Ethical responsibility in agricultural innovations: The role of technological imaginaries

M. Innocenti
Department of Philosophy, University of Milan, Via Festa del Perdono 7, 20122 Milan, Italy
E-mail: marco.innocenti@unimi.it

Abstract

This article explores the influence of the narrative and symbolic milieu around in-progress technologies on innovator's awareness of the moral significance of their actions and decisions. Discussing technological imaginaries within the framework of Responsible Innovation, we elaborate on the concept of 'naturalness' in the development of agricultural technologies. Arguably, this 'thick' concept, when associated with these imaginaries, can diminish the perceived moral significance of technology. We will take as a case study the biomonitoring technologies using beehives, a hybrid of digital tools and traditional agriculture. This example will illustrate how technological imaginaries around 'natural' technologies can influence ethical perceptions and, thereby, innovator's responsibility-taking.

Keywords: biomonitoring; concept of naturalness; moral significance; narrative ethics; Responsible Innovation

Introduction

As of 2013, the European Commission has declared Responsible Innovation a priority in its Horizon 2020 programme, and it is esteemed that its influence on government and corporate policies could remain significant in this decade as well (van den Hoven, 2022). According to the framework delineated by Stilgoe *et al.* (2013), this responsibility is to be understood according to the implementation of four characteristics in technological innovation: 'anticipation', 'reflexivity', 'inclusion', and 'responsiveness'. This type of 'in-process' accountability, i.e. continuously integrated at every stage of the process, would help to contain the inherent unpredictability of innovation exemplified by the well-known Collingridge paradox (1980). However, the impossibility of predicting the effects of technological innovations before their diffusion into society leads some philosophers to question the very compatibility between the notions of 'responsibility' and 'innovation' (Blok and Lemmens, 2015). Indeed, as is well known, moral responsibility requires specific epistemological conditions that should be granted to the moral agent, i.e., in this case, the company or research centre. According to Rudy-Hiller (2018), '(t)here are four plausible epistemic requirements involved: awareness of action, of moral significance, of consequences, and of alternatives'. In these pages, we will interrogate the second one, namely 'moral significance', i.e. the knowledge of its – not neutral - moral value). This is an epistemological condition seldom mentioned in studies in this field, but we believe it acquires particular relevance in the links between new technologies and nature.

The thesis we want to argue, and which we believe is relevant to EurSafe 2024, is that the narrative and symbolic context in which innovation takes place has an influence on the maintenance of this responsibility and the perception of 'moral significance' in the actions performed. After having briefly developed the issue of technological imaginaries in the context of the ethics of technology and Responsible Innovation, we will elaborate on the relevance of the concept of 'naturalness' with regard to the narrative accompanying the development of agricultural technologies. This technological imaginary may in fact obtain from the concept of 'naturalness' a mitigation of the 'moral significance' of certain

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aspects of technology, by virtue of the intrinsic value attributed to it. In the following section, we will therefore present the example of biomonitoring technologies through technological beehives, which gives rise to a distinctive type of hybridisation of digital tools and traditional agriculture, particularly indicative for this discourse.

The role of the symbolic environment in R&D

Alberto Romele (2023) criticises the 'empirical turn' in the philosophy of technology for overlooking how the technological mediations influencing the moral subject and activating a change in values are symbolically mediated. In his research, he introduces the concept of "technological imaginaries", by which he means "a set of representations charged with expectations, hopes, and fears that a certain group of people has about a certain technology and that cannot be reduced to the material elements that constitute that technology. Technological imaginaries are both (re)configured by technologies and (re)configure these technologies in their invention, design, implementation, and use" (Romele, 2023: pp. 49–50). In *Narrative and Technological Ethics* (2020) by Wessel Reijers and Mark Coeckelbergh this symbolic dimension of technologies is explored through the lens of narrative ethics, which is explicitly directed towards virtue ethics for Responsible Innovation. This aspect is all the more visible when one looks at the identity narratives, scenarios, and more or less collective and explicit aspirations that concretely guide the research and development of a technological innovation (and not only its use or diffusion). Consider the case of a tech start-up, where this dimension supports the engagement of the different members and brings them together around the emerging technology (O'Connor, 2002; Ryan *et al.*, 2023). Narratives thus constitute an infrastructure that supports the organisational fluidity and the regime of instability that characterises this type of enterprise (Burnell *et al.*, 2023; Deuten and Rip, 2000).

New technologies and the concept of 'naturalness'

In the field of new technologies for agriculture, these considerations should be combined with those concerning the concept of 'nature', since their narrative aspect often relies on considerations of 'naturalness', as we shall see in a moment. We can divide the issue into two distinct aspects: the indistinct multiplicity of conceptions associated with the name of 'nature' and its common normative conceptualisation (in fact, it is a 'thick' concept; see Hopster *et al.*, 2023). Regarding the first aspect, we can take the opening passage of John Stuart Mill's treatise *On Nature* (1874), which reads: "Nature', 'natural', and the group of words derived from them or derived with them from other words, have always loomed large in the thoughts of humanity and taken a strong hold on their feelings. (...) (B)ut it is unfortunate that a set of terms that play such a great part in moral and metaphysical theorising should have acquired many meanings that -differ from the main one yet -are linked to it enough to create confusion". Alongside this, although not independently, he notes and criticises the tendency to adopt a normative approach to certain meanings of the term 'naturalness', elevating the 'Follow Nature!' to ethical maxim.

