RESEARCH PAPER

Twisted thinking: Technology, values and critical thinking

Lavinia Marin and Steffen Steinert

Department of Values, Technology, and Innovation, Faculty of Technology, Policy and Management, Delft University of Technology, Delft, The Netherlands

ABSTRACT

Technology should be aligned with our values. We make the case that attempts to align emerging technologies with our values should reflect critically on these values. Critical thinking seems like a natural starting point for the critical assessment of our values. However, extant conceptualizations of critical thinking carve out no space for the critical scrutiny of values. We will argue that we need critical thinking that focuses on values instead of taking them as unexamined starting points. In order to play a crucial role in helping to align values and technology, critical thinking needs to be modified and refocused on values. Here, we outline what value-centred critical thinking could look like.

Introduction

Sometimes we get more than we asked for by introducing a technology into society, especially when technological innovations alter established ways of life. For instance, it is plausible that the contraceptive pill and surveillance technology have changed the framework of sexual morality and privacy norms, respectively (Cook, 2005; Horne *et al.*, 2015). We could make similar claims about the social impact and value implications of other technologies, such as social media and robots.

These examples show that technological innovations can have value implications. However, the precise nature and scope of the technologically induced and morally relevant changes are often unknown and mostly unintended. This is particularly true for novel technologies, where there is no historical precedent of a similar technology to draw on for anticipating change, and where the value implications become apparent only after the technology is introduced into society.

Technology should be aligned with our values to limit the gap between actual societal value implications of technology and desired societal value implications. Yet, how to do this remains an open question. Scholars have proposed several methods to align our technology with our values. The value-sensitive design approach, for instance, offers several methods to put values in the design of technology (Friedman and Hendry, 2019). Other approaches, such as techno-moral change scenarios (Swierstra and Keulartz, 2011; Waelbers and Swierstra, 2014), are used to anticipate technology's value implications so that it can be designed to avoid unwanted outcomes.

However, these professional approaches to technology assessment and technology–value alignment are virtually unknown to the people experiencing the actual social changes in the aftermath of a technological innovation. When a new technology disrupts our values, it does so by first shifting social practices, habits and norms – and these changes do not go unnoticed by most people. In these moments, there is a threshold where we, as a society, need to decide if we want to continue adhering to values that are taken for granted and value hierarchies, or if we need to re-evaluate our values in the light of new forms of life made possible by technology. This is not an easy decision,

CONTACT: L.Marin@tudelft.nl
ACCEPTING EDITOR: Steven Umbrello

and it cannot be taken by experts alone – although, of course, they should inform the public debate with scientific information and arguments. Democratic and open societies are characterized by value pluralism. In this context of value pluralism, new societal trajectories and values need to be negotiated among individuals who endorse different values. Most participants in these social negotiations, and in public debates, about values and technology are not trained in moral theory and ethics. That is to say, they usually do not have proficiency in arguing for and against the acceptability of values. Because professional ethics and philosophy focus on abstract principles, conceptualizations and systematizations, one can question their practical usefulness for societal negotiations about values that happen 'on the ground' (O'Malley, 2013). Furthermore, the initial reaction of most people to new and emerging technology is to endorse their interests and values without much refection. In the context of value pluralism, unreflective endorsement and doubling-down on one's values can lead to inflexibility and decreased openness to alternative values, which can contribute to a stalemate about which values to endorse as a society.

Given value pluralism, the limited impact of theories of moral philosophy for social negotiations about values and the fact that most people are not trained philosophers or ethicists, what is called for is a practical approach to deliberation that contributes to societal negotiations about values and technology. So, the issue we want to focus on in this article is what such a practical approach could look like. We take our starting point from critical thinking, which we take to be a competence that most educational systems aim to cultivate, and ask whether critical thinking can be developed into a practical approach to social negotiation about values and technology. The practical approach we are about to develop is not a competing moral theory. Rather, our aim is to show what a practical approach to societal value negotiation could look like.

Critical thinking (CT hereafter) seems promising here because it is 'thinking aimed at forming a judgement, i.e., making up one's mind about what to believe or do' (Bailin *et al.*, 1999, pp.286–7), especially when tradition or appeals to expertise are not viable options.[1] Hence, CT seems like a fruitful way to form judgements about values, especially in cases of emerging technologies with no precedent, and where we need to reassess which values should be at the centre. We think that a public endowed with CT is in a better position to debate and negotiate value choices in the context of new technologies because CT is, presumably, about objectivity and love of reason; hence it proposes a procedure of leaving personal preferences behind when focusing on the common good. However, we contend and will defend later, that CT cannot deliver on this promise, at least not as CT is usually construed in the literature. We will show that extant approaches consider CT to be instrumental and goal-directed, taking values as a given without subjecting them to critical scrutiny. In these traditional conceptualizations of CT as a systematic mode of thinking, there is no critical engagement with the values and goals themselves. Furthermore, extant approaches ignore the fact that our values can change during the development and use of a technology. What we need is a kind of CT that focuses on values instead of taking them as unexamined starting points.

We ask the following question: is the concept of CT, as it is usually considered in the epistemic and educational scholarship, helpful in addressing the challenges of value disruption caused by technological innovation? In answering this question, one of our aims is to provoke more reflection and discussion on what CT can be and what it can achieve. In exploring the limits of current accounts of CT, we will show that extant ways of thinking about CT do not stand up to scrutiny *vis*-à-*vis* values and technology. We argue that to play a crucial role in helping to align values and technology, CT needs to be modified and refocused on values. We propose a value-centred critical thinking (henceforth VCCT) that is better equipped to handle the challenges of technology–value alignment and value change.

---

[1]This corresponds to the Arendtian idea of thinking without precedent in new political situations (Arendt and Kohn, 2018, p.497).

By proposing a reconceptualization and refocusing of CT, the article makes the following contributions. First, it enhances the philosophical debate on critical thinking by providing a substantive account of critical thinking. Second, our value-centred approach to CT is not merely an intellectual exercise. A CT focused on values is a helpful supplement to efforts that want to align values and technology, such as responsible innovation and value-sensitive design. Integrating VCCT into these approaches can make them more powerful in achieving their goal.

We will proceed as follows. The first section critically discusses some of the existing accounts of CT and addresses the weakness mentioned in accounts of CT: They are value-blind and do not allow for CT to focus on people's values, concerns and commitments, especially in situations where values are under pressure. In the second section, we clarify the connection between values and technology. We will make the case that we cannot overlook the value–technology link because technology impacts values, and values influence technology development. What is more, it is crucial that we subject our values to critical scrutiny and gain clarity about our values and goals concerning technology. In the third section, we seek to ameliorate the value-blindness of CT approaches and present an improved version of CT that focuses on values. Our value-centred critical thinking (VCCT) delivers all the goods we want from CT in a world where values and technology intertwine and influence one another. The article concludes by introducing some ideas about the virtues needed to foster VCCT.

