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Research ethics in digital science - A tiny tutorial

Forum on Digital Ethics in Research, October 19th, 2023

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Research integrity statement

A shorter version of this talk was given as part of the eu-ROBIN project Ethics workshop on October 2nd, 2023

Workshop video available here

Robots in the beehive

ROBOROYALE

ROBOTIC REPLICANTS FOR OPTIMIZING THE YIELD BY AUGMENTING LIVING ECOSYSTEMS

PROJECT

In RoboRoyale, we aim for a minimally invasive approach to affect large ecosystems in a positive way: We aim to regulate (and also enhance) the egg-laying activity of a honeybee queen by replacing her courtyard by a set of robots that feed and nurse her. By providing an increased flow of proteinaceous food to the queen and guiding her to regions

https://roboroyale.eu/project.html

See also: [Stefaner et al. 2022] Martin Stefanec, Daniel N. Hofstadler, Tomáš Krajník, Ali Emre Turgut, Hande Alemdar, Barry Lennox, Erol Şahin, Farshad Arvin and Thomas Schmickl - *A Minimally Invasive Approach Towards "Ecosystem Hacking" With Honeybees*. Frontiers in Robotics and AI 9:791921. doi: 10.3389/frobt.2022.791921

Robots in the beehive

PROJECT

In RoboRoyale, we aim for a minimally invasive approach to affect large ecosystems in a positive way: We aim to regulate (and also enhance) the egg-laying activity of a honeybee queen by replacing her courtyard by a set of robots that feed and nurse her. By providing an increased flow of proteinaceous food to the queen and guiding her to regions that are ready for cell deposition we plan to enhance her egg laying rate, ultimately yielding stronger colonies and higher pollination activity. As we provide the high protein inflow exclusively to the queen and not to the rest of the colony (without robots these two flows are practically inseparable in nature) we induce a stronger brood production which will then require more protein, resulting in the workers having to engage in more pollen collecting (thus pollinating) flights. (1) This will positively affect plant growth, vegetation spreading, fruit and seed production. (2) This will in turn support animals as food. (3) Ultimately enhanced pollination can also lower the competition that honeybees have for nectar with other wild (and currently endangered) insects species, as increased pollen foraging will lead to decreased nectar foraging in return. In our proposed RoboRoyale system, we will provide the user/experimenter a novel method with which he/she can vary these two foraging activities of honeybees in a controlled manner. Thus, we aim at a 3-fold positive ecosystem effect. Such treatment cannot be established with conventional beekeeping methods (pollen traps) as it always cuts the whole colony (workers, brood and the queen) from the protein flow altogether. Our special idea is that we can affect a whole ecosystem, potentially millions of plants and, in consequence, hundreds of millions of animals and other organisms, by simply affecting one single living organism in a natural and non-invasive way with robots. This has never been done before, and it seems to us to be the most effective method to support the productivity of ecosystems with a minimum run-time effort and with an expected maximum of ultimate effect. To achieve this, we will have to produce miniature robots that are coordinated so well in a natural habitat, a vertical comb of a living bee colony, and that are embodying all relevant honeybee behaviors so well that a very hard referee (the living honeybee queen) accepts them as conspecific worker bees.

EU ethics self assessment

Section 5: ANIMALS		YES/NO/NOT CLEAR
Does this research involve animals?		**YES**
If YES:	Are they vertebrates?	**NO**
	Are they non-human primates (NHPs)?	**NO**
	Are they genetically modified?	**NO**
	Are they cloned farm animals?	**NO**
	Are they endangered species?	**NO**
Please indicate the species involved:		**Bees**

Insects are not covered by the Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes

Bee robots

Section 7: ENVIRONMENT, HEALTH AND SAFETY	YES/NO/NOT CLEAR
Does this activity involve the use of substances or processes that may cause harm to the environment, to animals or plants (during the implementation of the activity or further to the use of the results, as a possible impact)?	YES
Does this research involve endangered fauna and/or flora/or protected areas?	NO
Does this activity involve the use of substances or processes that may cause harm to humans, including those performing the activity (during the implementation of the activity or further to the use of the results, as a possible impact)?	Not clear

Bee robots

Section 8: ARTIFICIAL INTELLIGENCE	YES/NO/NOT CLEAR
Does this activity involve the development, deployment and/or use of Artificial Intelligence-based systems?	**YES**

