertainty, i.e., a conflict or uncertainty about the application conditions of a word or concept.

Note that this is not a set of necessary and jointly sufficient conditions and is supposed to give us a general description of the phenomenon in question. This characterization will be sharpened in subsequent subsections by being distinguished from adjacent concepts like *conceptual application, and conceptual change.*

2.4. Conceptual disruption and conceptual application

To sharpen the notion of conceptual disruption introduced here, we can contrast conceptual disruptions with the concept of conceptual application. We classify the world around us all the time. We do this by applying our concepts normally without much reflection. I intuitively recognize the object in front of me as a computer without giving it much thought. My concept of computer mediates, so to say, my experience with the world rather than being itself an object of study [26]. Thus, most of the time, the events, and artifacts I encounter do not generate any need for a conscious conceptual decision or application and therefore do not generate conceptual disruption. My concepts are in the *background*, so to say [32]. The computer in front of me is not conceptually disruptive as I immediately classify it as a computer without this application disrupting any expected course of events or norms. However, anything that requires conceptual reflection or conscious decision-making is arguably disruptive in the sense that it breaks with the current course of action and conceptualizations, often (but not necessarily) leading to *conceptual* or *classificatory uncertainty*.[4]

Often conceptual disruptions generate a conflict or even a dilemma – we often have several options to make fitting classifications. The conceptual uncertainty generated by conceptual disruptions usually forces the individual or community to make a conceptual decision, i.e., to consciously choose between different concepts. Often, each of the options is problematic in some respect and different options are preferred by different stakeholders. Even if an actual decision may be postponed, we normally cannot leave objects, actions, or situations unconceptualized if we wish to engage with them and talk about them. Leaving a situation or artifact unconceptualized can generate not only communicative disruption [28] but insecurity, distress, and uncertainty in the community and its members. Inaction often ends up being a kind of decision, for example by normalizing or legitimatizing the action that is not conceptualized. Such a normalization due to inaction may even contribute to an eventual conceptual decision in terms of the ethically less severe option – given that the inaction established a new social practice that left the action unpunished. For example, if after some time, Joe's action will remain unpunished, simply due to inaction or continued disagreement in the community, this may attract a conceptualization of Joe's action in terms of the ethically less severe concept, i.e., masturbation rather than sex that entails adultery.

2.5. Conceptual disruption and conceptual change

In addition to distinguishing conceptual disruption from concept application, we can distinguish an event that is conceptually disruptive from the possible change in conceptual norms and practices prompted by it [33]. A disruption of our ways of relating to the world may lead to a conceptual or social change but is conceptually distinct from it. In the example of Joe above, for instance, our classifications and practices are being challenged but are not yet changed or "overturned". The social disruption here consists not in the fact that norms are changed but that we no longer know "how to go on" [34] (§151) or what norms to follow – what I called "conceptual uncertainty". No conceptual change has been introduced yet. It is not that the concept of adultery has been changed – at this point, it has been disrupted in the sense that we can no longer simply apply it without deliberation. In other words, a conceptual disruption is an event that may *necessitate* a change in conceptual practices but that itself does not *constitute* any such change. Instead, it interrupts our unreflective or tacit classifications in a way that usually demands reflection and reasoning. Based on reflection and reasoning, we then have to make classificatory decisions that constitute or result in classificatory changes and potentially even genuine conceptual changes.

To emphasize the difference between a conceptual disruption and change, note that we can conceive of classificatory and conceptual changes that are not necessarily conceptually disruptive, i.e., which do not generate any conceptual uncertainty or difficult conceptual decisions. We can conceive of certain long-term and low-level conceptual changes that nobody really noticed and that did not require any decision of an individual, group, or institution (I call this "conceptual drift", cf. the notion of moral drift by [35]). We can even think of conceptual changes that happen rather quickly without requiring any conscious or collective decision simply because the change occupies a conceptual vacuum that is easily filled. Think for example of recent introductions to our vocabularies labeling certain phenomena that everyone easily recognizes but previously had difficulties talking and even thinking about. I am considering here concepts like mansplaining, which denotes certain activities of cis men that occupy a social space in a way that many people experience as offensive. It is at least not obvious why such conceptual introductions or changes should be classified as conceptual disruptions rather than mere conceptual developments.[5]