Technology and values

We want our technology to embody or realize particular values. For instance, a car is supposed to be safe. Put differently, technology ought to align with human values (Gabriel, 2020). Frequently, alas, technology and our values are not aligned. Sometimes, as Stuart Russell points out, we 'imbue machines with objectives that are imperfectly aligned with our own' (Russell, 2020, p.137).

As an older example of technology–value misalignment, take the Pinto that Ford started selling in 1971. The car design compromised passenger safety and led to the preventable deaths of dozens of people. This is because the car was not aligned with the value of safety of its passengers (van de Poel and Royakkers 2011, pp.67–9). A more recent example of the misalignment of technology and human values is the role of AI in (automated) decision-making. Algorithms are used in decision-making in various domains, ranging from parole decisions, screening job applicants, sorting college admission applications to decisions about whether to give somebody a loan (Angwin *et al*., 2016). As it turns out, these AI-enabled decisions can lead to biased and racist decisions, thereby reproducing existing inequalities (Benjamin, 2019). Here, technology is not aligned with the values of fairness and justice.

The examples above illustrate two causes of technology–value misalignment. One cause is the blatant and intentional neglect of particular value implications of the technology (Pinto). The other cause is ignorance of the possible value implications of using technology (AI and decision-making). Scholars and designers have proposed various methods to ameliorate the second cause and close the knowledge gap concerning the potential value implications of technology. For instance, value-sensitive design and design for values aim to incorporate stakeholder values into technology design and implementation (Van den Hoven *et al.*, 2015; Friedman and Hendry, 2019). These approaches aim to ensure that important human values are included in, or respected by, technology design.

Technology can fail to align or conflict with existing values, but technology can also contribute to changing values. Emerging technology can destabilize norms and values, sometimes leading to moral change (Swierstra, 2013). To anticipate and assess this impact of technology on values and morality, scholars have proposed analytic tools. For instance, one can use scenario methods (Boenink *et al.,* 2010; Swierstra and Keulartz, 2011; Waelbers and Swierstra, 2014) that stimulate the imagination in shaping of technology morality and social development.

The goal of these tools and methods is to reduce value misalignment and unwanted value change as much as possible. For emerging technology, this is not an easy feat because it is new, often unprecedented and so much of its impact depends on a multitude of factors. The issue of reducing value misalignment is complicated by the technicality of the debate – which requires a high level of proficiency in handling concepts. Most people touched by technological innovation and its effects rippling through society cannot argue in terms of techno-moral scenarios, nor are they familiar with fine-grained conceptual distinctions. Meanwhile, critical thinking is a competency taught in most universities and often in secondary education. Increasingly, people are aware about the benefits of CT and the epistemic values of trying to be objective in a debate and of examining all available evidence. Hence, we propose that a public debate about changing values and technologies has higher chances of finding a common ground if all those involved in it assume the ethos of CT. A critical debate about values seems like a useful standpoint from which to frame debates about emerging technologies, assuming that participants will remain critical in the process.

Critical thinking – what is it?

Critical thinking (CT) is often invoked to remedy new problems, mainly when it is unclear what to do or what to believe, and when precedents or similarities to familiar situations are missing. For instance, Alec Fischer contends that CT 'only occurs when the reasoning, interpretation or evaluation is challenging and non-routine' (Fisher, 2019, pp.29–30). Because of this apparent usefulness of CT for dealing with new situations, it is similar to what Hannah Arendt has described as *denken ohne Geländer* (thinking without a banister): that is, thinking without any safe guiding lines (Arendt and Kohn, 2018, p.497).

Given that tackling new and unclear situations is heralded as a distinctive feature of CT, it is no wonder that it has been invoked in situations related to novel technology development and technology use. For example, several authors have suggested CT as a tool to address cases where new practices of information sharing generated by social media have given rise to new informational practices, such as spreading misinformation and fake news online (Goodnight, 2009; Frau-Meigs *et al.*, 2017, p. 107; Grafstein, 2017; Heersmink, 2018; Schwengerer, 2020). Misinformation on our social media feeds is fuelled by the user's acts of sharing and reposting more than by any evil intent or targeted action of information warfare professionals (Vosoughi *et al.*, 2018). Because of the exponential effect of the user's individual actions on the internet, posting or sharing is no longer an action users can simply afford to take without much thought. Hence there are increasing calls for users to be more critical when on social media. These calls are exemplified by some policy proposals to step up initiatives to persuade online users to practise critical thinking (European Council, 2016). These demands for critical engagement may seem legitimate up to a point – why not think critically about the consequences of using a new technology? – but is CT the appropriate kind of thinking for the value changes associated with technological innovation? To answer this, we need first to understand what CT is and, secondly, its relationship with values.

Unfortunately, there is no universally agreed definition of CT practice. The scholarship on CT is riddled with competing, divergent explanations (Fisher and Scriven, 1997; Johnson and Hamby, 2015). Taking stock of the multitude of definitions of CT, Hitchcock proposed to view CT as one concept with multiple conceptions, identifying its core as 'careful goal-directed thinking' (Hitchcock, 2018). Yet the goal cannot be arbitrary; it must be aligned with discovering the truth before deciding what to do or believe about it. CT as a process of thinking does not designate a specific intellectual faculty; instead, it describes a manner of using existing intellectual skills to pursue the truth more than one's interests. Usually, in day-to-day life, we use thinking as a means to serve our pre-existing convictions; for example, when we debate with an adversary. We seek only to win the argument and do not care about uncovering the truth. In contrast, CT demands that we care more about the truth of the matter than about being right. We propose to understand the difference between CT and regular reflection through the ethos of thinking.

The ethos of CT

CT is usually described as a normative construct as it designates a form of 'good thinking'. Hence, 'any adequate account of it must explain the sense in which it is good' (Bailin and Siegel, 2003, p.181). Yet, what 'good' means for CT is the subject of a debate about whether CT is a valuable mode of thinking in a procedural way or in a substantive way. The ethos of CT concerns not only what makes CT an excellent process to engage in, but also the goals of CT. Why should anyone engage in CT, and why should societies invest resources in educating for CT at all? We can distil roughly three justifications for CT by surveying the existing literature:

