

Institution: University of Stirling
Unit of Assessment: D32 Philosophy
Title of case study: Context, Embodiment and Online Surrogacy: the Impact of 4E Cognition Research on the Ontario SmartData Initiative
<p>1. Summary of the impact</p> <p>Wheeler’s internationally influential research on 4E (embodied-embedded-extended-enactive) cognition has played a formative role in the genesis and development of SmartData, an innovative public-policy-realizing project spearheaded by the Office of the Information and Privacy Commissioner of Ontario (IPC). IPC is an agent of the Ontario legislature that acts to uphold and promote the protection of personal privacy. The goal of SmartData is to enhance personal data privacy on the Web, by developing Internet-based agents that act as online surrogates for individuals, securely storing and intelligently disclosing personal information as required. The identified research has influenced the content and implementation of SmartData, by contributing to (i) the IPC’s understanding of the link between privacy and context-sensitivity, (ii) the principles shaping the design of the online agents, and (iii) the specification of the first ‘proof-of-concept’ SmartData product, an under-development mobile phone book ordering application.</p>
<p>2. Underpinning research</p> <p>Wheeler was appointed to a Senior Lectureship in Philosophy at Stirling in 2004. He was promoted to Reader (2006) and then to Professor (2009). Over this period, he has produced a widely discussed series of research publications on the complex ways in which mind, body and world are causally and constitutively inter-related. This work on so-called 4E (embodied-embedded-extended-enactive) cognition includes a much cited monograph, <i>Reconstructing the Cognitive World</i> (2005) and over 25 subsequent publications in peer-review journals and edited collections.</p> <p><i>Reconstructing the Cognitive World</i>, which is the principal source of the opening phase of the impact described below, was completed following Wheeler’s appointment at Stirling and published by MIT Press in 2005. The book draws on sources as seemingly disparate as phenomenology, evolutionary robotics and dynamical systems theory, in order to articulate and defend a non-standard philosophical framework for cognitive science. <i>Reconstructing the Cognitive World</i> explores a number of interconnected themes that Wheeler has continued to investigate in subsequent research. This later research has resulted in – and, in a manner to be described below, has sometimes been carried out in interaction with – the second phase of the impact described here. Two longstanding themes in particular should be highlighted: (a) the challenges that confront the attempt to explain, in purely mechanistic terms, the remarkable but routine capacity of human intelligence to be fluidly and flexibly sensitive to what is relevant in context (a question which is intertwined with that of replicating such a capacity via artificial intelligence – AI) and (b) the ways in which, and the extent to which, human thought and reasoning are determined by features of our physical embodiment (a question which immediately raises issues regarding the possibility of creating disembodied – e.g. online – surrogates for our own decision-making).</p> <p>With regard to (a), Wheeler has argued as follows (publications 1, 2, 3, 5, 6): there are in fact <i>two</i> problems of relevance, the first concerns how a purely mechanistic system might achieve appropriate, flexible and fluid action within a context, while the second concerns how a purely mechanistic system might achieve appropriate, flexible and fluid action in worlds in which adaptation to new contexts is open-ended and in which the number of potential contexts is indeterminate; although a potential solution to the first of these problems exists (in terms of special-purpose, brain-body-environment couplings), our scientific understanding of the second remains radically incomplete. With regard to (b), Wheeler has argued as follows (publications 4, 6): although the role of physical embodiment in intelligent human action has been under-appreciated in most philosophy and cognitive science, what really matters about that embodiment is adequately</p>

captured by a view according to which the body is conceptualized as a material realizer of functionally specified cognitive architectures; so the temptations of a more radical (anti-virtuality) embodied position, according to which specific bodily acts and structures make some nonsubstitutable contribution to thought and reason, should be resisted. One outcome of this research is that Wheeler now has a reputation as a philosopher whose work is highly relevant to the understanding and future development of our online presence (see corroborating source A).

