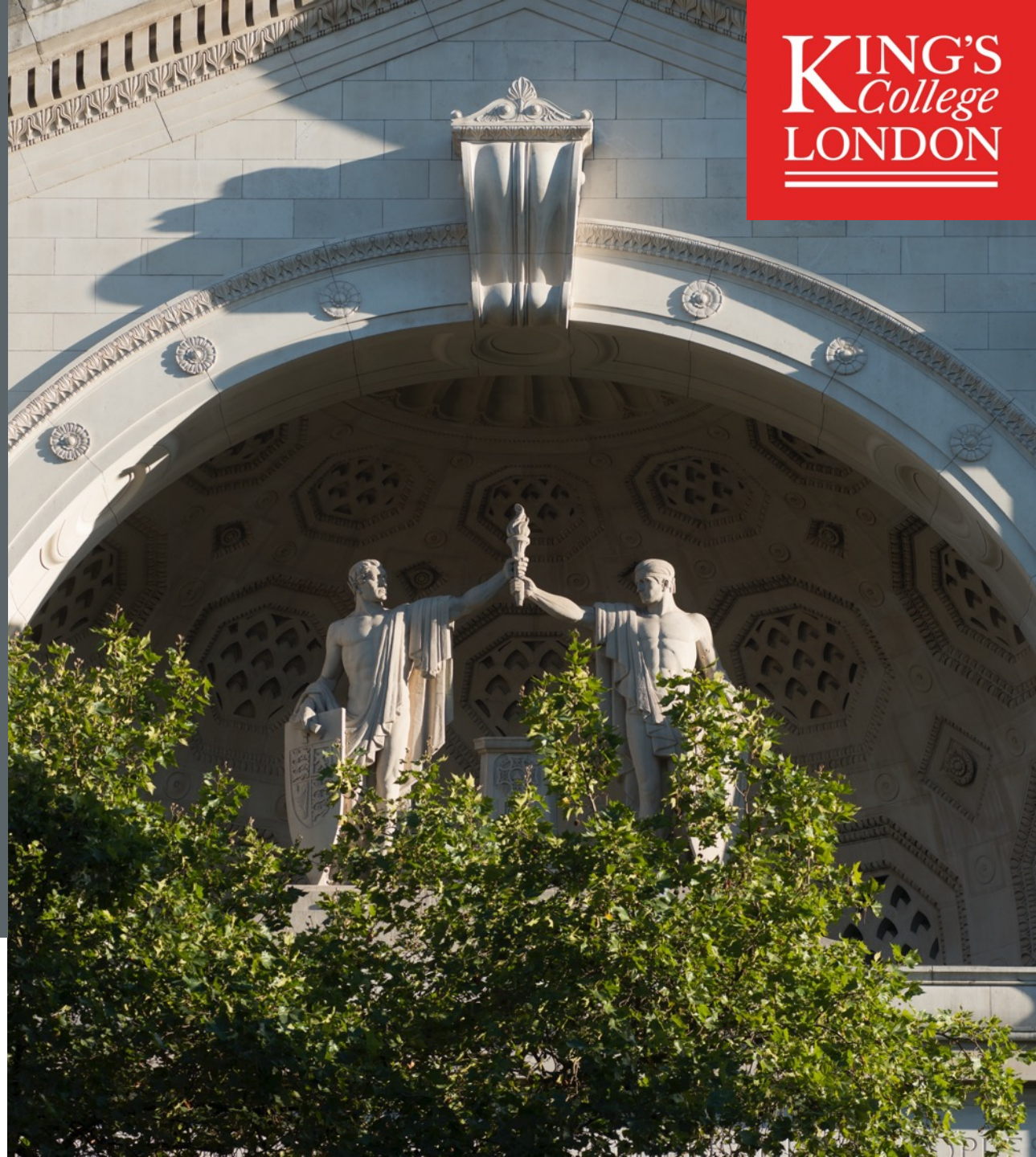


# Reimagining research ethics to include environmental sustainability

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**KING'S**  
*College*  
**LONDON**