a) *The societal value of CT* Beyond the obvious individual benefits for epistemic agents, CT plays a beneficial role for 'groups – communities, professional bodies, corporations, and entire societies' (Kary, 2013, p.12). Societal value can be construed as democratic since practising CT advances the quality of a public debate through the self-correcting tendencies of the members (Dewey, 2004). Having many citizens who are critical thinkers makes deliberation easier because people are motivated to listen to reason and can compromise. This effect on deliberation is caused by the ethos of CT that stresses that one can be wrong and should try to self-correct one's epistemic beliefs.
b) *The epistemic value of tracking truth* CT entails being as close to the truth as possible by being scientific in one's private life and engaging in inquiry. CT takes the form of promoting a scientific attitude in one's life by enjoying doubt (Dewey, 1929).[2] However, the difference between scientific thinking and CT is that while scientific pursuit contributes to science as a whole, even if individual scientists are sometimes wrong, critical thinkers are focused on themselves and their individual beliefs, with no explicit regard for advancing the collective knowledge (although this may be beneficial for the epistemic community as a whole, as a side effect).
c) *The value of intellectual autonomy* CT involves thinking for oneself with the goal of not being fooled by anyone. Engaging in CT means that one 'attempts to assess arguments and evidence on their merits, as opposed to relying on the intellectual authority of others' (Huemer, 2005, p.523); 'the role of critical thinking is defensive: to protect us from being coerced or brainwashed into believing what others want us to believe without our having an opportunity to inquire for ourselves' (Lipman, 2003, p.47).

CT and values

CT is a form of practical reason, helpful in deciding what to believe or do in a new situation; the ethos of CT endorses the assumption that there is always at least one preferable procedure to choose between two possible outcomes, and this is based on evaluating reasons. Almost always, values play an essential role in our practical decisions; this is unavoidable, yet it remains an open question of how to deal with values critically. In the CT scholarship, dealing with values was not explicitly tackled (except for Richard Paul's work) since values are considered personal choices that cannot be argued for or against, merely assumed as a starting point.

To explicate the role of values, Paul wrote extensively on two conceptions of CT, distinguishing between weak and strong CT (Paul, 1981, p.2). Weak CT uses the tools of logic (such as deduction and induction, but also inference) to debunk claims and also tries to spot fallacies. This

[2]A disciplined mind takes delight in the problematic, and cherishes it until a way out is found that approves itself upon examination. The questionable becomes an active questioning, a search; desire for the emotion of certitude gives place to quest for the objects by which the obscure and unsettled may be developed into the stable and clear. The scientific attitude may almost be defined as that which is capable of enjoying the doubtful' (Dewey, 1929, §IX).

'atomic' approach takes a claim as isolated from the other claims and evaluates its logical soundness. In contrast, strong CT is the kind of thinking that starts from the assumption that we all have preferred ways of life, and we tend to favour the statements supporting our existing world-views and values. Thus, strong CT focuses on bringing to light our existing value allegiances and questioning whether our behaviours align with our professed values. However, a significant problem with weak CT is that, as Paul puts it, there are no isolated claims, but rather 'argument networks' or 'world views' (Paul, 1981, p.3). Thus, our pre-existing world-views interfere with what we find acceptable as a claim and how willing we are to challenge some claims instead of others.

Paul's distinction between strong/weak CT helps us illuminate a blind spot in the existing literature on CT and values, namely CT's assumption that values are fixed and a starting point for a critical inquiry. We all have our value allegiances, and when these occur unexamined, they will influence what we find acceptable as a course of action. Paul's strong CT is a procedure whereby one asks whether ways of life actually align with one's professed values in the hope of finding a contradiction. For example, a sustainability advocate may discover she is wasting water and electricity in her own home. Such a discovery cannot be swept under the carpet; it contradicts one's values, and what should follow, according to Paul, is a change in one's way of life or a re-evaluation of one's values (e.g., perhaps the sustainability fan was not really attached to sustainability, but was professing it because of her friend's influence and family pressures). Strong CT examines the alignment of values with forms of life on the assumption that it is irrational to live in a way that contradicts one's values. Suppose the critical thinker discovers that one either does not understand the value of sustainability or has no reason to believe she endorsed it. In this case, these are positive outcomes of the CT process.

However, examining the values themselves and deciding whether one wants to endorse such values is not part of the scope of CT. Standard accounts of CT do not give us any hint on how to decide between competing values because CT functions negatively – debunking, unmasking, revealing inconsistencies, irrational alignments, fallacies, etc. CT does not give us a procedure to build our lives around certain values; it tells us only when we are inconsistent. Thus, the blind spot of CT is that it always takes certain values as a starting point and as the fixed ground against which one can compare beliefs and actions.[3] This presents a problem when trying to think through CT on value change under conditions of technological disruption.

Because of this implicit way of dealing with values – often assumed as unquestioned starting points for the process of reflection – CT has a blind spot in value debates. However, we still maintain that CT can make a significant contribution to debates concerning values because of its capacity to 'clear the field' before debate can occur. To achieve this, we think that CT should employ a more dynamic approach to values, for example, to challenge and question them, to make them variables in the pursuit of the most salient reasons for a belief or action. In the next section, we show what this critical approach to values looks like.

Value-centred critical thinking (VCCT)

If the alignment of technology and value is our goal, we have to determine which values technology should be aligned with. This, we contend, requires reflection on values. When new technologies appear in society, our norms and values can come under pressure because new technologies make new, previously unimaginable, actions possible. For instance, planes allow us to fly but also to bomb cities; the invention of satellites made GPS navigation possible, but satellites also create space debris; meetings with remote locations become possible with webcams, but so does surveillance from afar. With every new disruptive technology, society needs to ask itself whether it wants to stand by old values or promote other values, more aligned with new ways of life made possible

[3]We acknowledge that the same can be said for other approaches as well, e.g., liberal democracy takes some values as fixed grounds and evaluates actions accordingly.

by new technology? This value interrogation happens at a societal level, but individuals can face these quandaries as well.

According to traditional accounts, critical thinking has a twofold focus. First, critical thinking focuses on beliefs and, second, critical thinking focuses on the virtues of the individual thinker. Unfortunately, these two foci are inadequate. They allow no space for values because critical thinkers are supposed to bracket their preferences and personal attachments before they start the process of inquiry (Jackson, 2019, p.282). Because of this requirement, critical thinking loses sight of (personal) values. We contend that a space for values in critical thinking should be carved out explicitly.

Critically reflecting on values requires that the individual remains part of the process with individual character, goals and desires. Otherwise, the values would not be the individual's values. Value-centred critical thinking takes values as its focus. It is a thorough investigation of what to value, but it goes beyond that. It also includes assessing how values are related and reflection on the success criteria of value realization (see Tiberius, 2018. We propose that a critical examination of values should consist of the following aspects:

(a) *The values themselves* Here, one asks, 'What do I value?' This would be the starting point of inquiry where one takes inventory of one's values. We are very liberal here as to what can be included so that what people value includes objects, persons and the state of affairs. The list, for instance, could comprise spouse, family, career, being a good friend and the environment.

(b) *The strength of values* The question here is how strongly one endorses particular values. For instance, one may value family and truth, but only the first is strongly endorsed, while the truth is only weakly endorsed. That means that not all values from the list of (a) are endorsed to the same extent.