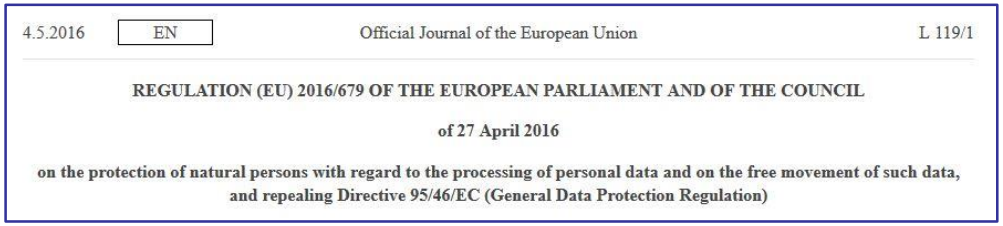
Overview

- Vocabulary
- Thought experiments – Some ethical frameworks
- Robots in the beehive: a (short) ethical analysis
- Some more research ethics questions
- Summary – Some recommendations

Vocabulary

Ethics is not

- the law
  - rules of conduct
  - comes from: sovereign authority



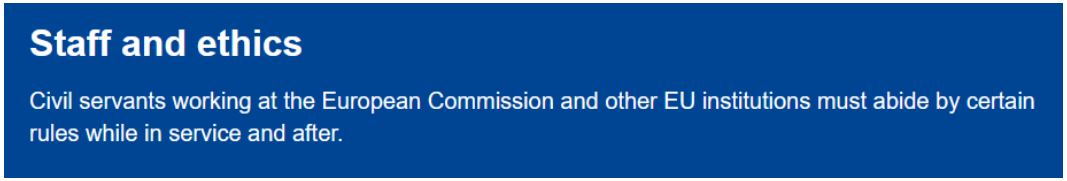
4.5.2016 EN Official Journal of the European Union L 119/1

REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 27 April 2016

on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

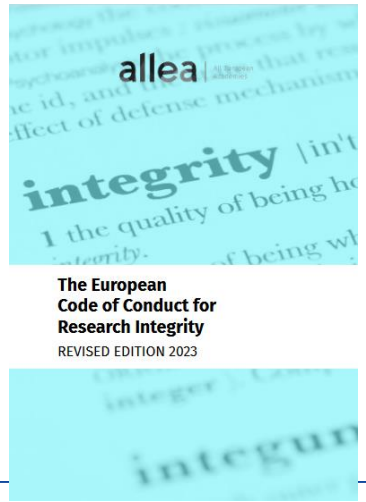
- staff regulations
  - rights and duties
  - come from: organization



Staff and ethics

Civil servants working at the European Commission and other EU institutions must abide by certain rules while in service and after.

- deontology
  - code of conduct
  - comes from: profession



Morality and values

- Morality
  - set of rules and principles according to which one directs one's life and behaviour,
    considered in relation to good and evil
  - comes from: society (social consensus), religion, yourself
  - normative

  e.g., do not lie, do not steal

Tumisu - Pixabay

- Values
  - something desirable, that you stand up for
  - come from: society, yourself
  - a value can be broken

  e.g., honesty, benevolence, respect of human dignity

Gerd Altmann - Pixabay

Ethics [CERNA18]

- Personal or (more often) collective thought about human behaviours and values they are based on
- To wonder about topics, situations, possible decisions and actions along the way
- An approach that aims at behaving / acting at best in a specific context, i.e., at determining what can be considered the right decision or action, according to arguments based on scales of values
- Ethics does not command, ethics recommends

Peggy und Marco Lachmann-Anke - Pixabay

→ Ethical debate is based on conflicts between values

[CERNA18] Commission de réflexion sur l'éthique de la recherche en sciences et technologie du numérique d'Allistene - *Proposition de formation doctorale, Initiation à l'éthique de la recherche scientifique*, octobre 2018

Ethics: in a nutshell

Ethics is different from (or, *in English,* more than) compliance:

- Saying what should or should not be done is not sufficient
- Ethics is a continuous thought, that evolves all the time
- Ethics has to do with dilemmas: situation where a decision is not compliant (trade-offs)

Ethics: approaches [CCNE21]

"A collective deliberation, always to be resumed, must make the difference between the possible and the acceptable [...]".

"New knowledge, by complicating or shifting the scope of our questioning, often increases our uncertainties."

"Ethical reflection therefore requires us to question the principles that define the very notion of progress [...]"