In the next section, I propose a framework for thinking and empirically studying conceptual disruptions further. This framework consists primarily of the characterization just introduced and several distinctions that are intended as tools that hopefully help to further describe phenomena as conceptually disruptive and that help to distinguish them from other kinds of social or non-social disruptions and changes. Concretely, I distinguish between personal and public (social) disruptions, shallow and deep conceptual disruptions, and different ways in which conceptual disruptions manifest themselves. Finally, I propose a model of how technology-induced conceptual disruptions occur and how they can be overcome. The hope is that this framework will help philosophers of technology identify different kinds of conceptual disruptions and assist them in identifying their causes as well as possible solutions. The framework developed here is summarized in Table 1. In the final subsection, I provide a short introduction to how to potentially apply this framework in future empirical or conceptual work on

[4] I thank Elizabeth O'Neill for the term *conceptual uncertainty*. See Ref. [22]; MacAskill er al. (2020) or [8] for the term *moral uncertainty*. Again, conceptual uncertainty is not a necessary condition for conceptual disruption.

[5] Here we can clearly see a parallel to Christensen's notion of disruptive innovations. The innovations are not disruptive if they merely involve a development. They must significantly disrupt and change this development.

Table 1
A typology of conceptual disruption.

Type	Personal conceptual disruption	Public conceptual disruption	
Description	Pertains only to an individual and their immediate peers.	Pertains to the larger society or the entire community. Often involves social institutions.	
Examples	An individual or small group questioning certain classificatory practices, e.g., whether Joe engaged in adultery or masturbation.	The larger society negotiating and potentially changing certain classificatory practices, say, pertaining to whether Joe engaged in adultery or masturbation.	
Actors	Individuals & Users	Legislators	Civil Society
Description	An individual may decide how to classify a new object or situation	In important cases or cases of public interest, it might be a legislator who has to make a conceptual decision.	In cases of public interest or cases that are not yet legally regulated, it will be the general public who has to make a conceptual decision.
Examples	Deciding whether a tomato is a vegetable or a fruit in the personal realm.	Deciding whether to classify a tomato as a fruit or vegetable in international business interactions.	Deciding whether sex with a service robot is considered adultery or masturbation.
Type	Shallow	Deep	
Description	Does not pertain to socially fundamental concepts that likely substantially affect few other concepts in the conceptual network.	Pertains to socially fundamental concepts with many inferential relations to other fundamental concepts in the conceptual network.	
Examples	Cloud computing, Black Friday, workshop, shopping, cup …	Person, object, nature, privacy, consent, friendship, emotion, democracy …	
Causes	Conceptual gap	Conceptual Overlap	
Description	New technology gives rise to a new object or event that cannot be conceptualized at all.	New technology gives rise to a new object or event that can equally well be conceptualized by two or more concepts.	
Examples	Technologies that are now described with basic terms like hammer, knife, music, and internet.	Classifying Joe's action as masturbation or adultery; The invention of the mechanical ventilator leading to a conceptual overlap concerning the notion of death.	
Solutions	Introduction	Elimination	Selection
Description	We can overcome a conceptual gap/ overlap by introducing new concepts either by introducing a new simple or complex term or by changing the use of a word.	We can eliminate a concept from our vocabulary to overcome a conceptual disruption. Elimination can also happen when concepts change (replacement).	We can simply select one of the concepts available, which does not necessarily lead to a conceptual broadening or change but to a change of application conditions.
Example	Brain death, artificial person …	Our old concept of person, phlogiston …	Adultery or Fun, Object or Tool, Death or Alive …

technology-induced conceptual disruptions. These guidelines are supposed to be abstract enough to help different students and researchers to get different kinds of projects off the ground.[6]

3. Toward a framework for thinking about conceptual disruption

3.1. Personal and public conceptual disruptions

How can we further think about conceptual disruptions? The first and arguably most pressing distinction I propose is one between personal and public conceptual disruptions. Conceptual disruptions may occur to an individual as well as to the larger community and the characterization above is intentionally broad enough to allow for such a distinction. This distinction can be brought to life by the example above. There is an important distinction to be made between conceptual disruption of the individual or small groups, say Joe and his family, and society at large. Laura and Joe's conceptual conflict has little impact on the wider society, but societal conceptual disagreements often affect the individual. This is of course not always the case. Often, public conceptual disruptions and even conceptual changes remain on the level of the public but hardly affect the personal realm. Think of the example of how to classify tomatoes. The relevant authorities in the United States define tomatoes as vegetables for practical reasons pertaining to their use while botanists classify them as fruit for scientific reasons. The ordinary individual is usually unaware of this conflict and is also not required to commit to a conceptual decision regarding tomatoes. Thus, if a new hybrid tomato is introduced to the world market, this might conceptually disrupt the US classificatory practices but not necessarily personal classifications.

