Institution: The University of Edinburgh

Unit of Assessment: 4

Title of case study: M: The Lothian Birth Cohorts: informing and changing policy and public perceptions on what is and is not associated with normal cognitive ageing

1. Summary of the impact (indicative maximum 100 words)

Impact: UoE research into the determinants of cognitive change during ageing, including intelligence, has changed perceptions of the public and has informed policy debate.

Significance: Understanding age-related cognitive change is essential for informing policy and addressing challenges that arise from increasing numbers of older people in society.

Beneficiaries: UK government and policy-makers; specialist charities; the public; the arts.

Attribution: Research on the Lothian Birth Cohorts was led by Deary (UoE) since 1996.

Reach: UK and beyond; featured in regional and national policy documents, third sector literature, >300 international press articles, presented at science festivals and in an art exhibition and a play.

2. Underpinning research (indicative maximum 500 words)

Longitudinal studies of birth cohort data led by Professor Ian Deary (Professor of Differential Psychology; Director, Centre for Cognitive Ageing & Cognitive Epidemiology, UoE, 1985–present) have explored why some individuals remain healthy in old age while others do not. The underpinning research has produced novel information, including crucial observations on life course decisions that impact on health, that determines why cognitive abilities decline at different rates for different people across their lifetimes, informing debate among the public and policy-makers.

Given the rapidly increasing number of older people worldwide, there is considerable and increasing interest in the determinants of health and well-being in old age, and in factors that undermine independent living or require medical intervention or long-term care. In developing policy, healthcare and personal care provision, and informing and supporting the ageing population and potential or current carers of older people, it is crucial to identify these determinants, and to dispel unsupported assumptions about cognitive ageing.

From 1996, Deary and UoE colleagues have undertaken longitudinal follow-up studies of members of the Scottish Mental Surveys of 1932 and 1947 [3.1]. All children in Scotland who were born in 1921 and 1936, respectively, were formally assessed with standardised mental ability tests. The research has been conducted with surviving members of these birth cohorts based in the Lothian region of Scotland, the Lothian Birth Cohorts 1921 and 1936 (LBC1921 and LBC1936).
The studies are extraordinary in that they explore lifetime cognitive ageing in the same individuals. Moreover, they are almost unique in having childhood mental ability data for people who are in old age: from age 70 to their late eighties.

Research using LBC1921 and LBC1936 has assessed multifactorial determinants of age-related changes, including genetic [3.2, 3.3], physical [3.4], medical, biological, psycho-social, demographic, and lifestyle as well as cognitive factors (overviewed in [3.1, 3.5]). This research has resulted in well over 100 peer-reviewed publications and a book [3.1].

In addition to this new information on the determinants of life and cognitive changes, the research has identified other information critical to public health policy. In particular, childhood cognitive ability scores have been used to predict various health outcomes across the life-course. Children with higher mental capabilities live longer [3.1], and are less likely to develop heart disease and

dementia [3.6]. They are also less likely to take up smoking and other disadvantageous lifestyle characteristics [3.1]. Specifically, the cohort studies have demonstrated the ability to detect reverse causation in what otherwise seemed like likely determinants of lifetime cognitive change. Thus, coffee drinking, body mass index, alcohol consumption and inflammation, which were previously viewed as possible factors contributing to the trajectory of cognitive ageing, have turned out to be associates of childhood mental capability. That is, people with higher childhood mental ability make lifestyle choices regarding these factors, and controlling for variations between people in childhood mental ability eliminates the association between these factors and cognitive function in old age.

3. References to the research (indicative maximum of six references)

The number of papers from this research area is large, so examples below include both individual research projects and more generic/overview contributions.

3.1 Deary I, Whalley L, Starr J. A Lifetime of Intelligence: Follow-up Studies of the Scottish Mental Surveys of 1932 and 1947. Washington, DC: American Psychological Association, 2009. [Available on request.]

3.2 Deary I, Whiteman M, Pattie A, et al. Cognitive change and the APOE epsilon 4 allele. Nature. 2002;418:932. DOI: 10.1038/418932a.

3.3 Deary I, Yang J, Davies G, et al. Genetic contributions to stability and change in intelligence from childhood to old age. Nature. 2012;482:212–5. DOI: 10.1038/nature10781.