"Each time [progress] is invoked, we must critically analyse the certainties and convictions that underlie it […]

This critical analysis must be based, on the one hand, on values and, on the other, on the most lucid possible assessment of the benefits and risks."

"But listing these values to define an 'ethical invariant' is not enough. [...] any particular issue requires them to be articulated in order to find the best possible balance when they come into competition."

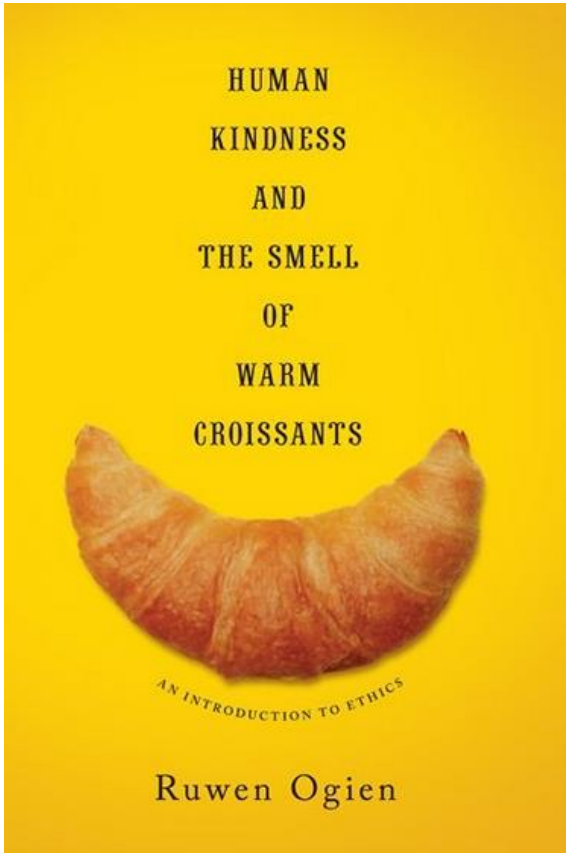
[CCNE21] Comité consultatif national d'éthique pour les sciences de la vie et de la santé – *Rapport d'activité 2019-2020*. Août 2021. Translated with DeepL- Emphasis added

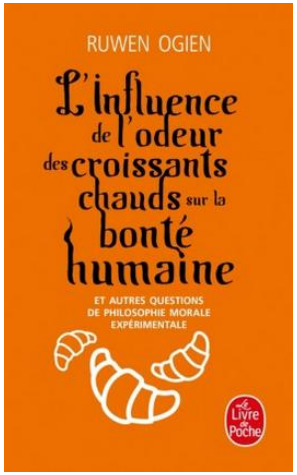
Thought experiments

Some ethical frameworks

Interesting exercises: thought experiments

Moral dilemmas allow us
“to identify more clearly the factors that influence our moral judgements”