The distinction between personal and public conceptual disruption motivates a distinction between different *domains of conceptual disruption*. The domain of conceptual disruption determines who gets to decide how to solve a conceptual disruption – who are the actors and stakeholders (see Table 1). Clearly, in the personal realm, it seems that conceptual disruptions can be solved by negotiating a classificatory decision that all members of the (small) group agree with. In the case of public conceptual disruption, only the larger society or a legislator has the power to generate a resolution to the disruption. Often, a classificatory decision made by society at large or the legislator has an effect on the personal domain. For example, in the case of Joe and Laura, it might be decided in the family that Joe committed adultery but decided by the larger community that he did no such thing and is innocent. The family now has to position itself in relation to this public verdict and decide whether it wishes to take the public's opinion into account when judging Joe's actions. We can think of a part of society reaching a different verdict than the legislator, in which case we might expect activism toward a legislative change. Clearly, the notion of power is relevant here.

This distinction also allows us to construe conceptual disruption as a

[6] At this point, the reader might wonder whether concepts and languages that express these concepts are not themselves a kind of mediating technology (e.g., Refs. [18,48]. I agree that we can view language and conceptual thought in general as a kind of technology that, like more paradigmatic technologies (stone tools, books, smartphones), instantiate a mediating relation between us and our social and physical environment. Languages, like technologies in general, shape the relationship between humans and the world (cf. [5], and allow us to coordinate our actions in ways that were fundamental for our success [6]. Consequently, words and concepts can and have been socially disruptive technologies themselves just as new technologies can of course disrupt this technology. Again, these disruptions are often experienced as especially deep because of their mediating role of concepts and words. Words and concepts may be said to even have immense metaphysical power besides their epistemic power. Disrupting a socially constructed concept like marriage for example can arguably not just disrupt our access to the world but change the social world in often drastic ways [53, 55, 21].

broader philosophically interesting phenomenon that can occur independently of disruptive technologies (if, e.g., an epistemically inexperienced agent encounters a novel argument that challenges their worldview). For example, an ethicist might analyze an action of an individual as publicly conceptually disruptive if it has few ramifications for the community. This raises the question of whether intentional conceptual disruptions are morally permissible [36]. An epistemologist might wonder whether conceptual disruptions reveal something about the world or our conceptual practices [28,33]. Public conceptual disruptions, for example, occur in the sciences all the time. Concepts of motion, gravity, force, plant, species, and so forth have been disrupted by new empirical evidence and scientific methodologies prompted by technological breakthroughs. The invention of the computer for example generated tremendous progress and insight in cognitive science (e.g., the computational theory of the mind).[7] According to [37], fundamental conceptual disruptions are an integral part of scientific progress.

Even though I take personal instances of conceptual disruption to be highly interesting, for the purpose of studying public disruptions and socially disruptive technologies, they are arguably less central. This is largely because the changes in social norms and practices we are interested in are usually prompted by public conceptual disruptions. I take a genuine classificatory change as a consequence of a public conceptual disruption to require a*collective decisio* as to how to classify an event or object. As mentioned, collective decisions may or may not be the result of a democratic decision-making process. They can also develop naturally over generations. How exactly they are overcome will be a topic for a more empirical paper. I will, in the following, focus on these public conceptual disruptions as a subclass of social disruptions more generally. Nevertheless, public conceptual disruptions will likely affect the individual and their conceptualizations of the world. In other words, public and personal conceptual disruptions can of course be interdependent, and public conceptual disruptions often lead to personal conceptual disruptions. It is also important to note that many social and moral changes begin with disruptions of individuals that then generate more social disruptions [12].