# Format of talk

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- Describe adverse environmental and associated impacts of digital research endeavours
- Need for normative consideration in research processes
- Historically, research ethics governance frameworks do not explicitly consider these impacts
- Propose modification of Emmanuel et al.'s (2008) international research ethics framework
- Describe what this would look like in practice
- Describe why it is difficult to implement in practice



# Digital Tech: material



Inside DataVita's Fortis data centre in Scotland's central belt

[https://www.bbc.co.uk/news/technology-67053139?utm\\_campaign=The%20Week%20in%20Data%20TWD&utm\\_medium=email&utm\\_content=278212966&utm\\_source=hs\\_email](https://www.bbc.co.uk/news/technology-67053139?utm_campaign=The%20Week%20in%20Data%20TWD&utm_medium=email&utm_content=278212966&utm_source=hs_email)



**Digital Tech:  
relies on mining**





# Digital Tech: has high energy demands

\*relates to GHG emissions, depending on the country



**Digital Tech:  
associated  
with e-waste**

# **DIGITAL RUBBISH**

a natural history of electronics

Jennifer Gabrys



...including  
during  
manufacturing



# REASSEMBLING RUBBISH

WORLDING ELECTRONIC  
WASTE

JOSH LEPAWSKY



....change is happening

# MORE FIELDS ARE STARTING TO TACKLE THE ISSUE

Thinking Geographically about AI Sustainability

Meilin Shi, Kitty Carter, Zilong Liu, Krzysztof Janowicz, Nina Wiselmann, Judith Versteeg, Grant McKenzie, Anita Graessl, Rui Zhu, and Gongchen Mai

arXiv.org > cs > arXiv:1907.10997

Energy and Policy Considerations for Deep Learning in NLP

Ernesto Strubell, Ananya Ghemawat, Andrew McCallum

arXiv.org > cs > arXiv:1910.09700

Computer Science > Computers and Society

Submitted on 10 Oct 2019 (v1), last revised 4 Nov 2019 (this version, v2)

Quantifying the Carbon Emissions of Machine Learning

Alexandre Lacoste, Alexandre Lacoste, Victor Schmidt, Thomas Dandekar

From an environmental standpoint, there is a few crucial aspects of training a neural network that have a major impact on the quantity of carbon that it emits. These factors include: the location of the server used for training and the energy grid that it uses, the length of the training procedure, and even the model of hardware on which the training takes place. In order to approximate these emissions, we present our Machine Learning Emissions Calculator, a tool for our community to better understand the environmental impact of training ML models. We accompany this tool with an exploration of the factors that drive it, as well as concrete actions that individual practitioners and organizations can take to mitigate their carbon footprint.

arXiv.org > cs > arXiv:1907.10997

Computer Science > Computers and Society

Submitted on 22 Jul 2019 (v1), last revised 13 Aug 2019 (this version, v2)

Green AI

Roy Schwartz, Jesse Dodge, Noah A. Smith, Oren Etzioni

The computations required to train a deep neural network can make it difficult for us to consider the environmental impact of these computations. These computations have a surprisingly large carbon footprint, and even the model of hardware on which the training takes place. In this position paper, we propose reporting the carbon footprint of these computations. We propose reporting the carbon footprint of these computations in a way that is both greener and more inclusive—establishing a standard for reporting the carbon footprint of these computations.

On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?

Authors: Emily M. Bender, Timothée Gabeau, Angelina McMillan-Major, Ghazwan Chehab

Authors Info & Affiliations

Publication: "Fact" '20: Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency

2021 • Pages 610–621 • <https://doi.org/10.1145/3447188.3445922>

nature astronomy

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Comment | Published: 10 September 2020

The ecological impact of high-performance computing in astrophysics

Simon Portegies Zwart

Nature Astronomy 4, 819–822 (2020) | [View this article](#)

1835 Accesses | 10 Citations | 600 Altmetric | Metrics

Computer use in astronomy continues to increase, and so also its impact on the environment. To minimize the effects, astronomers should avoid interpreted scripting languages such as Python, and favour the optimal use of energy-efficient workstations.