(c) *Intellectual autonomy concerning values* Some authors (Thorseth, 2008; Paul and Elder, 2009; McPhee, 2016) stress that CT encourages intellectual autonomy and thinking for yourself. For instance, you should not believe something because you blindly follow the opinion of an authority figure. We think that intellectual autonomy can be extended beyond beliefs to include values. We have in mind here that critical and autonomous thinkers should inquire into the origin of their values and ask where a particular value endorsement is coming from and what motivates them to endorse a particular value. No human is an island, and what we value and how we value it is influenced by our culture and socio-political environment. This is to say that what to value and the standard of how to value something is tied to social and cultural practices, expectations and ideals. Put differently, the modes of valuation are linked to the standards adopted for evaluating (Anderson, 1995). These standards are reproduced through continuous and dynamic social and cultural processes (Smith, 1991). Critically reflecting on these standards and the origin of values can loosen the grip of stale traditions and authority.

(d) *The conceptions of the values* Critical thinkers should ask how they understand values and what conceptions they use to talk about them. John Rawls (1999) distinguishes between concept and conception. Two people can have different conceptions of the same value. For example, one person may mean justice as fairness, the other justice as equality. This is why people sometimes talk past each other, although they seem to be talking about the same thing. Reflecting on the conceptions that one uses to think about a particular value gives one a clearer picture of how one values something and how these conceptions relate to other value conceptions.

(e) *Standards for the success of value fulfilment* Thinking about the standards of value fulfilment means thinking about when a value is successfully realized or fulfilled. Take the example of someone who values family. Having the value family comes with some standards that indicate when the value is fulfilled or when one falls short of fulfilling the value. For instance, spending time with your kids and spouse could count as fulfilling the value. Benchmarks of

success are related to the conceptualization of the value because conceptualizations often include standards. This, in turn, means that standards of success for value fulfilment can be reinterpreted, and standards can be changed.

(f) *Value fulfilment* Here the leading question is whether one is on track to fulfilling one's values or whether one falls short of fulfilling values. This also means considering the means to realize values and whether the means chosen are optimal or whether there are alternative means. Because people endorse multiple values, reflecting on value fulfilment requires thinking about potential conflicts between core values.

(g) *Reflection on the means to realize values* Focusing on the means to realize value can be helpful in at least two ways. First, some means can be inappropriate to realizing a value. For instance, if you value friendship, you should try to spend time with friends. Second, critically reflecting on value fulfilment also includes considering how the means to achieve one value affect the realization of another value. By working round the clock, one may advance one's career, but this can have negative implications for the value of family and friends.

(h) *Priorities of values* Reflecting on the priorities of values means asking which values are most important. Multiple priorities and hierarchies can exist. Thus, reflection on hierarchies of value includes taking seriously the idea that value hierarchies can differ, depending on the social domain (Dumont, 1980; Weber, 2013). For instance, in the social domain of friendship, the value of honesty may have a different position than it has in the domain of politics.[4] Critically reflecting on the value hierarchy that one has and being attentive to potentially different value hierarchies give one a better insight into one's individual system of values.

(i) *Appropriateness of value* Appropriate here means appropriate for the person (Tiberius, 2018) and not appropriate according to some objective standard. Values can fit our desires and emotions, or they can be misaligned with them. This means that some values a person endorses may not align well with their desires and emotions. For instance, there could be a misalignment between the desire to become an artist and the value of being a successful CEO. Another vital aspect of critically reflecting on the appropriateness of value is thinking about whether the values can be fulfilled together or whether they clash (Tiberius, 2018). Some values may not be compatible.

(j) *Missing values* Critically reflecting on values includes considering which values to endorse. One reason to think about missing values is that values can contribute to the fulfilment of other values. So, endorsing a particular value could, in combination with the other values, increase the level of overall value fulfilment. Take instrumental values and their contribution to ultimate values. Instrumental values are the things that we value because they are means to other values. Adding a particular instrumental value can contribute to the realization of an ultimate value. For instance, maybe one should start valuing regular exercise if one values health.

(k) *Relation of values* Like humans, values are not islands. They are not isolated from each another but 'form a system of mutual reinforcement and integration that help or hinder their fulfilment' (Tiberius, 2018, p.40). Psychological research on values supports this idea. For instance, according to the influential model of personal values of Shalom Schwartz (1992, 2015), our values are systematically related to one another. Some values can be satisfied together, whereas other values are in opposition and satisfying one influences the satisfaction of the other.

(l) *Ways of valuing things, or modes of valuation* There are different ways of valuing. For instance, one can love something or merely appreciate it. Not all modes of valuation may

[4]Max Weber famously popularized the idea that modern society comprises different value spheres. There are different spheres of social life (for instance, market, family, and politics) that are distinguished by their ultimate value.

be appropriate. To take an example from Elizabeth Anderson (1995, p.10), 'consideration' is a kind of valuation suitable to sentient beings, and 'appreciation' is a mode of evaluation appropriate for inanimate objects. Critical reflection on the modes of valuation can reveal that something is not appropriately valued. For instance, upon reflection, somebody could conclude that a person should be appreciated instead of merely tolerated. Modes of valuation are social and cultural because how we value, and what kind of good something is, is determined by social practices, social relations and norms.

VCCT individual: careful, goal-directed thinking about values, with the goal of achieving maximum individual value fulfilment

So far, we have considered critical reflection on values from the perspective of the single individual. The individual approach of thinking critically about values can be summarized.

We have seen that most authors (see Hitchcock, 2018) take critical thinking to be normative; that is, critical thinking is 'good thinking'. There are different forms that good thinking can take. For instance, one could say that good thinking should make warranted inferences and should not include fallacies. It is sensible to say that good thinking should also be aware of the factors that influence it. This involves being aware of the biases and heuristics that affect thinking and the values on which thinking is based. Put differently, the foundations of thinking need to be critically examined.

The individualistic and autonomy-focused perspective on critical thinking is useful, but socially atomistic and maybe unachievable in practice. It is all well and good to reflect critically on your own personal values. However, in a pluralistic society, where members have different value commitments, it is not enough that everybody thinks about her own value fulfilment. The values of individuals can clash and conflict. As we know all too well, the pursuit of individual value fulfilment can interfere with the individual value fulfilment of others. What we need, we wager, is an approach of thinking critically about values that can help us align multiple values so that maximum value fulfilment can be achieved.

VCCT collective/social: careful, goal-directed thinking about values, with the goal of achieving maximum value fulfilment for a significant portion of the collective/group

The idea of critical thinking about values that considers social dimensions echoes Paul's (1981) conception of a strong critical thinking, which is about examining our ways of life, our allegiances and alignment between values and actions. This kind of strong CT always examines networks of beliefs and networks of values: 'In place of "atomic arguments" one focuses on argument networks (world views); in place of conceiving of arguments as susceptible of atomic evaluation one takes a more dialectical/dialogical approach' (Paul, 1981, p.3). Recall that our proposed value-centred critical thinking considers relations of values.