3.2. Deep and shallow conceptual disruptions

The characterization engineered above is also intentionally broad enough to allow for different degrees of conceptual disruptions. I especially distinguish here between deep and shallow conceptual disruptions. Deep conceptual disruptions pertain to our most fundamental concepts like *person, nature, friendship, or responsibility*. A similar distinction between shallow and deep can also be found in the more general concept of social disruptions. According to [2] (p. 6), socially disruptive technologies are especially deep if they "challenge basic categories and concepts of thought, such [as] the distinction between virtual and real, natural, and artificial, or dead and alive. They affect basic human practices, fundamental concepts, ontological distinctions, and go to the heart of our human self-understanding." Thus, if we consider concepts themselves as being a kind of essential mediator between the subject and the world, a disruption of this mediation can generate tremendous individual and public disruption. Note that the notion of fundamentality is similar but to be distinguished from the notion of generality.[8] Disrupting the notion of animal will be deeper than disrupting the more specific notions of dog and cat but not all fundamental concepts have such a general–specific distinction. It is not clear for example what the notion of responsibility is a super-ordinate concept of. Thus, the notion of responsibility is fundamental – not in the sense of more general but in the sense of the idea that changing it will affect many other concepts.

So, the more fundamental a concept is, the more will a disruption of this use affect other concepts that are inferentially related to it, especially given the important mediating and creative role of concepts [26]. Many disruptions and possible changes of classifications, therefore, have a *ripple effect* [38], such that other inferentially closely related concepts likely get disrupted as well. This ripple effect is often associated with a kind of classificatory dilemma. For example, in the case of Joe and Anita, conceptualizing Joe's action as either masturbation or adultery is both more or less equally problematic in the sense that both options are in conflict with other related conceptual commitments. Whatever society ends up deciding, both classifications will have social ramifications that can be described as socially disruptive. Any classificatory choice will likely lead to further classificatory changes down the line (a kind of conceptual trickle-down effect), which leads to further social disruptions and changes in practices and norms that are often difficult to predict.[9] However, as we will see later, different solutions to conceptual disruptions will be more or less disruptive. The more fundamental the concept – the more disruptive will it be to change it.

Furthermore, I take it that if a conceptual disruption is *deep*, then the community is often *forced* to make a classificatory decision that has severe social ramifications. While the individual may often leave difficult events or artifacts unclassified, classificatory uncertainty is often more socially disruptive than finally achieving a classificatory decision. Such classificatory decisions are often highly political, such that different groups in a society pull in different directions leading to a potentially long conflict of classification that is difficult to resolve. This means that many conceptual disruptions may take years or even generations to be resolved in the sense of it being decided what concepts to apply to a novel circumstance. Such a decision, if it pertains to fundamental concepts, likely generates more conceptual and social disruption as already mentioned. It is therefore likely that conceptual disruptions that are deep social disruptions concern us for decades and are not usually mere singular occasions of classificatory uncertainty.

Importantly, because social disruptions are often unexpected and generate uncertainties, especially deep conceptual disruptions can cause feelings of great distress and insecurity [12]. This is not to say, however, that disruptions cannot also coincide with feelings of excitement and progress. For example, when a close friend has unexpectedly returned early from a long trip, we may speak of joyful disruptions. They can also be positive in the sense that a new technology can disrupt a course of events that we consider harmful. A disruption may prompt changes for the better and therefore be appreciated or even intentionally generated. It might even be objected that the negative connotation of the term *disruption* is unfortunate for thinking about conceptual disruptions given the fact that conceptual disruptions can also be positive. However, I take it that the connotation is not entirely unfortunate or unjustified. Disruptions may have positive consequences, but most disruptions are arguably themselves not positive. At least for the most part, they are negative in a sense as they create uncertainty and prevent us from going about things uninterruptedly – even if the consequences are good.

[7] I thank one of the reviewers for reminding me of these instances.

[8] I am thinking of concepts like AGENCY, AUTONOMY, CONTROL, DEMOCRACY, HUMAN DIVERSITY, HUMAN RELATIONS AND COMMUNITY, HUMAN RIGHTS, HUMAN VULNERABILITY, HUMAN-NATURE RELATION, INTRINSIC VALUE OF NATURE, JUSTICE, NATURAL, ARTIFICIAL, PERSONHOOD, RESPONSIBILITY, SOLIDARITY and so forth (cf. [6]. These are all fundamental human concepts but not necessarily general in the sense that ANIMAL is more general than DOG.