3. References to the research

1. Wheeler, M., Reconstructing the Cognitive World: the Next Step, MIT Press, Cambridge, Mass., 2005, 339pp. Peer reviewed publication. (<http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=11219>). MIT Press is arguably the world's leading publisher of philosophy of cognitive science. The book received extremely positive reviews in highly reputable publications such as the Times Literary Supplement (by the philosopher of mind and psychiatry George Graham, 23/06/06, "[a] challenging defence of anti-classical assumptions for cognitive science"), Mind (by the philosopher of embodied cognition Shaun Gallagher, July 2007, "packed full of good and innovative arguments"), and Artificial Life (by the AI researcher Ezequiel Di Paolo, Spring 2007; "could turn out to be the initial articulation for the most radical break in cognitive science in decades"). The reception and sales of the book resulted in its paperback publication by MIT in 2007. It has been the topic of four international workshops: Tilburg University, Netherlands, 2006; the Free University of Amsterdam, Netherlands, 2008; Goldsmiths University of London, 2009; the Goethe University of Frankfurt, Germany, 2010.
2. Wheeler, M. 'Cognition in Context: Phenomenology, Situated Robotics and the Frame Problem', International Journal of Philosophical Studies, 16(3), 323-49, 2008. Peer reviewed publication.
3. Wheeler, M. 'Plastic Machines: Behavioural Diversity and the Turing Test'. Kybernetes, 39(3), 466-80, 2010. Peer reviewed publication.
4. Wheeler, M. 'Embodied Cognition and the Extended Mind', in Garvey, J. ed., Continuum Companion to the Philosophy of Mind, Continuum, London, 2011, pp.220-238. Invited contribution reviewed by editor.
5. Wheeler, M. 'Naturalizing Dasein and other (Alleged) Heresies', in Kiverstein, J. and Wheeler, M. eds., Heidegger and Cognitive Science, Palgrave-Macmillan, Basingstoke, 2012, pp.176-212. This collection includes chapters by Hubert Dreyfus, Matthew Ratcliffe, Andrea Rehberg and Erik Rietveld that criticize arguments from Wheeler's book Reconstructing the Cognitive World, including, prominently, those concerning the problem of relevance. Wheeler's 'Naturalizing Dasein' piece responds to the criticisms.
6. Wheeler, M. 'What Matters: Real Bodies and Virtual Worlds', in Harvey, I., Cavoukian, A., Tomko, G., Borrett, D., Kwan, H. and Hatzinakos, D. eds., SmartData: Privacy Meets Evolutionary Robotics, Springer, Berlin, 2013, pp.69-80. Peer reviewed collection. The reviewer rated the paper "excellent" and "very compelling"; accepted with no changes.

4. Details of the impact

SmartData is a project of the Office of the Information and Privacy Commissioner of Ontario (IPC), in collaboration with the Identity, Privacy, and Security Institute of the University of Toronto (IPSI). IPSI is the home of the encryption specialist Dr. George Tomko who originally conceived the technical dimension of SmartData. IPC is an agent of the provincial legislature of Ontario that acts "to uphold and promote open government and the protection of personal privacy in Ontario" (corroborating source B). One of IPC's flagship policies is 'privacy by design', as proposed by Ann Cavoukian, the Information and Privacy Commissioner of Ontario, and endorsed by the International Data Protection and Privacy Commissioners meeting in Jerusalem in October 2010. As Cavoukian puts it, "[p]rivacy can no longer be assured solely by compliance with regulatory frameworks; rather, privacy assurance must come from designing privacy protection right into technology, business practices and physical design" (corroborating source C).

Against this background, the goal of SmartData is to develop Web-based autonomous agents that will act as an individual's online surrogate, securely storing their personal information (e.g. financial details, information regarding medical conditions and treatment), and intelligently disclosing that information with appropriate sensitivity to the context of any data request. The vision is one of protecting/reclaiming individual informational privacy in an age of increasing worries about the ways in which businesses, governments and criminal organizations may access and control online personal information. The model for SmartData is evolutionary computation and embodied cognition within a dynamical systems framework. It is built on an optimism that, using this model, it will be possible to artificially evolve online agents that are capable of disclosing personal information in a context-sensitive fashion. The human beings for which these virtual agents are online surrogates will need only to set up the initial conditions for data release contexts and then inform the agent should these conditions alter. Decisions regarding data release will then be made by the agent through its autonomous context-sensitive application of these conditions. Cavoukian has described SmartData as "an innovation that is desperately needed because without it, our data will move beyond our reach and our ability to ultimately maintain control" (corroborating source D).

The initial phase of the impact described here was direct but unplanned. As Michelle Chibba, the IPC's Director of Policy and Special Projects, put it "[Wheeler's] book 'Reconstructing the Cognitive World'... was the inspiration for the Smart Data vision" (email of 27 October 2011; see corroborating sources E, F). The SmartData model combines embodied cognition, evolutionary robotics and a dynamical systems approach to intelligence. This was precisely the set of ideas that was explored and developed, in a distinctive way, in Wheeler's *Reconstructing the Cognitive World*. The book also focussed on context-sensitivity in intelligence, and on the role of the set of ideas just mentioned in showing us how the capacity for such sensitivity may be mechanized.