3.4 Deary I, Whalley L, Batty G, Starr J. Physical fitness and lifetime cognitive change. Neurology. 2006;67:1195–200. DOI: 10.1212/01.wnl.0000238520.06958.60.

3.5 Deary I, Corley J, Gow A, et al. Age-associated cognitive decline. Br Med Bull. 2009;92:135–52. DOI: 10.1093/bmb/ldp033.

3.6 McGurn B, Deary I, Starr J. Childhood cognitive ability and risk of late-onset Alzheimer and vascular dementia. Neurology. 2008;71:1051–6. DOI: 10.1212/01.wnl.0000319692.20283.10.

Associated Research Grants

The research has attracted around £14M of research funding from the Medical Research Council, Biotechnology and Biological Sciences Council, Economic and Social Research Council, Wellcome Trust, Age UK among others; for example: Deary et al. The Disconnected Mind. Help the Aged (Age UK). £4.1M. Jan 2006–Dec 2010 and Deary et al. A genome-wide association study of non-pathological cognitive ageing. BBSRC. £0.9M. Sep 2008–Jan 2011 (Ref. BB/F019394/1). It resulted in the establishment of the new MRC Centre for Cognitive Ageing and Cognitive Epidemiology (£3.4M; Sep 2008–Aug 2013; G0700704/846898). Full list available on request.

4. Details of the impact (indicative maximum 750 words)

Pathways to impact

Publications from this research have provided the major route to impact. Accompanied by press releases, they have been widely publicised in the media (e.g., a feature on BBC Radio 4's PM programme in June 2013 [5.1]). In addition, Deary and colleagues have actively pursued impact, by presentation to policy-makers and at public engagement events.

Impact on public policy

The Foresight Mental Capital and Wellbeing Report (2008), commissioned by UK Government for policy-makers, professionals and researchers, cited the research [5.2 a&b]; Deary co-wrote the supporting state of the science review, 'Normal Cognitive Ageing'. This report was used to help construct the independent think-tank New Economics Foundation's 'Five Ways to Wellbeing' (2008). The Five Ways have been used by health organisations, schools and community projects around the world to help people to take action to improve their wellbeing.

Deary has contributed chapters to two Age UK publications 'Improving Later Life' (2011 and 2013) [5.3 a&b] with a wide circulation to Age UK stakeholders (over 5,000 copies distributed). The Head of Research at Age UK [5.4] cites the project results as directly influencing Age UK policy and

giving it the authority to sit on advisory committees and influence policy, including the inclusion of "dementia" in the UK Coalition Government Program for Government [5.5].

As a result of publication [3.3] (2012), the UK Minister for Universities and Science asked to meet Deary [5.6]. Referring to the *Nature* paper [3.3], he said, "*This is an illuminating study; ingenious in the way it drew on the database; and fascinating in showing that a quarter of the change in intelligence across the lifespan is explained by genetic factors*."

Deary and colleagues presented the LBC1936 research to the Scottish Government Cross Party Group on Older People Age and Ageing (Sep 2011) [5.7] and to Edinburgh City Council A City for All Ages (June 2010). They also presented to NHS Health Scotland the importance of cognitive ageing for the Scottish population. The Director of Public Health Science, NHS Health Scotland stated *"As a result of this, cognitive epidemiology and ageing are now part of the thinking and debate in Health Scotland"* [5.8].

The team has also provided written and oral evidence to the Scottish Parliament Finance Committee Demographic Change And Ageing Population Inquiry [5.9], highlighting the importance of the LBC1936; the fact that how individuals age with respect to cognition is dependent on many factors. Furthermore, they emphasised that "a quarter of the variation in lifetime cognitive change is estimated to be caused by genetic differences, implying that the majority are non-genetic and therefore may be subject to social and public health interventions."

Impact on public engagement

The UoE group's two publications on the genetics of intelligence [3.3, 3.6] have sparked enormous public interest internationally, and resulted in articles and comments online, comments on Twitter, more than 300 articles in the international press and 2,600 views of videos about the research on YouTube.

Since 2008, Deary and colleagues have presented the research to the University of the Third Age, many Probus clubs and retired people's groups and at the Edinburgh International Science Festival (family audience; April 2010–2013; 2013 visitor numbers: 3,055, 58% children).