[9] Consider [38] example of how changes in women's reproductive practices after the introduction of the pill also eliminated one of the main arguments against homosexual intercourse as being reproductively inefficacious. As more and more heterosexual couples engaged in sexual intercourse without any reproductive ambitions, this, according to Mol, had a ripple effect as it made homosexual sex more accepted.

3.3. Causes of conceptual disruption

In general, technology-induced conceptual disruptions as caused by new technologies that generate new artifacts, states, or events that we currently are not in the position to clearly classify given our current conceptual resources.[10] These conceptual resources may be deficient in two distinct ways – either in terms of a *conceptual overlap* or a *conceptual gap*.[11] Conceptual overlaps are the most common in our conceptually highly developed societies. An overlap occurs if the new artifacts, actions, or events generated by a new technology seem to fit two or more familiar categories more or less equally well. Conceptual overlaps are especially socially disruptive in the sense that they present us with a certain classificatory dilemma. Neither of the categories we currently possess seems to fit and both are (more or less) problematic given their respective inferential relations. This means that we need to relate this new artifact, state or event to other artifacts, states or events we are more familiar with and that are already conceptualized. This is bound to generate further conceptual disruption beyond this particular new technology. By being forced to relate the new technology to other concepts, we disrupt *them* to some degree as well, as we necessarily question their relation to other concepts and this new technology. Thereby, we create more overlaps and gaps [39].

For example, in the example of Anita, neither adultery nor masturbation seems to completely describe Joe's action (Fig. 1). On the one hand, our prototypical applications of the term masturbation normally do not involve another autonomous agent. Anita, however, seems autonomous, which suggests the correct application of the concept of adultery. On the other hand, adultery normally requires another person. Anita is arguably not a person but a machine. Thus, adultery does not fit well either. The cause of this conceptual conundrum is the fact that neither *person* nor *object* is fit to describe the properties displayed by the new technological kind of artifact of which Anita is an instance. Now, the idea of an overlap clearly reveals itself. Both conceptual pairs (*adultery* and *masturbation* on the one hand and *person* and *object* on the other) describe one aspect of the action or artifact but clash with other aspects that are considered at least prototypical. Since we can only relate to the new artifact in one way (we cannot conceptualize Anita as both a person and a tool), we must make a difficult conceptual and therefore difficult moral decision. Note also that it is not just that certain actions *involving* Anita, but Anita herself is conceptually disruptive. It is not the technology itself, but the artifacts, events and states produced by the new technology that disrupt our concepts.

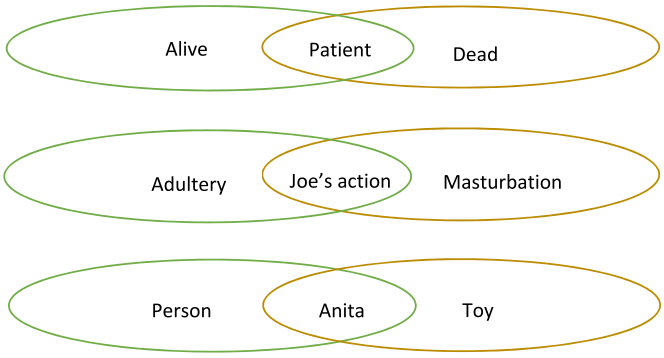

Fig. 1. Examples of conceptual overlaps.

Similarly [35] and [40] argue that the invention of the mechanical ventilator has not only revolutionized the medical profession but required a new conceptualization of the concept of death. Mechanical ventilation is the medical use of pumped air to assist patients in breathing (ventilating) when the lungs are not able to pump on their own. This medical technology evolved over the course of the mid-20th century and became increasingly effective. By the 1960s, some patients with severe brain injury could be kept breathing indefinitely using mechanical ventilation. The medical state of these patients was without precedent: They showed no significant brain activity but retained the ability to breathe, assisted by ventilation technology. This confronted doctors and families of the patients with classificatory uncertainty: Were they dead or alive? Descriptive ambiguity about the patients' states was intertwined with moral uncertainty regarding our moral obligations towards them. Concretely it created uncertainty as to whether the organs of the patients might be used for organ transplantation, or whether removing ventilation would be an instance of "killing" or "letting die". Both seem to capture one aspect of the new state. This overlap disrupts these concepts as we are forced to question their application conditions rather than simply applying them to familiar situations.