Short Paper

KIG: a tool for Carbon footprint monitoring in physics research

Francesco Minarini, PhD student in Physics (University of Bologna, Italy and INFN)

research areas: Green Computing for High Energy Physics

International Symposium on Green & Cloud (ISGC) 2021, Academia Sinica, Taipei, Taiwan

arXiv > cs > arXiv:2206.06370

Computer Science > Computers and Society

(Submitted on 13 Jun 2022)

Don't "research fast and break things": On the ethics of Computational Social Science

David Leslie

arXiv > physics > arXiv:2203.12389

Physics > Physics and Society

(Submitted on 23 Mar 2022 (v1), last revised 23 Aug 2022 (this version, v2))

Climate impacts of particle physics

Kenneth Bloom, Veronique Bovsvert, Daniel Britzger, Michal Buuck, Astrid Eichhorn, Michael Headley, Kristin Lohwasser, Petra Merkel



NEUROVIEW | VOLUME 106, ISSUE 1, P17-20, APRIL 06, 2020

How Can Neuroscientists Respond to the Climate Emergency?

Adam R. Aron, Richard B. Ivry, Kato J. Jeffery, ... Robert Schmidt, Christopher Summerfield, Arne E. Urai, Show all authors

Open Access • DOI: <https://doi.org/10.1016/j.neuron.2020.02.019> • [Check for updates](#)



# Ethical justification for change

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1. Utilitarian: failing to consider the burdens associated with the manufacture, use and disposal of digital technologies creates imbalances in any utilitarian decision-making approach because it means ignoring key links in the consequentialist pathway that are associated with harms that come from the use of these technologies during the research process. Pierce and Jameton (2004) argue that when these burdens are added, 'everyday decisions unquestioned by ethicists and regarded as rational and even praiseworthy may be seen as questionable and possibly maleficent' (p119).
2. Justice: is a key underlying principle of many modern day societies. In a globalised world, to be just means ensuring the fair and equitable distribution of benefits and burdens not only within national boundaries but for all those who are subject to a given governance structure. Understandings of justice developed in recent decades argue that all individuals and communities affected by a particular process, technology and/or product wherever they are in the world, and whatever aspect of the product/process/technology they are affected by have moral standing and should be the subjects of justice considerations (e.g. Marion Young / Fraser's, 'all subjected principle')

# Current research ethics frameworks

- Historically revolved around ethics principles concerned with the protection, rights, safety, and welfare of individual research participants
- Respect for community emphasised to sit alongside individually focused principles
  - Community harms = more than the sum of individual values and interests (will communities be beneficiaries of the research/share the same goals)
  - e.g. how an AI algorithm to detect skin cancer was shown to have been optimised for fair skin, being less able to detect Melanoma on darker skin
  - e.g. using AI for diagnosis given issues with recognising certain faces
- Moral gaze focuses only on humans, and only on particular humans. One of two things needs to happen (depending on your philosophical beliefs):
- Need for moral gaze to expand to include the environment (ecocentric ethics) OR remain on humans (anthropocentric ethics), but consider the harms caused by adverse environmental effects
- [https://www.nature.com/articles/d41586-022-03050-7?error=cookies\\_not\\_supported&code=3e4d4a57-54e0-405d-bbf9-61d3bcf9aa2b&utm\\_medium=Social&utm\\_campaign=nature&utm\\_source=Twitter#Echobox=1666213670-1](https://www.nature.com/articles/d41586-022-03050-7?error=cookies_not_supported&code=3e4d4a57-54e0-405d-bbf9-61d3bcf9aa2b&utm_medium=Social&utm_campaign=nature&utm_source=Twitter#Echobox=1666213670-1)
- <https://www.theatlantic.com/health/archive/2018/08/machine-learning-dermatology-skin-color/567619/>