Writing on critical thinking often stresses the positive social effects of critical thinking, such as the benefits brought to the epistemic community as a whole (Ritola, 2012; Kary, 2013). Critical thinking is said to foster citizenship and advance democracy. Critical thinking with a focus on value fulfilment for a significant portion of the collective makes good on the promise of a social value of critical thinking. We do not think there is a clear-cut procedure for VCCT. Instead, there are ways in which one could be reflective about values in a more deliberate way by looking into the different aspects of value fulfilment we have outlined above, such as conceptions of values, means–value relations, value hierarchies and standards of success for value fulfilment.

We borrow from the ethos of CT the idea of epistemic pluralism: CT recognizes the fact that no human is omniscient, we all have blind spots in our knowledge and should keep an open mind to contradicting evidence or statements. We need others to help us see these blind spots. Epistemic pluralism accepts that multiple beliefs about a topic may be legitimate and justified, even

if seemingly contradictory. In the same vein, VCCT endorses value pluralism: multiple values can be appropriate for a situation; there can be numerous ways of achieving these values and organizing them in order of importance. Hence a pursuit of VCCT will keep in mind that the reflection of values needs to achieve some collective ends as it tries to maximize value for most people, even if it may contradict our own personal values.

Table 1. Conceptual articulations of VCCT and differences from CT

Critical thinking (CT)	**Value-centred critical thinking (VCTT)**
Descriptive, applies especially to facts and reasons for choosing a belief	Normative, applies to values and reasons for a belief
Individualistic trait (skill or virtue)	Both individual and collective traits (skills or virtues)
Aim is to arrive at a belief or an action for the individual	Aim is to arrive at clarification about values to be pursued collectively
Epistemic pluralism: multiple reasons work well for justification	Value pluralism
Procedural approach	Deliberative approach
Toolkit: use rules of deduction and induction, avoidance of fallacies, thorough examination of evidence	Toolkit: systematic inquiry about value fulfilment (see list of aspects above)
Purpose: intellectual autonomy and truth tracking	Purpose: collective alignment about values to be pursued and the appropriate means to do so

Examples of VCCT in technological contexts

Social media platforms (also known as social networking sites) are websites where users can generate, share and modify content. Users have the option of disclosing their names or staying anonymous. Nevertheless, each user has an associated nickname that helps to attribute their actions to one individual, making it easy for other users to follow one individual, creating networks of friends and acquaintances (Boyd and Ellison, 2007). The actions of sharing, linking and posting users perform on social media have been described as 'uncritical engagement' (Zimmer *et al.,* 2019), especially when users engage with misinformation, click-bait or conspiracy theories. It has been said that online users should try to be more critical, given that the effect on other users' beliefs and behaviour cannot be anticipated. The younger the users, the greater the preference to get their news from social media platforms. Youngsters often rely on what their friends share and bypass mainstream mass-media sources (Wohn and Bowe, 2016; Boyd, 2020).

This means that what one user shares just for fun may be taken as a serious source of information by followers and can unwittingly lead to the formation of ungrounded beliefs. Because of this haphazard way of getting information without any editorial filters, social media have been called an 'epistemic threat' (Goldman and O'Connor, 2019) to democracy and the epistemic environment in general, understood here as 'the totality of resources and circumstances relevant to assessing epistemically interesting statuses' (Blake-Turner, 2020, p.9). However, we contend that users being more critical is not enough to tackle the epistemic dangers of social media. What we need instead is VCCT.

The personal value of using social media needs to be acknowledged by users from the start and made explicit for others. The value of social media depends on user preferences: some use social media for entertainment, some for socializing, some for connecting with new people; some use it as a rich source of information about news in general or a specific topic, while some use it as a source of unexpected insights, preferring to browse without aim until something stirs their imagination. The interaction of users with undisclosed values about social media can lead to misunderstandings. For example, someone sharing a conspiracy theory just for fun may inadvertently be misinforming others who take the story seriously. We think users engaging in VCCT will be aware of the plurality of values in using social media and try to signal how they value social

media – either on their personal profiles or in everyday posts. Furthermore, when it is unclear how others use social media, a direct inquiry about their values and intentions can be made.

VCCT can also help address value conflicts through debates about the individual and the collective sustainability of these values. For example, sometimes, people share conspiracy theories because they believe in them. What should we do if someone in our network pollutes our feed with outlandish claims? A classical critical thinker would take these claims at face value, look for evidence for them and ask the other to justify them. However, this tactic may be detrimental for the critical thinker because it takes a lot of effort to engage with such claims, usually with little success (Battaly, 2021). Frequently, contentious issues are not factual but rather normative – users who share misinformation because they believe in it see the world in a certain way and cannot be persuaded by descriptive argument alone (Marin, 2021).

Hence, from the perspective of VCCT, engaging with these users in a critical dialogue about values is more fruitful than factual/evidence-based dialogue. Such a dialogue could aim at uncovering what values one endorses when sharing conspiracy stories: what the world would look like if such stories were true, how we could live in such a world and whether one could accept that most people would endorse such values and world-views. Conspiracy theorists are often opposed to scientific institutions, but they usually do not think what it would mean if everyone shared their anti-science view. By pointing out practical and untenable consequences of their world=view, one could engage them in a fruitful dialogue about what values can be collectively upheld. One might engage these users and ask them to what extent the values endorsed are theirs and to what extent they are following a trend of sharing misinformation without any thought about values. One additional step would be to ask these users to what extent they themselves can live a life in accordance with the values promoted by their posts, hence identifying a misalignment between values and ways of life (Lipman, 2003).

What we aim to show is that disagreements about values are often disguised as disagreements about facts. Once the value dimension is introduced, a different kind of discussion can take place, at a normative level, about what should be done and what is worth pursuing as citizens or as epistemic agents. There are many more examples pertaining to social media where VCCT would be beneficial. Consider, for instance, the use of filters on social media. Because of recommender functions, people often see pictures with a particular style or with a particular filter. The algorithms of social media platforms push a specific standard of beauty upon their users. This standard is sometimes called ‘Instagram face’. The continued exposure to these images and constant comparison with enhanced pictures can change how people perceive themselves, particularly young women. In extreme cases, this can lead to so-called ‘Snapchat dysmorphia’, where people seek plastic surgery to look more like their filtered image (Haines, 2021; Ryan-Mosley, 2021).