New technologies can also generate what can be called a *conceptual gap*. Conceptual gaps occur if the new artifacts, states, or events generated by new technologies do not fit any single familiar category. This is disruptive because it clearly fails to allow us to "go on" as before, to use Wittgenstein's phrase again. Again, we cannot leave new artifacts, actions, or events unclassified if we want to coordinate our joint actions related to them via language. Conceptual gaps often require the introduction of new simple words (words that are not composed). Imagine what happened after the invention of the first stone tools. What do we call this new thing that cracks our nuts? Words like *hammer, bow, arrow, boat, house,* etc. are so basic that they are difficult to analyze or describe without using the very word we want to define. I take it that very primitive words like hammer were solutions (arguably themselves *technological* solutions) to certain coordination problems generated by a conceptual gap created by a new technological invention. With the advent of more recent breakthrough digital technologies, we had to introduce new simple words like *computer*, *internet*, *telephone*, chatbot, and so forth.[12] These words, too, are difficult to analyze or decompose in terms of more basic words or concepts.

Importantly, an overlap often also creates a conceptual gap. There is a clear conceptual gap created by the mechanical ventilator as it neither fits the concepts of alive nor dead. The gap occurs by the fact that we need a new category to overcome the overlap since neither the current concept of death nor the current concept of alive completely fits the new state generated by the ventilator.

We can use this model of the causes of conceptual disruptions (overlaps and gaps) to make clearer when we are faced with a conceptual disruption and when we do *not* have to do with one. Think about a new app for example that offers us a new way of buying products online. Take the example of Amazon, which has been a paradigmatic disruptive innovation in the business world and has been socially disruptive in many ways. This does not mean, however, that Amazon disrupted our concept of shopping. It seems that there was neither a conceptual gap nor a conceptual overlap. There was no question that the new way of shopping was best conceptualized *as* shopping even if the venue or platform was different and led to all kinds of social disruptions. Similarly, think of the example above of the mechanical ventilator. The mechanical ventilator disrupted our concept of death as it confronted us with a conceptual overlap that we could only see or find relevant once this machine made it difficult to apply our old concepts of being dead and being alive. This does not mean that the mechanical ventilator disrupted our concept of machine or ventilator. Clearly, those concepts are excellent fits to describe this new technology.

[10] Another way to put this is that conceptual disruption and changes always occur when our current conceptual repertoire is not expressive enough to conceptualize a new object or event or if our current conceptual network generates inconsistencies that are experienced as socially highly disruptive.

[11] See [10] for the terms "gap" and "overlap" in the legal domain.

[12] I thank one of the reviewers for pressing me on these examples.

3.4. Solutions to conceptual disruptions

Some philosophers have recently argued that conceptual engineering – the intentional engineering of our representational devices – is hardly possible either due to a strong commitment to semantic externalism (according to which the meaning of a word is not fully determined by us) or because changing the use of a term is practically extremely difficult [27,41]. However, in the case of conceptual disruption (gaps and overlaps), some degree of conceptual engineering is difficult to avoid or deny. I take it that we can overcome overlaps by engaging in some form of conceptual selection, introduction, and/or elimination, i.e., by various forms of linguistic interventions (see [28] for this term). Selection is the most straightforward. In the case of Joe and his action involving Anita, we can simply collectively select the concept of adultery to conceptualize this action. This does not necessarily change our concept of adultery (at least on some notions of conceptual change), but it certainly changes our intuitive application conditions: We now (rightly or wrongly) apply a concept that was previously only applied to humans to robots. Again, this might generate further both social and conceptual disruptions and in most cases is guided by both epistemic and political constraints involving power relations [42–45].[13]

Another and often more conservative and simpler solution to an overlap problem is to introduce a new concept, e.g., by intentionally extending/broadening or narrowing down the use of established categories [46], for the notion of a conceptual modulation). If this change in use changes the concept (makes it broader or narrower), philosophers in the conceptual engineering literature call this "revision" [27,47].[14] However, revision is not innocent either and often occurs by means of extending nearby concepts as well. For example, if we extend the extension of *adultery* to include robots, this may either extend the class of persons, such that it includes robots or broaden the notion of adultery such that adultery no longer requires a person. An alternative possible solution to both classificatory gaps and overlaps is to introduce a new concept by introducing a label or word to cover either the gap or to overcome the overlap. In the case of a gap, an introduction is a straightforward process especially if we introduce a primitive word that labels an already clearly conceptualized novel object, action, or situation. For example, when we invented hammers or used stones to function as hammers, we probably simply introduced a label to denote objects used for hammering – something we already more or less conceptualized mentally.