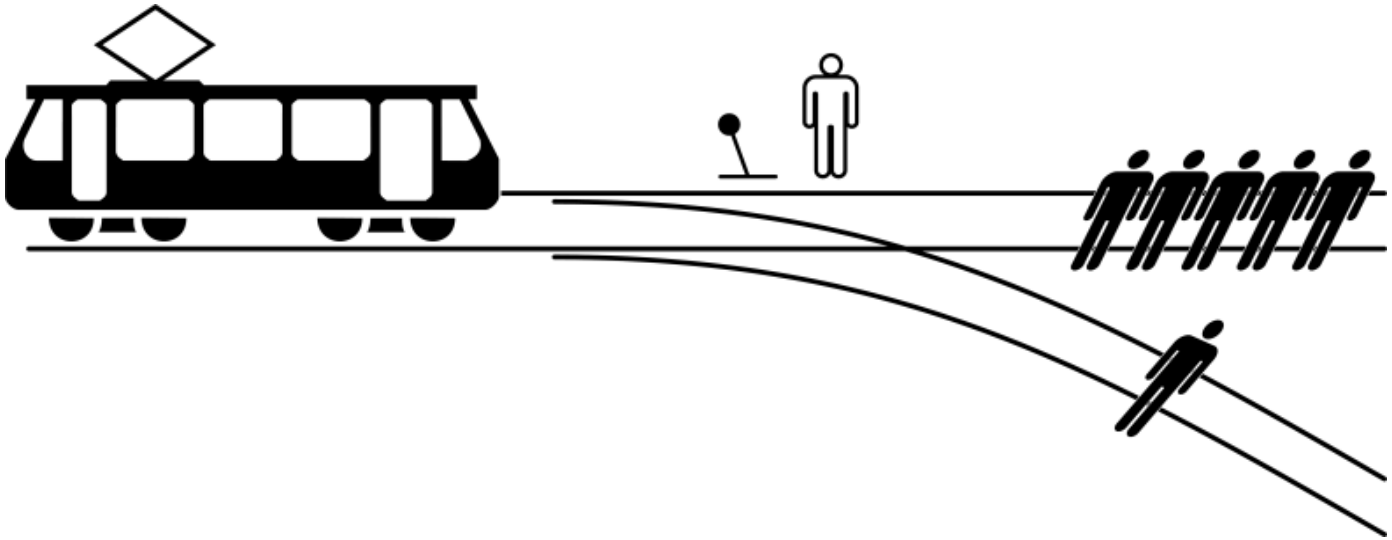




Thought experiment: the trolley dilemma [Foot02]

What is your decision?

- I pull the lever
- I don’t pull the lever

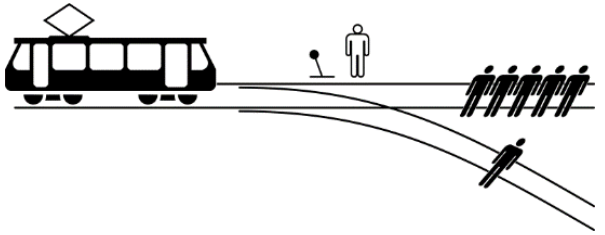


McGeddon, Wikipedia - CC BY-SA 4.0

[Foot02] Foot, Philippa. *Moral Dilemmas and Other Topics in Moral Philosophy*. Clarendon Press.Oxford University Press, 2002. DOI:10.1093/0199252866.003.0002

Trolley: consequentialism

What is your decision?
- I pull the lever
- I don't pull the lever



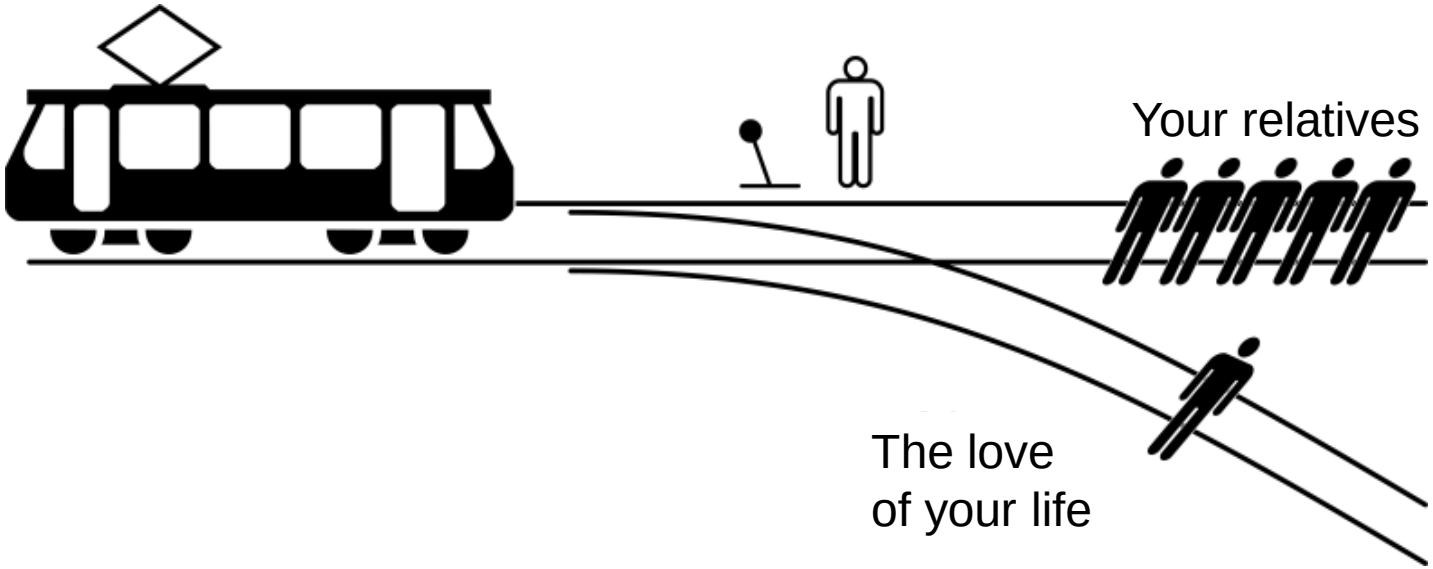
Right decision = action whose **outcomes (consequences)** are "the best"
- positive consequentialism: maximise good (e.g., 5 alive / 1 alive)
- negative consequentialism: minimise evil (e.g., 1 dead / 5 dead)

