Institution: University of Exeter

Unit of Assessment: 23 – Sociology

Title of case study: The Implications of Recent Advances in Biology

1. Summary of the impact

John Dupré has been engaged in an intensive investigation of contemporary genomic science and its implications for policy, practice and public understanding. His research has been at the forefront of criticism of popular deterministic understandings of genetics, challenging public assumptions, and informing debates over the relevance of genomics/genetics to understandings of a wide range of issues of public concern, including health and illness, ideas of 'human nature', 'normality', and gender and 'race', as well as philosophical issues like the possibility of free will. His research questioning both Darwin's idea of the 'Tree of Life', and interpretations of human evolution in evolutionary psychology, has contributed to public discussion and understanding of evolution. In sum, Dupré's work has had an impact on **media and public understandings of, and debates about, science**, as well as on **UK science policy.**

2. Underpinning research

In 2003 Dupré was appointed Director of Egenis, the ESRC Centre for Genomics in Society, a £2.5m investment by the ESRC. Under his direction, in 2007 Egenis was awarded a further £4.1m, continuing it for another five years. Over the last 10 years, Dupré's research has led the Egenis research agenda, and his public engagement and impact activities have complemented and driven those of Egenis as a whole. The research has been directed at providing a philosophical understanding of recent work in molecular biology which has undermined widespread assumptions about the nature of genetic inheritance (Section 3, Reference 1). At the same time, he has presented his work in a variety of ways that are widely accessible to general audiences. He has explored the relevance of these scientific developments to a broad range of issues, including understandings of health and illness, ideas of 'human nature' and 'normality', and the implications of these both for important social categories such as gender and 'race', and also for philosophical issues such as the possibility of free will (2). Not only has research in genomics illustrated the complexity of interactions between multiple genes and multiple features of the environment in determining phenotypes, the emerging field of epigenetics has also provided increasing understanding of the ways that environmental factors can modulate the structure and behaviour of the genome. He has also been concerned with a number of ramifications of these central developments in genomics in other areas of biology, especially evolutionary theory (3).

With respect to evolution, Dupré has argued that research in genomics and epigenetics decisively undermines the popular notion of grounding human nature in psychological modules evolved in the Pleistocene era. Applying understandings of microbiology derived from genomic tools, he has explored the implications of the phenomenon of lateral gene transfer for the popular Darwinian notion of the 'Tree of Life' (4). In the 'Questioning the Tree of Life' Network - an international collaboration between philosophers of biology and biologists, led by Egenis with Dupré as PI, and funded by the Leverhulme Trust - the participants have supported Dupré's view that the Tree of Life is an increasingly questionable construct.

Dupré's argument in favour of understanding human development as an interactive process, constantly driven by environmental factors as much as by biological causes, provides a picture of developmental plasticity quite incompatible with traditional ideas of 'biology as destiny', especially in respect to gender. With respect to 'race', the ability of complex genetic screens in certain contexts to make reliable predictions of self-identified 'race' has had some tendency to revive ideas of race as a biological category or natural kind. Dupré has provided detailed analyses of this population genetic research which show that such ideas about race are quite unjustified (4, 5).

3. References to the research

1) *Genomes and What to Make of Them,* Chicago: The University of Chicago Press, 2008 (with Barnes, B. S.) [submitted output]

2) *Processes of Life: Essays in the Philosophy of Biology*, Oxford: Oxford University Press, 2012 [supplied on request]

3) 'Postgenomic Darwinism', in Brown, W. and Fabian, A. (eds.), *Darwin*, Cambridge: Cambridge University Press, 2010, pp. 150-171 [submitted output]

4) 'The Tree of Life: Introduction to an Evolutionary Debate', *Biology and Philosophy*, 2010, 25(4): 441-453 (with O'Malley, M.A. and Martin, W.), DOI: 10.1007/s10539-010-9208-4

5) 'What Genes Are and Why There are No Genes for Race', in Koenig, B., Lee, S. and Richardson, S. (eds.), *Revisiting Race in a Genomic Age*, New Brunswick, NJ: Rutgers University Press, 2008, pp. 39-55 [supplied on request]

Research quality: All the outputs derive from peer-reviewed ESRC-funded research. References 1 to 3 are published by leading University Presses and manuscripts were peer-reviewed. Reference 2 was very favourably reviewed in *Science*, 17 August 2012: 800-801, DOI:10.1126/science.1224870.

Key Grants

a) *A Process Ontology for Contemporary Biology*: ERC Advanced Investigator, 2012 - €1.95m

b) *Questioning the Tree of Life*: Leverhulme (PI: Dupré, Co-I: O'Malley, M. A.), 2008 - £71.6k

c) ESRC Research Centre award for Egenis, 2008-12 - £4.1m

d) *Philosophical Issues in Genomics*: AHRC Research Grants Scheme, 2005 - £97k

e) *Stem Cells CBAR, Phase 1*: ESRC, 2005 - £290k

f) ESRC Research Centre award for Egenis, 2003-7 - £2.49m

g) *Philosophy of Biology*: AHRB Research Grants Scheme, 2003 - £277k

4. Details of the impact

The primary impact objective of Dupré's research, and that of the Egenis Centre more broadly, has been about improving public understanding of science - through promoting more sophisticated appreciations of genetics and of evolution, and informing public discourse, which can lead to better informed decision-making. The research has obvious and immediate relevance to this goal, and Dupré has disseminated his research findings to a variety of specialist and non-specialist audiences. A central strategy has been to speak in a variety of forums and to publish in a wide variety of media, from academic papers to general news media, from podcasts to radio broadcasts, to stimulate better-informed discussion of biological issues.