An arguably less disruptive way of introducing a new concept is by composing established words [36]. Conceptual composition is the process of composing two concepts in a compositional way, such that the new meaning is derived mostly or fully from the meanings of the constituents [48]. I take it that concept composition is the most common way of overcoming the most common kind of conceptual disruption. Interestingly, any composition immediately makes a certain selection. For example, in the case of *brain dead* the conceptual engineers in the medical profession decided that being kept "alive" by a mechanical ventilator is a form of being dead and not a form of being alive. Thus, a combination always requires a kind of decision for one of the members of the conceptual pairs that are overlapping. Importantly, when composing a new concept by adding linguistic material to an established category, this new conceptual decision arguably changes the established concept at least to some degree and at least in some cases. By combining *brain* and *death*, we now decided that one can be dead even if one's body (minus the brain) is still intact. This has arguably not just solved the conceptual disruption created by the mechanical ventilator, it has arguably also changed the concept of death, by broadening what it can mean to be dead (again, I do not here want to commit to any view on conceptual change).

A more radical option for solving a conceptual overlap by revision (elimination and introduction) is to completely rethink the conceptual framework and make drastic changes in the overall approach to how to classify the world ([10] call this a "regime change"). This, however, probably generates far more conceptual disruption than it was supposed to solve. A complete overhaul of our conceptual resources likely requires a long time to establish itself and not only harms communication but cooperation more generally [36]. This is why we normally try to keep conceptual disruption to a minimum. Thus, most of the time, we fall back to the first four options of introducing new terminology or revision of existing classifications, especially by introducing complex words, thereby deciding for one of the constituents of the conceptual pair and embracing the problems that come with it. The key idea is then that not all solutions to a conceptual disruption are themselves equally conceptually disruptive and the introduction of a new word, whether a primitive or composed word, is often the least disruptive way of overcoming a conceptual disruption compared to a complete change of our conceptual resources (Fig. 2).

3.5. Guidelines for studying conceptual disruptions further

One purpose of the framework introduced here is to help students and researchers to engage in further empirical and conceptual analyses of the phenomenon of conceptual disruptions. How could such an analysis proceed? I suggest the following steps to get such a project off the ground.

1. Identify the disruptor: What is the disruptive technology?

The first step is to identify what technology you would like to study. This step is important in order to gain an understanding of how a classification might be disrupted. For example, in the robot example, the reason the concept of adultery was disrupted is that a new form of artifact has many properties of a typical person as well as a paradigmatic tool. To give another example think about how ChatGPT has disrupted our concept of speech and communication. What is currently being debated is whether ChatGPT really talks or understands natural human language. This is a clear disruption of our ordinary un-reflected applications of concepts pertaining to speech and linguistic understanding. What makes this technology disruptive is that it engages with us in ways that are normally associated with human speakers, i.e., the concept of a

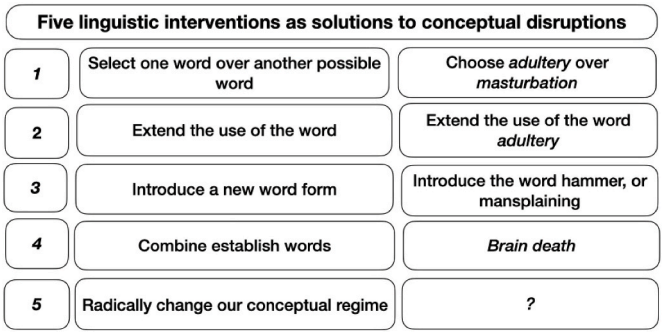

Fig. 2. Solutions to a conceptual gap or overlap.