# In fact, we have a duty to expand our moral gaze...

- In evaluating the risks of research, focus is primarily on those risks related to participants (in digital science, this would be around, e.g data governance issues). However, when calculating the potential benefits, we expand their purview to include non-participants, including those from both present day as well as future generations. The focus on risks to participants is understandable given that history's research-related harms have directly affected research participants. Nonetheless, it stands to reason that if present-day and future generation non-participants matter when calculating the potential benefits of research, then present-day and future generation non-participants should also matter when calculating the risks and harms associated with research. To not do so gives rise to a risk-benefit calculation – and research conduct – that is one-sided, misguided, and does not properly respect the rights, safety and welfare of non-participants and future generations.
- *Jeffrey d'Souza and myself, forthcoming*

# Research ethics framework

Emanuel et al (2008)	Modified research ethics framework (additions)
<b>Social value:</b> research must have reasonable potential to benefit participants, community, and/or society. Adverse effects must be minimised.	<b>Social value:</b> Adverse effects that are explicitly associated with the environment need to be considered.
<b>Respect for participants; community partnerships:</b> respecting all of those affected by the research (participants and community)	<b>Respect for persons, communities, and environment:</b> Respect for environment means being attentive to the adverse environmental impacts of using digital tech during research and taking steps to reduce them.
<b>Fair participant selection:</b> participants selected in a way that is fair, allows generation of reliable/valid data, minimises harm; communities involved in the research process and receive benefits.	<b>Justice:</b> fair collection, storage, use, linkage, and sharing of data, as well as attention to equity and benefit sharing of research outcomes. Furthermore, consideration to environmental justice issues associated with the manufacture, use and disposal of digital tools used during research process.
<b>Favourable risk/benefit ratio:</b> determined by those affected by partaking in the research and/or affected by the research outcomes.	<b>Favourable risk/benefit ratio:</b> also includes also those affected by the manufacture of digital products used during the research process, and the subsequent disposal of digital research products and e-waste.



# Implementation of framework in practice

For researchers and research ethics committees	For research policymakers
<ul style="list-style-type: none"><li>• Where data are stored?</li><li>• Differential storage of data (long and short latency times) to reduce energy costs where possible.</li><li>• Algorithms optimised for environmental considerations. Considerations of obsolescence.</li><li>• See Lannelongue (2021) for more in-depth guidelines</li><li>• Lannelongue L, Grealey J, Bateman A, Inouye M. Ten simple rules to make your computing more environmentally sustainable. <i>PLoS computational biology</i> 2021;17(9):e1009324-e</li></ul>	<ul style="list-style-type: none"><li>• Not <i>solely</i> relying on the increasing efficiency of digital technologies to reduce the adverse environmental impacts. Put constraints in place.</li><li>• Constraining the level of resources provided to researchers.</li><li>• Resources could be shared more equally with research proposals that use methodologies with lower environmental costs (e.g., research addressing social/political/economic determinants (which likely have bigger impact on outcomes)).</li></ul>

# Interviews with UK digital health researchers

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- Researchers wanted to take responsibility through ‘collective responsibility’
- Exceptions (appealing to worse problems; energy hungry algorithms needed)
- Struggled to reconcile perceived responsibilities in practice – data practices under institutional control
- Response-able (Haraway; Johnson and Michaelis, 2013).
- Though – co-alignment was reflected upon
- Calls for regulation (.....we’re regulated anyway; we need to be told what to do)
- Compliance-based approaches are limited/can be problematic – ‘responsibilisation of the individual’ (Rose, 1999)
- ‘Better rules’ or alternative approaches (funding streams etc) may work better (Jamieson, 2015).

-Samuel (submitted) *Researchers’ views on their responsibilities towards the environmental sustainability of their practices: a case study of data-intensive UK health research*

-Samuel (minor revisions). BMCethics



# Limitations/considerations

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- Should researchers have responsibility? Can they? [ethics]
- Bottom up / top down are both important to enact change [sociology]
- Will regulations lead to compliance-based approaches?
- How to address tensions between other priorities e.g., data governance [also SJ vs env impacts]



# Thank you

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