The second phase of the impact involved a planned intervention. Wheeler was invited by IPC to take part in the IPSI SmartData International Symposium ('Privacy meets Evolutionary Robotics: Protecting our Freedoms with Virtual Tools', Toronto, May 2012). This symposium refined SmartData by bringing together academics, members of IPC (including the Commissioner) and experts from the computer and Web industries (e.g. a senior researcher from IBM's Blue Gene supercomputing project). Representatives from Google and Facebook, plus privacy stakeholders in the public sector, were present. Wheeler gave two presentations (Philosophical Reflections on the Design of Autonomous Agents: the Problem of Relevance' and 'What Matters: Real Bodies and Virtual Worlds') in which he applied arguments and insights from the research described above to SmartData. He also took part in a 4 hour closed meeting which brought together selected invited speakers, the local SmartData team, and representatives from IPSI and IPC, to shape the future of the project. Wheeler was asked to submit a paper to the symposium proceedings, published by Springer in their 'Security and Cryptology' series (publication 6). This allowed his experience at the symposium to influence his research, demonstrating a mutually profitable interaction between impact and research. (The corroborating sources for this paragraph are detailed in G.)

IPC subsequently invited Wheeler to be a named collaborator on a major grant application (1 million Canadian dollars) made via IPSI to the University of Toronto's 2013 Connaught Global Challenges Fund Award. This award aims to support a project that "focus[es] intently on a leading global challenge of the 21st century" (corroborating source H). SmartData was one of three shortlisted applications (corroborating source H). Although the bid was ultimately unsuccessful, IPC has been encouraged to submit to the 2014 competition. In addition, in 2012, Wheeler drew on the research described above to contribute to the design of a proof-of-concept SmartData study, a mobile phone application for ordering books online, in which a spoken request such as "Buy me a paperback copy of X, lowest price, delivery time unimportant" will be carried out (including seller credibility checks and payment) by an application that adapts over time to user preferences. This study will test the SmartData concept, set a baseline, and gain further insights into the theoretical and technical issues. It is in progress.

5. Sources to corroborate the impact

A. For example, Wheeler was an invited speaker at 'The Philosophy of the Web' (Sorbonne and Pompidou Centre, Paris, 2012), a seminar organised in part by Harry Halpin of the World Wide Web Consortium (W3C), the leading international agency for Web standards (<http://www.w3.org/>). See <http://web-and-philosophy.org/seminaire-philosophie-du-web/>

B. Quotation from <http://www.ipc.on.ca/english/Home-Page/>

C. Quotation from <http://www.privacybydesign.ca/index.php/ambassadors/>

D. Quotation from <http://www.privacybydesign.ca/index.php/time-to-get-smart-about-big-data-enter-smartdata/>

E. In an email of 27 October 2011 to Wheeler from Michelle Chibba, she writes: "[i]t was your book on "Reconstructing the Cognitive World" that was the inspiration for the Smart Data vision. The thought leader behind this new research area, Dr. George Tomko, read your book and the questions that you raised resonated with him. It is for this reason we have reached out to you because your grounding in philosophy alongside your interests in artificial intelligence and artificial life is a much-needed area of input as we formulate this vision of Smart Data agents."

F. See <http://www.ipsi.utoronto.ca/sdis/bibliography.pdf#> for a list of "[w]orks related to the development of SmartData". Two of Wheeler's publications (1 and 2 above) are mentioned.

G. See <http://www.privacybydesign.ca/index.php/time-to-get-smart-about-big-data-enter-smartdata/> for a piece by Ann Cavoukian in which she writes: "More than 20 of the world's most innovative thinkers from such fields as evolutionary robotics, engineering, cognitive science, brain imaging, computer sciences, philosophy and privacy, gathered recently at the University of Toronto from May 14 to 16, for an International Symposium... All of the speakers are world renowned experts in their fields including... Dr. Michael Wheeler of the University of Stirling, Scotland... We were also honoured to have Dr. Kirk Jordan from the Computational Science Center at IBM Watson Research Center and Bob Blainey, an IBM Fellow at the Hardware Acceleration Laboratory IBM Software Group presenting as well. These experts turned their minds to launching this revolutionary concept." (The same piece appears on the website of the Ontario Ministry of Research and Innovation, <http://www.mri.gov.on.ca/blog/index.php/2012/05/cavoukian-3/>.) See <http://www.ipsi.utoronto.ca/sdis/index.html> for the SmartData symposium website. See <http://www.ipsi.utoronto.ca/sdis/program.html> for a video of Ann Cavoukian's contribution to the Toronto symposium in which she highlights the importance of context. See <http://www.ipsi.utoronto.ca/sdis/program.html> and <http://www.ipsi.utoronto.ca/sdis/program-day-3.html> for videos of Wheeler's talks at the symposium.

H. Quotation from <http://www.research.utoronto.ca/u-of-ts-connaught-fund-announces-innovation-and-summer-institute-awards/>. The shortlist for the award is also published here.