[13] It is not implausible to think that this decision changes the concept of adultery at least to some degree – a change which we can classify as a conceptual revision or broadening) of the concept (cf., [46]. We can think about a conceptual revision as a replacement of the old narrower concept with a new similar but broader concept. So even if we simply make a conceptual decision, we likely change and introduce new material into our conceptual network. I will not however make any commitments here regarding the notion of conceptual change and leave this problem for future work.

[14] We can understand a revision as the simultaneous elimination and introduction of a concept. The narrower concept associated with a term is eliminated and the new broader concept gets conventionally associated with the same term.

speaker is normally not applied to machines but to humans.

2. Identify the disrupted concept: what conceptual pair/set of concepts is being disrupted?

This step can also be the first. You may be interested in a specific concept and then study how that concept or conceptual pair might be disrupted by a given technology. However, standardly, one might first be interested in a new technology. The main task at this point is to identify the concepts that are directly or indirectly impacted by the new possibilities of action, artifacts, states, or events the new technology gives rise to. For example, in the mechanical ventilator example, this was the conceptual pair of death versus alive. In the case of ChatGPT, the disrupted concepts are related to communication.

3 Identify the domain, stakeholders, actors, and depth of the disruption

To decide how to react to the conceptual disruption, you need to study which stakeholders are involved in the disruption and whether it mainly affects an individual and their peers or if it is a social phenomenon. Depending on this question, different solutions will be adequate. This is where the notions of personal and public conceptual disruptions come in handy. Many technologies are already established in the broader community and still exert pressure and disruption on individuals. However, as we saw in the robot case, some new technologies are also publicly disruptive, such that more needs to be done than for the individual to simply get used to the conceptual disruption.

4. Identify possible solutions to the disruption

In the case of a conceptual overlap, the solution is to pick one of the available concepts or to introduce an entirely new concept [49]. How such a concept can be chosen is a difficult question and most likely any given decision will change the respective concept slightly or sometimes even more drastically leading to new conceptual disruptions [36]. In the case of a gap, a new label needs to be introduced and its meaning needs to be negotiated. Literature on such difficult decisions can be found in the conceptual engineering debate (see [29] and [50] for reviews). Note that different solutions will bear different inferential risks and disruptions (risks and disruptions pertaining to the concepts that are implicated in the concept in question, i.e., inferentially related to it).

4. Conclusion and future directions

In this paper, I introduced a framework for studying conceptual disruptions generated by new technologies. I first introduced the concept of conceptual disruption as any intentional or unintentional disruption of the ways in which we unreflectively apply our concepts and words, i.e., disruptions pertaining to our classificatory practices and norms. New technologies or artifacts can generate conceptual disruptions if their products or innovations fail to fit any single familiar category (a conceptual gap) or if they more or less equally fit into more than one category (a conceptual overlap), such that we are forced to reconsider our current norms or practices of classification. I argued that conceptual disruption often constitutes a deep kind of social disruption both on the individual and societal level that should be distinguished from mere terminological changes. Still, the inference from a conceptual disruption to a conceptual change is illegitimate for the simple reason that not all classificatory changes count as a conceptual change and because conceptual disruptions are often the trigger of a conceptual change but not the conceptual change itself. Finally, I introduced a set of guidelines for further studying concrete conceptual disruptions in future work and I gave cutting-edge chatbot technologies as a brief case study.

Relevant future foundational work on the topic of conceptual disruption could investigate the mechanisms by which technology generates conceptual disruption in greater detail. It could also investigate how conceptual decisions are made and which technologies under which circumstances generate what kind of classificatory changes (introduction of a new word or modification of the use of a word). Second, philosophers of technology could further study under what conditions it is permissible to disrupt as well as under what conditions we are entitled to change a concept or conceptual network. It might be that the permissibility conditions for conceptual *disruption* differ from the permissibility conditions for conceptual or classificatory *change*. Moreover, it seems that if conceptual disruptions often lead to further social disruption, we should take conceptual disruption into account when determining whether we should intentionally change a concept, e.g., engage in conceptual engineering. Finally, it is currently underexplored how conceptual disruption can lead to changes in moral as well as social norms and vice versa. I hope that the framework presented here will help to foster this type of research further.

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Consent for publication

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Availability of data and material

Not applicable.

Competing interests

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Authors' contributions

NA (I am the only author).

Data availability

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