Examples
- Utilitarianism: the greatest good for the greatest number of people
- Selfishness: the greatest good for oneself
- Precautionary principle: risks minimisation

Thought experiment: another trolley dilemma

What is your decision?

- I pull the lever
- I don’t pull the lever

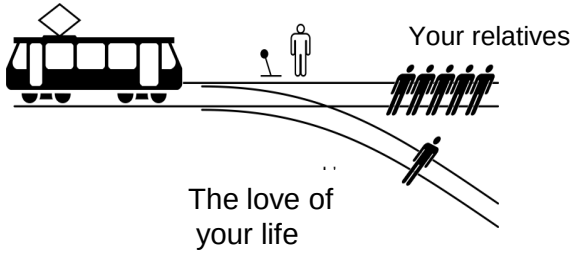


From McGeddon, Wikipedia - CC BY-SA 4.0

Another trolley

What is your decision?

- I pull the lever
- I don’t pull the lever



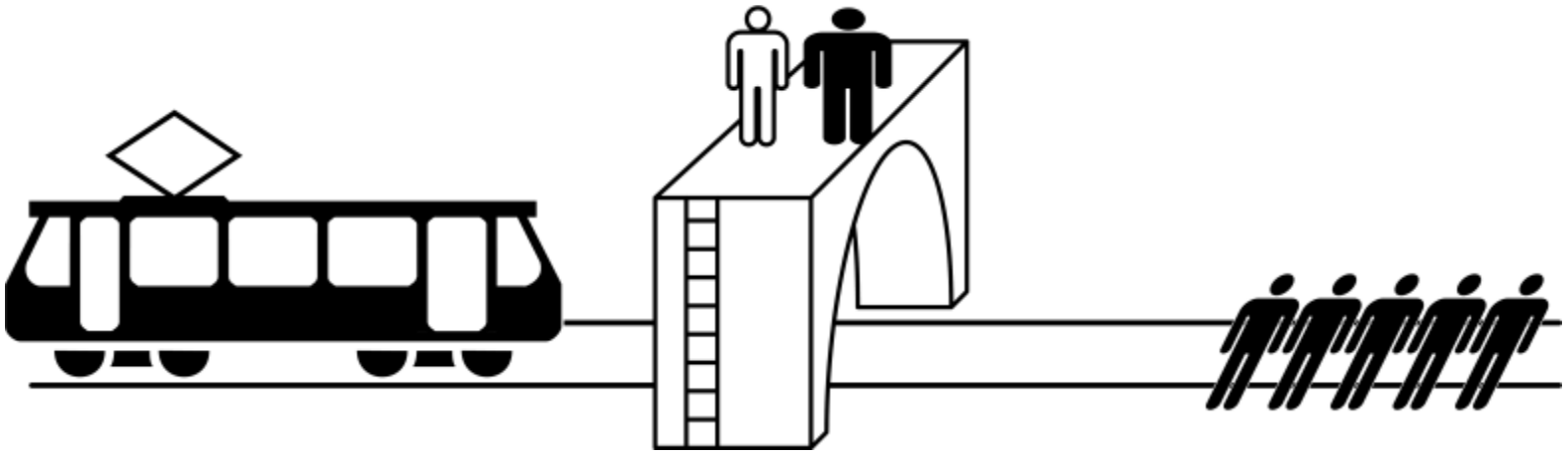
Ethical thought always takes place within a context

Which hierarchy of values do I consider in this situation?

Thought experiment: the footbridge dilemma [Thomson76]

What is your decision?