In the early 2000s, these analyses reappeared in several texts, such as Sagoff (2001a,b) and Verhoog *et al.* (2003), to outline the impact of these concepts in the perception of organic farming, conventional agriculture, and the use of Genetically Modified Organisms. Also in these cases, the different conceptions of the term are criticised for its acritical use in a (positive) normative sense, either without specifying the implied meanings (Verhoog *et al.*, 2003) or without considering the empirically validated advantages in the use of GMOs (Sagoff, 2001b). More recently, an article by Hopster *et al.* (2023) highlighted these two aspects in correspondence with certain new technologies that define unprecedented relationships with nature, such as cellular agriculture, solar geoengineering, and biomimicry. In the next session, we intend to extend these reflections by examining the new links between artificial intelligence and the practice of biomonitoring through sensors and cameras applied to a hive of honeybees. In this case, the

'thick' concept of nature can lead to assigning an intrinsic positive moral value to relying on a non-human activity (bee's foraging) for an important task such as monitoring the environment, thus discouraging the developers of this technology from taking responsibility for any critical outcome.

Biomonitoring and technological hives

Like all organisms within an ecosystem, honeybees can be effective bio-indicators, providing evidence of its health status (Farias *et al.*, 2023). Morphological or physiological changes in the animal and the substances it touches or ingests can reveal multiple characteristics of its environment (Girotti *et al.*, 2020). For different reasons, *Apis mellifera* is a highly suitable species for this task. Firstly, because of the thoroughness of the monitoring a honeybee colony allows, which is linked to its foraging activity. Between one-quarter and one-third (Ohlinger *et al.*, 2024) of the average 20 000 bees in a hive carry out 'several foraging trips per day (approximately 12–15 in their active period), covering an area of approximately 7 km^2' (Mair *et al.*, 2023). Another feature is their effectiveness in sampling and storing 'data' from the surrounding environment, collecting 'about ten million micro-samples of nectar and pollen per day', and accumulating them in the honeycombs grid (Mair *et al.*, 2023). Regarding the extraction of these data, the last decades have seen a shift from the analysis of honey samples or bee bodies in the laboratory to the widespread creation, by start-ups, makers, and amateurs, of minimally invasive acoustic sensors to be put inside hives, of weight sensors for their bases, and video cameras for their entrance (Ammar *et al.*, 2019; Burma, 2023). This allows for a smoother and more immediate transition from the colony's collected and produced data (such as its humming) to digital data processed through the machine-learning technique (Zhao *et al.*, 2021; Hadjur *et al.*, 2022). Moreover, video cameras at the hive entrance can detect the status of the surrounding biodiversity by recognising and analysing the variety of colours of the pollen carried by the bees (Conti *et al.*, 2016; Papa *et al.*, 2022). All this leads to creating a hybrid that is singularly effective in collecting, accumulating, and processing data about the surrounding ecosystem.

The resulting hybrid, taken as a whole, can be understood as an unprecedented case in which a digital technology is made capable of analysing the space around it from the perspective of a living (super) organism. Compared to other forms of monitoring, such as the reconstruction of a digital twin, this new technological medium boasts a more significant measure of 'naturalness' according to one of the gradients identified by Siipi (2008), namely the axis of greater or lesser human control. The risk here is that through this allegedly positive entrustment of nature, any resulting limitations derived from it are not considered humans' responsibility. Yet, many plants, including tomatoes, potatoes, tomatoes, and field beans, require wild bees for adequate pollination (Goulson, 2003), and the latter's presence is threatened by competition with hives *in situ* (Thomson, 2004). Two features commonly identified as undesirable in the new digital technologies (such as AI technologies) thereby can find their 'redemption' (i.e., a status of non-contestability) in the aura of 'naturalness' that can be attributed to this system. These features are the 'sampling bias', derived from the systematic exclusion of certain data sets in the training of artificial intelligence (Ferrara, 2023), and the formation of an 'echo chamber' through the gradual elimination of competing influences on the (informational) ecosystem (Levy and Razin, 2019). In other terms, through the technological imaginary of the 'natural technology', the 'sampling bias' and the 'echo chamber' of new ICTs are subtracted from the moral significance generally attributed to them through their hybridisation with a 'natural' species which is, in turn, a 'sampling *bios*' (forming an '*eco*-chamber').

Conclusions

Beginning this article with the concept of Responsible Innovation, we pointed out how the awareness of the moral significance of an action is necessary for the attribution and assumption of responsibility (especially 'active' responsibility) in the research and development of new technologies. We have

therefore argued how this awareness can be influenced by the technological imaginaries that permeate the environments of research and development of an emerging technology, and that project its future scenarios and impacts. In the context of agricultural innovations, we wanted to focus on how the thick concept of 'naturalness' can imbue these imaginaries and influence the awareness of this moral significance in the developed product. The example we gave is that of the biomonitoring of the environment by means of a beehive equipped with sensors and cameras, in which the beehive becomes a highly predictive 'black box' whose inputs and outputs are being monitored. In this case, the imagery of 'natural technology' that may be associated with it runs the risk of overshadowing the moral significance of the use of this technological hybrid.

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