The widespread use of filters on social media is not compulsory, and VCCT could contribute to a more critical engagement with the practice. Critical thinking about values on a personal level could help people figure out whether what they do on social media chimes with their personal values, whether it conflicts with other values they have or inhibits overall value fulfilment. For instance, engaging in VCCT, users would inquire where the beauty standard comes from and whether one just uncritically follows a trend. Recall that being critical about the origin of values and standards is an aspect of VCCT. So, engaging in VCCT, one would try to understand how the value of beauty, or beauty of this particular kind, relates to other values one endorses. Maybe clinging to a particular standard for the value of beauty inhibits the fulfilment of other values and leads to less value fulfilment overall.

Social media is not the only domain where VCCT could provide a clearer picture of the relationship between technology and our values. For example, consider the mundane activity of online shopping, which is facilitated by artificial intelligence. Algorithms, and computer technology in general, make shopping online and the delivery process a speedy affair. Customer expectations have evolved with this development, and customer tolerance for slow shopping is low. These expectations drive ever-faster delivery times because retailers want to see satisfied customers and stay

competitive.[5] Placing a high value on fast delivery can have implications for other values. Critically reflecting on these value implications by engaging in VCCT can help people rethink their priorities and contribute to a better alignment of personal and collective values. For instance, one should try to consider all the values at stake in the process of fast delivery, and not just the personal value of convenience. Remember that VCCT suggests that one takes into account the relationship of values. Reflecting on the multiple values at play and their relationship will reveal that fulfilment of one value, convenience, can mean negative implications for the fulfilment of another value (e.g., the value of safe work and the health of other people). Fast delivery is usually to the detriment of the workers in distribution centres and delivery drivers, who are under constant time pressure (Kantor *et al.*, 2021).

The clash of the value of personal convenience with the value of safe work is connected to the broader issue of what kind of society and economy we want to have and how we, as a collective, value the workers who deliver our orders. VCCT suggests that we critically reflect on our ways of valuing and the priorities of values. The way we, as a society, value the workers, packers and drivers could require revision. Critical reflection might reveal that this revision should include paying them more and changing their working conditions.

VCCT invites us to broaden our scope and go beyond personal values to consider whether a particular social prioritization of values is conducive to the goal of maximum value achievement for a significant portion of society. For example, the issue of delivery speed and working conditions needs to be embedded in a broader discussion about what kinds of economy we want and whether models of doing business align with other social values, such as sustainability and justice. Critical thinking that focuses on social and individual values (instead of beliefs and goal achievement) takes the plurality of values in society seriously and could lead to a change of values that enables more value fulfilment.

We have focused on social media and online shopping, but critical thinking that is sensitive to values can also play a positive role in other domains. Consider artificial intelligence and personnel selection. It is common for many companies to use artificial intelligence in their personnel selection and recruiting processes (Heilweil, 2019). The use of AI in the recruitment process could shift what employers come to value and expect from their applicants. Some technology tends to introduce commercial values and values related to quantification into where they may not belong, such as in recruitment, and where other, more holistic, ways of valuing would be more appropriate. Critical thinking about company values could help explain what values the company stands for and what the company really values in an applicant.

The issue of artificial intelligence in recruitment is part of a more extensive general debate about the role of artificial intelligence in decision-making. This debate concerns, among other things, the use of artificial intelligence systems in parole hearings and decisions about loans. Frequently, the systems make unfair and biased decisions (Angwin *et al.*, 2016). This debate might benefit from a little VCCT because it asks us, as a society, to reflect critically on our value priorities and whether the means we pick to fulfil some of our values are appropriate.

Conclusions

We have argued that, in order to play a crucial role in helping to align values and technology, the standard account of CT needs to be modified and refocused on values. We proposed a value-centred critical thinking (VCCT) that is better equipped to handle the challenges of technology-value alignment and the potential value changes induced by technology. We outlined our idea of VCCT and described several aspects of a critical reflection on values, for instance, questioning the values

[5]According to a 2018 global study by the delivery company UPS, most people expect speedy delivery and same-day shipping to arrive at noon (see https://www.ups.com/assets/resources/media/knowledge-center/ups-pulse-of-the-online-shopper.PDF).

themselves, their relationship and hierarchies, reflecting on the means to achieve values, conceptions of values and modes of valuation. While some might say that VCCT is just another mode of CT but specifically focused on the context of values, we contend that there is a fundamental difference between the two: VCCT is fundamentally a collective epistemic virtue, whereas CT is focused on the individual.

The individual dimension of CT is visible in the public discourse surrounding it: namely highlighting the benefits of the individual process of thinking critically for society. CT is promoted in education and life-long learning because policymakers and society at large acknowledge that there is societal value in the pursuit of CT (Williams, 2015). It is assumed that the societal value emerges from the aggregate of the individual benefits of CT: the larger the mass of critical citizens, presumably the stronger a democracy is; the more people are critical thinkers in their personal lives, the less epistemic harms will be promoted at a societal level (such harms include publicly denying climate change, anti-vaxxer discourses, conspiracy theories). The more autonomous people are in their thinking, the less they will be susceptible to propaganda and extremist views in national politics.

Most accounts of CT share a common presupposition: individuals need to become critical thinkers before society as a whole can become critical. However, CT is primarily an individual process, and this already poses a challenge for situations where values need to be debated. In conditions of value change, like those posed by technological innovations, we do not engage in debates about personal values, rather about what values a society as a whole should pursue. If CT entails re-evaluating one's own beliefs, the values and beliefs of other society members fall by the wayside. Moreover, there is no implicit norm stating that once a critical thinker has changed her beliefs, she should try and persuade others; this is entirely up to the critical thinker. Yet, in value debates, this matter cannot be left to chance since value beliefs are not merely the result of aggregated individual choices; instead, these emerge from trends in public thinking about an issue and can influence how individuals see a value concern. Thus, our investigation opens up the problem of achieving the epistemic virtues needed for criticality, primarily at a collective level.

Future research could look into what exactly is the collective nature of VCCT. We think VCCT should occur in social settings when people are confronted with the values at stake in a technological innovation. The potential misalignment of values and technology challenge us at the social level, and need to be tackled at the same level. This is why we propose seeing VCCT as a collective virtue emerging in group deliberations about value. Collective virtues are the virtues that can be ascribed to groups, regardless of whether these might also be attributed to the individuals in the group (Lahroodi, 2007). A group is virtuous if it has a reliable disposition to act in a certain virtuous way (Byerly and Byerly, 2016). While some virtues can be displayed by individuals as well as by collectives, certain virtues can be ascribed only to collectives and these concern ways in which 'members of the collective interact with one another' (Byerly and Byerly, 2016). An example of distinctly collective virtues is solidarity, which is 'a virtue that concerns the way in which the members of a group empathize with and unite themselves to each other' (Byerly and Byerly, 2016, p.49). Is VCCT similar to solidarity, as a kind of collective commitment of a group to think together critically about their values, or is it more like an individual virtue showcased by members of a collective? The answer to this question awaits clarification, but we hope that we have made a convincing case for the value of critical thinking focused on value.