Impact on culture and creativity

To celebrate its 75th anniversary, the Wellcome Trust commissioned a play about the LBC1936. 'Still Life Dreaming', was performed to over 700 people at the Edinburgh Festival Fringe (Aug 2011). The BBC Arts correspondent Will Gompertz said *"The play reveals some of the results and explores the subject of cognitive aging. Which is interesting."* [5.10]. There were reviews in whatsonstage.com, the BBC Review Show (19 Aug 2011), and an article in The Times (20 Aug 2011). Actor Simon Callow commented directly on the project in an article in the Times (15 Feb 2010): *"I was able to spend a day with Deary and his team of exceptional scientists…I can think of no more urgent and important project for every one of us."*

The LBC1936 has been the focus of a series of art works. Linda Kosicewicz-Fleming's (www.ccace.ed.ac.uk/transformations) [or http://tinyurl.com/mstw2bs] photographic and video installations were exhibited (200 attendees) and a discussion event held (40 attendees; Apr 2010). The work also appeared at 'The Art of Ageing' (Newcastle, Jan–Mar 2011). This work was profiled in The Times (24 Apr 2010, p. 31), linking physical fitness and mental ability, and in a YouTube video viewed over 1,300 times.

The LBC1936 is the focus of a permanent exhibit at the Science Museum, London (daily footfall up to 20,000) in the "Who Am I?" gallery, which opened in June 2010.

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.1 BBC Radio 4's PM Programme (5 June 2013). Seven-minute feature by BBC Health Correspondent on the LBC1936 featuring interviews with Ian Deary and Age UK's Head of Research. The feature was written up on BBC Online: http://www.bbc.co.uk/news/health-22767016. *[Corroborating example of impact on mass media.]*

5.2 a. Foresight Mental Capital and Wellbeing Project (2008). Final Project report. The Government Office for Science, London. Chapter 5: Mid-adulthood – work and skills: interventions. http://www.bis.gov.uk/assets/foresight/docs/mental-capital/final_project_report_part4.pdf *[Deary's work cited on p. 215].*

b. State of Science Review: Deary I and Gow A. Determinants of Normal Cognitive Ageing: Implications for Mental Capital (2008). http://www.bis.gov.uk/assets/foresight/docs/mental-capital/sr-e14_mcw.pdf.

5.3 Publications with chapters written by Deary corroborating influence on Age UK advice:

a. Improving Later Life (2011). http://www.ageuk.org.uk/documents/en-gb/for-professionals/research/improving_later_life_book%28final%29.pdf?dtrk=true *[Deary's contribution p. 8–11 'Thinking Ahead'.]*

b. Improving Later Life. Understanding the Oldest Old (2013). http://www.ageuk.org.uk/Documents/EN-GB/For-professionals/Research/Improving%20Later%20Life%202%20WEB.pdf?dtrk=true [*Deary's contribution p. 46–49*.]

5.4 Factual statement from Head of Research at Age UK corroborating influence of research on Age UK policy. *[Available on request.]*

5.5 The Coalition: Our Programme for Government. Cabinet Office, 2010. http://www.direct.gov.uk/prod_consum_dg/groups/dg_digitalassets/@dg/@en/documents/digitalasset/dg_187876.pdf *[Corroborating inclusion of dementia in research policy, "We will prioritise dementia research within the health research and development budget. p. 25.]*

5.6 Factual statement from the Minister of State for Universities and Science. *[Corroborating meeting with Deary. Available on request.]*

5.7 Minutes from Cross Party Group on Older People Age and Ageing meeting. *[Corroborating presentation given by Deary, Sep 2011 "the results gave a fascinating insight into ageing and the factors that affected retention or loss of cognitive ability in particular". Available on request].*

5.8 Factual statement from Director of Public Health Science, NHS Health Scotland, which confirms "cognitive epidemiology and ageing are now part of the thinking and debate in Health Scotland". *[Corroborating impact on Public Health Scotland*. *Available on request*]

5.9 Scottish Parliament Finance Committee Demographic Change And Ageing Population – Written Evidence (2012). Corroborating submission to Scottish Parliamentary Committee http://www.scottish.parliament.uk/S4_FinanceCommittee/Inquiries/Centre_for_Cognitive_Ageing_and_Cognitive_Epidemiology.pdf.

5.10 BBC Friday Review Show and BBC Arts Correspondent Will Gompertz' blog. http://www.bbc.co.uk/news/entertainment-arts-14589329 *[Corroborating use of term "Cognitive Ageing in popular culture.]*