Dupré gave evidence to the House of Lords Select Committee on Science and Technology Inquiry on Genomic Medicine (April 30, 2008). He emphasised, *inter alia*, the need for better patient understanding of genetic tests. In paragraph 6.7 of its report (Section 5, Reference 1) the Committee recommended that '*debate should aim to improve public understanding of genetic risk and predictive testing in common complex disorders*', a recommendation accepted in the Government response: '*We have asked the HGC to consider how to generate demonstrably effective and informative debate around the issues raised by complex diseases*' (2).

Dupré was later asked to write an article, 'Are there "Genes For" Traits?' (March 8, 2010), for BioNews, a website dedicated to promoting better public understanding of genetics and related areas. The article was reproduced as part of a School Resource Pack, 'Spectrum of Opinion: Genes, Autism and Psychological Spectrum Disorders', produced by the Progress Educational Trust (PET), with the aim of informing debate on assisted conception and genetics. The pack, piloted at the Robert Napier School in Gillingham, Kent, is available for download by teachers to support lessons and homework on the topic (3). He was also invited to give a keynote presentation to an international conference in the Netherlands (14-16 March 2013) on 'Genetics Education in the 21st Century, Design Criteria and Good Practices', for an audience of 100 researchers, developers, teacher trainers and teachers in science education.

Dupré was invited to take part in the first Nobel Week Dialogue, in connection with the 2012 Nobel awards, in which he participated in panels on genetics and nurture, and on human evolution (4). Contributors included leading scientists (e.g. seven Nobel Laureates) and policymakers (e.g. the US Secretary for Energy), and the proceedings, which took place before an audience of more than 1200 people, were streamed to a worldwide online audience via Nobelprize.org. Films of the discussions have been posted on the Nobel Week Dialogue site and on YouTube. Dupré was quoted in a piece on the event for the Bloomberg News website. The Bloomberg science correspondent later noted that reading Dupré's work had led him to change his reporting of genetics, such as avoiding using words like 'blueprint' (5).

Further specific impact relates to public understanding of evolution. This includes the debate generated by Dupré's criticism of the traditional 'Tree of Life' representation of evolution. On January 21 2009, *New Scientist* published a cover feature entitled 'Why Darwin was Wrong about the Tree of Life', which quoted Dupré, as did the Daily Telegraph (January 22 2009) (6). A consequence of these two articles was considerable international debate, including among creationists and scientists, questioning Darwinism further and quoting Dupré in blogs and discussion forums online, for example *NEUROLOGICA* blog, *Sandwalk*, *Darwin's God* blogspot, *Who is Your Creator?*, and *Texas Citizens for Science*.

Dupré's work on Darwinism has been presented to a wide range of audiences in talks in the USA, Mexico, Israel, Canada, Belgium, France, Norway, Germany and the UK, including a contribution to the prestigious Cambridge Darwin lectures in 2009, with an audience of c. 800. The podcast of that talk has been downloaded almost 26,000 times since March 2009 (7). In December 2009, Dupré gave a talk to the American Philosophical Association on 'Post Genomic Darwinism and Human Nature'. In the week following, the Cambridge Darwin Lecture podcast received 2,193 downloads, circa 20 times its weekly average. A talk on Darwinism at the American Association for the Advancement of Science meeting in 2009 was followed by an interview on the BBC World Service; the BBC interviewer later stated that Dupré had made a 'considerable contribution' to extending public understanding of Darwinism (8). The talk contributed to Dupré's election to a Fellowship of the American Association for the Advancement of Science, the only UK-based philosopher with this distinction, further raising the international public profile and reach of his work, and augmenting its impact-generating capacities.

In 2012, Dupré published a column for Project Syndicate (9), which works with 475 leading newspapers in 151 countries (and one of the top five internet news sources in the world for 2012, according to the influential Real Clear website). There he argued for the importance of open debate about weaknesses in current evolutionary theory, despite the dangers of unintentionally lending encouragement to anti-evolutionists in so doing. This column prompted extensive commentary and discussion in leading and widely-read science blogs, including a critical discussion on Jerry Coyne's *Why Evolution is True*, and a defence on Massimo Pigliucci's *RationallySpeaking* (10).

5. Sources to corroborate the impact
1) http://www.publications.parliament.uk/pa/ld200809/ldselect/ldsctech/107/107i.pdf
2) http://www.official-documents.gov.uk/document/cm77/7757/7757.pdf
3) http://www.progress.org.uk/spectrumjohndupre
4) http://www.nobelweekdialogue.org/
5) http://www.bloomberg.com/news/2012-12-09/genome-challenge-emerges-in-sharing-dna-benefits-across-society.htmld Bloomberg science correspondence, email correspondence to Dupré, 11 December 2012
6) New Scientist, 'Uprooting Darwin's Tree', 24 January 2009, online 21 January 2009: http://www.newscientist.com/article/mg20126921.600-why-darwin-was-wrong-about-the-tree-of-life.html?full=true http://www.telegraph.co.uk/science/4312355/Charles-Darwins-tree-of-life-is-wrong-and-misleading-claim-scientists.html
7) Cambridge Darwin Lecture series podcast Download Statistics http://www.sms.cam.ac.uk/media/535812/statistics
8) Interviewer for BBC World Service's *Science in Action* programme (*2*0 February 2009) – letter to Dupré.
9) http://www.project-syndicate.org/commentary/evolutionary-theory-s-welcome-crisis-by-john-dupre
10) http://rationallyspeaking.blogspot.co.uk/2012/09/jerry-coyne-vs-john-dupre-on-status-of.html