Acknowledgements

Lavinia Marin has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie programme (grant 707404). This publication is part of the Value Change project that has received funding from the European Research Council under the European Union's Horizon 2020 research and innovation programme (grant 788321). The opinions expressed here reflect only the authors' views. The European Commission is not responsible for any use that may be made of the information this article contains.

References

Anderson, E. (1995) *Value in Ethics and Economics*, Harvard University Press, Cambridge MA.

Angwin, J., Larson, J., Mattu, S. and Kirchner, L. (2016) May 23) 'Machine bias', *Propublica,* 23 May, available at https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing (accessed March 2022).

Arendt, H. and Kohn, J. (2018) *Thinking without a Banister: Essays in Understanding, 1953-1975,* Schocken Books, New York.

Bailin, S., Case, R., Coombs, J. R. and Daniels, L. B. (1999) 'Conceptualizing critical thinking', *Journal of Curriculum Studies*, 31, 3, pp.285–302. https://doi.org/10.1080/002202799183133

Bailin, S. and Siegel, H. (2003) 'Critical thinking' in Blake, N., Smeyers, P., Smith, R. and Standish, P. (eds) *Blackwell Guide to the Philosophy of Education*, Blackwell, Oxford, pp.181–93.

Battaly, H. (2021) 'Engaging closed-mindedly with your polluted media feed' in Hannon, M. and de Ridder, J. (eds) *Routledge Handbook of Political Epistemology*, Routledge, Milton Park, pp.312–24.

Benjamin, R. (2019) *Race After Technology: Abolitionist Tools for the New Jim Code*, Polity, Cambridge.

Blake-Turner, C. (2020) 'Fake news, relevant alternatives, and the degradation of our epistemic environment', *Inquiry*, 63. available at https://doi.org/10.1080/0020174X.2020.1725623 (accessed March 2022).

Boenink, M., Swierstra, T. and Stemerding, D. (2010) 'Anticipating the interaction between technology and morality: a scenario study of experimenting with humans in bionanotechnology', *Studies in Ethics, Law, and Technology*, 4, 2. https://doi.org/10.2202/1941-6008.1098.

Boyd, D. and Ellison, N. (2007) 'Social network sites: definition, history, and scholarship', *Journal of Computer-Mediated Communication*, 13, 1, pp.210–30. https://doi.org/10.1111/j.1083-6101.2007.00393.x.

Boyd, K. (2020) 'Group epistemology and structural factors in online group polarization', *Episteme*, 17 December. https://doi.org/10.1017/epi.2020.47.

Byerly, T. and Byerly, M. (2016) 'Collective virtue', *Journal of Value Inquiry*, 50, 1, pp.33–50. https://doi.org/10.1007/s10790-015-9484-y.

Cook, H. (2005) 'The English sexual revolution: technology and social change', *History Workshop Journal*, 59, 1, pp.109–28. https://doi.org/10.1093/hwj/dbi009.

Dewey, J. (1929) *The Quest for Certainty: A Study of the Relation of Knowledge and Action*, Allen & Unwin, London.

Dewey, J. (2004) [1915] *Democracy and Education: An Introduction to the Philosophy of Education*, Aakar Books, Delhi.

Dumont, L. (1980) *Homo Hierarchicus: The Caste System and its Implications*, University of Chicago Press, Chicago.

European Council (2016) 'Media literacy and critical thinking – education's role: Council conclusions of 30 May 2016 on developing media literacy and critical thinking through education and training', *EUR-Lex*, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM:150102_3 (accessed March 2022).

Fisher, A. (2019) 'What critical thinking is' in Blair, A. (ed.) *Studies in Critical Thinking*, University of Windsor, Windsor, Ontario, pp.7–32.

Fisher, A. and Scriven, M. (1997) *Critical Thinking: Its Definition and Assessment*, Centre for Research in Critical Thinking, University of East Anglia, Norwich.

Frau-Meigs, D., Velez, I., and Flores Michel, J. (2017) *Public Policies in Media and Information Literacy in Europe: Cross-Country Comparisons*, Routledge, Milton Park.

Friedman, B., and Hendry, D. (2019) *Value Sensitive Design: Shaping Technology with Moral Imagination*, MIT Press, Cambridge MA.

Gabriel, I. (2020) 'Artificial intelligence, values, and alignment', *Minds and Machines*, 30, 3, pp.411–37. https://doi.org/10.1007/s11023-020-09539-2.

Goldman, A. and O'Connor, C. (2019) 'Social epistemology' in Zalta, E. (ed.) *Stanford Encyclopedia of Philosophy*, Metaphysice Research Laboratory, Department of Philosophy, Stanford University, Stanford CA, available at https://plato.stanford.edu/ (accessed March 2022).

Goodnight, G. (2009) 'Critical thinking in a digital age: argumentation and the projects of new media literacy' in OSSA Conference Archive, paper 58, University of Windsor, Windsor, Ontario, available at https://scholar.uwindsor.ca/cgi/viewcontent.cgi?article=1143&context=ossaarchive (accessed March 2022).

Grafstein, A. (2017) 'Information literacy and critical thinking' in Sales D. and Pinto, M. (eds) *Pathways into Information Literacy and Communities of Practice*, Elsevier, Amsterdam, pp.3–28. https://doi.org/10.1016/B978-0-08-100673-3.00001-0.

Haines, A. (2021) 'From "Instagram face" to "Snapchat dysmorphia": how beauty filters are changing the way we see ourselves', *Forbes*, 27 April. Available at https://www.forbes.com/sites/annahaines/2021/04/27/from-instagram-face-to-snapchat-dysmorphia-how-beauty-filters-are-changing-the-way-we-see-ourselves/?sh=205b901a4eff

Heersmink, R. (2018) 'A virtue epistemology of the internet: search engines, intellectual virtues and education', *Social Epistemology,* 32, 1, 1–12. https://doi.org/10.1080/02691728.2017.1383530.

Heilweil, R. (2019) 'Artificial intelligence will help determine if you get your next job', *Vox,* 12 December, available at https://www.vox.com/recode/2019/12/12/20993665/artificial-intelligence-ai-job-screen (accessed March 2022).

Hitchcock, D. (2018) 'Critical thinking' in Zalta, E. (ed.) *Stanford Encyclopedia of Philosophy*, Metaphysice Research Laboratory, Department of Philosophy, Stanford University, Stanford CA, available at https://plato.stanford.edu/ (accessed March 2022).

Horne, C., Darras, B., Bean, E., Srivastava, A. and Frickel, S. (2015) 'Privacy, technology, and norms: the case of smart meters', *Social Science Research*, 51, pp.64–76. https://doi.org/10.1016/j.ssresearch.2014.12.003.