- I push the guy
- I don't push the guy

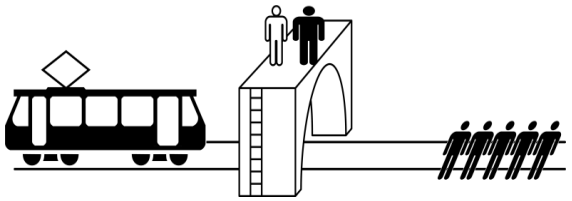


P.Gaborit, from McGeddon, Wikipedia - CC BY-SA 4.0

[Thomson76] Thomson, Judith Jarvis - *Killing, Letting Die, and the Trolley Problem*. The Monist, 59(2), 204–217, 1976. DOI:10.5840/monist197659224

Footbridge: deontology

What is your decision?
- I push the guy
- I don't push the guy



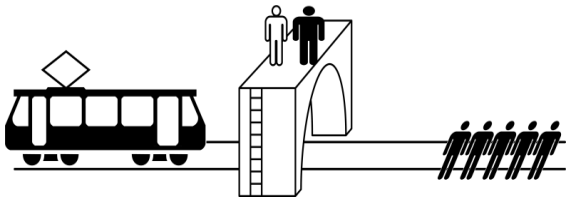
Right decision = **action** that respects some principles (whatever the consequences)

Kant's categorical imperatives:
"Act only on that maxim whereby you can at the same time will that it should become a universal law"
"Act as to treat humanity whether in your own person or in that of another never as means but always as an ends"

Examples
- Always tell the truth
- Do not make an attempt on somebody's integrity

Footbridge: virtue ethics

What is your decision?
- I push the guy
- I don’t push the guy
- I jump



Right decision = action that shows a particular virtue of the **agent**

Examples
- honesty, courage, caution, self-sacrifice

Robots in the beehive: a (short) ethical analysis

Bee robots: a paradox?

- Project is designed according to some goals

*"**affect** large ecosystems in a positive **way**"*

*"**resulting** in the workers having to engage in more pollen collecting (thus pollinating) flights."*

AND

- Project is likely to go against those goals

→ Likely to induce disruption of the hive

→ Likely to threaten pollination and food security

(competition: ↑ domestic honeybees → ↓ wild bees)

→ **Uncertainties**

Ethics / robots in the beehive (deontological point of view)

"make the difference between the possible and the acceptable"

Design micro-robots replicating bees' behaviours

Put robots into the beehive

Modify the bees' behaviours

? + Experiments with insects?

Sustainability of robots?

"question the principles that define the very notion of progress"

Increase scientific knowledge: robotics, ethology ✓

Protect, restore and promote sustainable use of terrestrial ecosystems, […] halt biodiversity loss (UN SDG #15) ?

Ethics / robots in the beehive (uncertainties)

"critically analyse the certainties and convictions"

[Stefaner et al. 2022]

"A small group of robots operating in a honey bee colony and interacting with the queen bee, a central colony element, has the potential to change the collective behavior of the entire colony ***and thus also improve its interaction with the surrounding ecosystem****."*

?

?

"It is the first step towards a team of robots working in ***a bio-compatible way*** *to study honey bees and* ***to increase their pollination performance****, thus* ***achieving a stabilizing effect at the ecosystem level.***

?

?

Ethics / robots in the beehive (consequences)

"on the most lucid possible assessment of the benefits and risks."

See project and questions about uncertainties

- Effects on bees
  - Potential behavioural changes in bees: bees being stressed, killing each other, killing the queen, becoming "lazy", etc.
  - Robustness of robots (failures?)
- Effects on environment
  - Resources necessary to make and operate robots, lifecycle
  - Harm to the surrounding ecosystem through the bees
- Other uses, misuses
  - Use modified insects to modify ecosystems
  - Other uses of microrobots

Some more research ethics questions

Research ethics–some questions 1) research topic

Who suggested the research topic?

→ PhD advisor, funding organisation, boss, me?

Why is this topic worth researching?

→ motivations? e.g., scientific, societal, financial, commercial, strategic

What is my own interest in this topic?

→ my motivations? e.g., I like it, renowned team, lab in a nice city, I will be paid, international opportunities, professional opportunities

Who employs/pays me?

→ what about my independence of mind?

Possible conflict: personal ethics (as a citizen)/professional ethics (as a researcher)

Research ethics–some questions 2) design

→ What is intended to be assigned to the software/device, i.e., which functions, and why (in the name of what)?

→ Is it always possible to express those functions with mathematical concepts, and therefore to program them?

Is it possible to catch and encode all the subtleties of those functions?

Is this modelling of reality scientifically sound?