Huemer, M. (2005) 'Is critical thinking epistemically responsible?', *Metaphilosophy*, 36, 4, pp.522–31. https://doi.org/10.1111/j.1467-9973.2005.00388.x

Jackson, S. (2019) 'How a critical thinker uses the web' in Blair, A. (ed.) *Studies in Critical Thinking*, University of Windsor, Windsor, Ontario, pp.269–97.

Johnson, R. and Hamby, B. (2015) 'A meta-level approach to the problem of defining "critical thinking"', *Argumentation,* 29, 4, pp.417–30. https://doi.org/10.1007/s10503-015-9356-4.

Kantor, J., Weise, K. and Ashford, G. (2021) 'Inside Amazon's employment machine', *New York Times*, 15 June. https://www.nytimes.com/interactive/2021/06/15/us/amazon-workers.html.

Kary, D. (2013) 'Critical thinking and epistemic responsibility' in Mohammed D. and Lewinski, M. (eds) *Virtues of Argumentation,* OSSA Conference Archive, paper 86, University of Windsor, Windsor, Ontario.

Lahroodi, R. (2007) 'Collective epistemic virtues', *Social Epistemology*, 21, 3, pp.281–97. https://doi.org/10.1080/02691720701674122

Lipman, M. (2003) *Thinking in Education*, Cambridge University Press, Cambridge.

Marin, L. (2021) 'Three contextual dimensions of information on social media: lessons learned from the covid-19 infodemic', *Ethics and Information Technology*, 23, S1, pp.S79–S86.

McPhee, R. (2016) 'A virtue epistemic approach to critical thinking', unpublished PhD thesis, Bond University, Gold Coast Australia, available at https://pure.bond.edu.au/ws/portalfiles/portal/36124417/Russell_McPhee_Thesis_.pdf (accessed March 2022).

O'Malley, M. (2013) 'Value ethics: a meta-ethical framework for emerging sciences in pluralistic contexts' in Baumbach-Knopf, C., Achatz, J. and Knoepffler, N. (eds) *Facetten der Ethik*, Königshausen Neumann, Würzburg, pp.71–90.

Paul, R. (1981) 'Teaching critical thinking in the "strong" sense: a focus on self-deception, world views, and a dialectical mode of analysis', *Informal Logic*, 4, 2. https://doi.org/10.22329/il.v4i2.2766.

Paul, R. and Elder, L. (2009) 'Critical thinking, creativity, ethical reasoning: a unity of opposites' in Cross, T. and Ambrose, D. (eds) *Morality, Ethics, and Gifted Minds*, Springer, New York, pp.117–31.

Rawls, J. (1999) *A Theory of Justice,* Belknap Press, Cambridge MA.

Ritola, J. (2012) 'Critical thinking is epistemically responsible', *Metaphilosophy*, 43, 5, pp.659–78. https://doi.org/10.1111/j.1467-9973.2012.01773.x.

Russell, S. (2020) *Human Compatible: Artificial Intelligence and the Problem of Control*, Penguin Books, Harmondsworth.

Ryan-Mosley, T. (2021) 'Beauty filters are changing the way young girls see themselves', *MIT Technology Review*, 2 April. Available at https://www.technologyreview.com/2021/04/02/1021635/beauty-filters-young-girls-augmented-reality-social-media/

Schwartz, S. H. (2015) 'Basic individual values: sources and consequences' in Brosch, T. and Sander, D. (eds) *Handbook of Value,* Oxford University Press, Oxford, pp.63–84. http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780198716600.001.0001/acprof-9780198716600-chapter-4

Schwartz, S. (1992) 'Universals in the content and structure of values: theoretical advances and empirical tests in 20 countries', *Advances in Experimental Social Psychology,* l, 25, pp.1–65. https://linkinghub.elsevier.com/retrieve/pii/S0065260108602816.

Schwengerer, L. (2020) 'Online intellectual virtues and the extended mind', *Social Epistemology*, 35, 3, pp.312–22. https://doi.org/10.1080/02691728.2020.1815095.

Smith, B. (1991) *Contingencies of Value: Alternative Perspectives for Critical Theory*, Harvard University Press, Cambridge MA.

Swierstra, T. (2013) 'Nanotechnology and technomoral change', *Etica and Politica*, 15, 1, pp. 200–19.

Swierstra, T., and Keulartz, J. (2011) 'Obesity in 2020: three scenarios on techno-socio-ethical co-evolution' in Korthals, M. (ed.) *Genomics, Obesity and the Struggle over Responsibilities*, Springer, Dordrecht, pp.97–112. http://link.springer.com/10.1007/978-94-007-0127-4_7.

Thorseth, M. (2008) 'Reflective judgment and enlarged thinking online', *Ethics and Information Technology*, 10, 4, pp. 221–31. https://doi.org/10.1007/s10676-008-9166-6.

Tiberius, V. (2018) *Well-Being as Value Fulfillment: How we Can Help Each Other to Live Well*, Oxford University Press, Oxford.

Van den Hoven, J., Vermaas, P. E. and van de Poel, I. (2015) 'Design for values: an introduction' in Van den Hoven, J., Vermaas, P. and van de Poel, I. (eds) *Handbook of Ethics, Values, and Technological Design*, Springer, Dordrecht, pp.1–7. http://link.springer.com/10.1007/978-94-007-6970-0_40.

van de Poel, I. and Royakkers, L. (2011) *Ethics, Technology, and Engineering: An Introduction*, Wiley-Blackwell, Hoboken NJ.

Vosoughi, S., Roy, D. and Aral, S. (2018) 'The spread of true and false news online', *Science*, 359, 6380, pp.1146–51. https://doi.org/10.1126/science.aap9559.

Waelbers, K. and Swierstra, T. (2014) 'The family of the future: how technologies can lead to moral change' in Van den Hoven, J., Doorn, N., Swierstra, T., Koops, B.-J. and Romijn, H. (eds) *Innovative Solutions for Global Issues*, Springer, New York, pp.219–36.

Weber, M. (2013) *Economy and Society,* University of California Press, Berkeley.

Williams, E. (2015) 'In excess of epistemology: Siegel, Taylor, Heidegger and the conditions of thought', *Journal of Philosophy of Education*, 49, 1, pp.142–60.

Wohn, D. and Bowe, B. (2016) 'Micro agenda setters: the effect of social media on young adults' exposure to and attitude toward news', *Social Media + Society*, 2, 1. https://doi.org/10.1177/2056305115626750.

Zimmer, F., Scheibe, K., Stock, M., and Stock, W. (2019) 'Fake news in social media: bad algorithms or biased users?', *Journal of Information Science Theory and Practice*, 7, 2, pp.40–53.