→ What is the subjectivity that is put in the models / that is in the data?

Is it well located and identified?

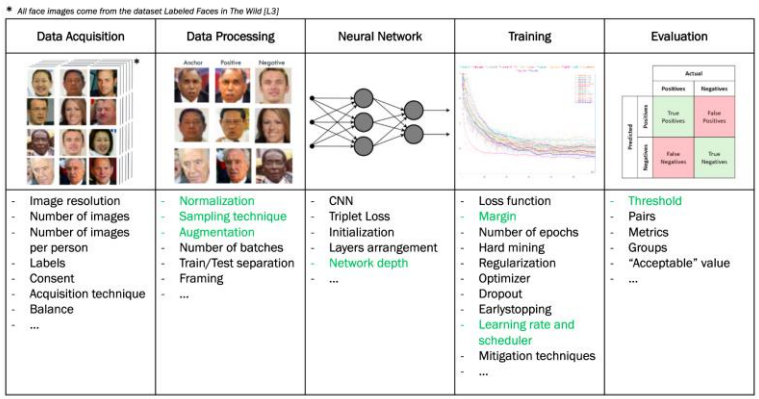


Figure 1 : List of design choices for a facial authentication system and investigated choices (in green)

From: M. Gornet, Cl. Kirchner, C. Tessier - Operational fairness for facial authentication systems. *ERCIM News* 131, October 2022

Research ethics–some questions 3) (future) use

→ What are the intended uses of this software/device?

→ Is such a software/device desirable for these uses? In the name of what?

→ What are the potential side effects and misuses of this software/device?
Can a researcher anticipate all uses, all effects?
What are their responsibilities?

→ How are the conflicts between principles or requirements handled?

e.g.,

Transparency, explicability, predictability	/ Security
Accuracy	/ Private life and personal data protection
Accuracy	/ Environment preservation
Decision aid, “autonomy”	/ Operator’s or user’s autonomy
Increase of device capabilities	/ Preservation of human (*or… bees*) skills
Off-the-shelf solutions	/ Sovereignty

Research ethics–some questions 4) users

→ Will the users of this software/device informed/trained– and how– about
- what it does
- what it does not do
- what it does not replace

Will there be clear cautions about how to use the device/software?
Can the software/device explain to the user what it is doing?

Mohamed Hassan - Pixabay

→ Has the impact of the software/device on the user (and environment) been assessed?

To what extent is it likely to modify behaviours–positively (intended behaviour) and negatively (to the detriment of what)?

→ Who controls what is inside the software, especially code and data (where are they stored)?
Is the user aware of that?

Summary – Some recommendations

Summary

International texts about “AI and ethics” suggest that “an ethical AI” is possible

But:

→ Ethics is NOT

- tick-boxes
- compliance
- labels
- certificates
- or law!

→ All the criteria that are set out in the texts cannot be met at the same time!

Ethics is a continuous thought process, along the way and is a matter of trade-off

Some recommendations (1)

- Avoid thinking only in a utilitarian way (consequences),
  ask also: in the name of what?

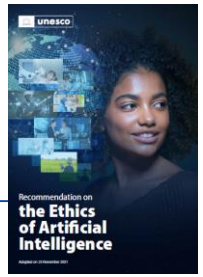
- Question motivations:
  increase knowledge? help people (*or… bees*)? develop industry? do as others do? believe a device is better than nothing? etc.

- Question criteria such as: be quicker, be cheaper, increase security, less human involved, save environment, etc.

- Question the needs (are they real needs?)

- Question the choices in algorithms (parameters, thresholds, etc.)

Some recommendations (2)



108. Member States should ensure that AI researchers are trained in research ethics and require them to include ethical considerations in their designs, products and publications, especially in the analyses of the datasets they use, how they are annotated, and the quality and scope of the results with possible applications.

Everybody should be trained in ethical thinking

students, researchers, engineers, companies, decision-makers, policy-makers, users…

it is not only a matter for ethics experts or ethics officers!

Ethical thinking should always be associated

with research projects, master theses, doctoral theses, etc.

Every scientific paper should include an ethical discussion

And: ethical issues are tightly interwoven with scientific issues

→ ethical issue can lead to new scientific developments

Who/what can help?

Talk with colleagues who are aware of ethical issues

Lear about the institution procedures

Talk with the ethics officer

Ask the research ethics committee of the university for advice

Read papers about ethical considerations in research