Institution: University of Dundee
Unit of Assessment: UoA4 – Psychology, Psychiatry and Neuroscience
a. Context

Our research addresses aspects of neuroscience, psychiatry and psychology with major impacts leading to health and wellbeing benefits. The principal non-academic beneficiaries are the Scottish, UK and European Governments, health practitioners, the pharmaceutical industry, the education sector and the public. Our approach is to develop internationally leading, academically rigorous research that enhances the work of these beneficiaries. The principal non-academic impact of work within the unit reflects the strategic themes within the unit: Addiction and Cognitive Development.

Addiction: Drug addiction is a major burden to society; Dundee suffers disproportionately from drug-related deaths (0.2/1,000 people in 2011), more than in any other city in Scotland. Work within the unit tackles this issue at multiple levels and has had impact in a number of domains:

- Quantifying the problem and directing responses: How many drug-related deaths are there and what might be done to prevent them? This is the subject of the impact Case Study: "Directing changes in government policy to address illicit drug-related deaths".
- Understanding the causes. Work investigating the mechanisms of addiction provides knowledge that impacts treatment, informing the development of addiction medications (by the pharmaceutical industry) and drug policy.
- Communicating the problem; raising practitioner, public and government awareness through effective dissemination of research and education.

Cognitive Development: Children are vulnerable to environmental toxins, inadequate nutrition and other deprivation, with potentially devastating consequences. Furthermore, failure to identify disabilities, such as ADHD, autism and dyslexia, during children's education has major implications in later life. Research within the unit has achieved impact by:

- Understanding environmental factors that contribute to normal and aberrant development. For example, nutrient requirements; the subject of the impact Case Study: "The role of long-chain polyunsaturated fatty acids in the health and development of children".
- Working with industrial partners to develop meaningful human/animal models and measures of cognitive development enabling translation of molecular neuroscience to clinical practice.
- Working with children to assess and remedy disrupted cognitive development. This approach has influenced educational strategies for children in schools and clinical treatments.

The relationships between the impact and the activities within the unit:

Addiction: Clinical research by **Matthews**, **Steele**, **Baldacchino** and **Kidd** examines opioid dependence, including the characterisation of methadone-dependent patients in Tayside and Fife. **Steele** uses behavioural neuroimaging of brain activity in response to reward and loss in these individuals. The work has an impact on public understanding of science: the contributions of **Hales**, **Baldacchino** and **Steele** to understanding opioid use and abuse were highlighted in the 2012 BBC documentary, "Addicted to Pleasure". The work of **Baldacchino** and **Kidd** has had international impact on approaches to identify and describe drug deaths and to support interventions.

Molecular, cellular and behavioural research in the **Belelli**, **Hales** and **Lambert** laboratories investigates mechanisms of alcohol, cocaine and opioids in the reward pathway. Close interaction between clinical and basic research is leading to the development of translational approaches, thus increasing the likelihood of developing more effective methods for drug development with benefits to the pharmaceutical industry and addicts receiving treatment.

Cognitive development: Work by **Willatts** investigating the effects of fatty acids led infant formula manufacturers to add long-chain polyunsaturated fatty acids to infant formula. **Willatts** developed a series of behavioural tests for use in infants that can be adapted for behavioural studies of rodents. In a project related to **Willatts'** pioneering work, **Martin** is investigating the effects of diet on rodent cognition and (with **Langston**) combining behavioural analysis of cognition with *in vivo*

electrophysiological recording. **Langston** has contributed to newspaper and television reports communicating the importance of research into cognition, including several BBC News reports (http://www.bbc.co.uk/news/science-environment-23447600) and articles in the international press.

Clinical investigator **Coghill** studies the antecedents and consequences of abnormal cognitive development in children suffering from ADHD and leads associated international research and health improvement programmes (UK and China). In collaboration with **Steele** and **Matthews** he is developing diagnostic magnetic resonance imaging to benefit these patients.

Sani conducts work on the impact of group identification (http://www.healthingroups.org/), with benefit to health constituencies in Scotland (e.g. Royal College of General Practitioners in Scotland, the Public Health Departments of NHS Lothian, Tayside and Fife and the Centre for Confidence and Wellbeing in Scotland). **Hopkins**' research investigates how issues of power, conflict, prejudice and discrimination impact upon notions of identity reporting his findings to the UK government's Foresight Project (http://www.bis.gov.uk/foresight/our-work/policy-futures/identity) and the Equality and Human Rights Commission.

Booth examines the relationship between exercise and teenagers' academic attainment, receiving coverage on the BBC (http://www.bbc.co.uk/news/uk-scotland-24608813) and in the press (http://www.express.co.uk/news/uk/438362/Exercise-can-make-teenagers-brighter-and-improve-their-grades) with impacts on public awareness, future government policy and school curricula.

b. Approach to impact

Interactions with key target groups:

Scottish, UK and European governments: Members of the unit inform government recommendations and policy. **Hales** is a member of the Healthcare Improvement Scotland Chronic Pain Steering Group, which initiated publication of the Scottish Intercollegiate Guidelines Network guideline on the treatment of chronic pain. **Connolly** advised the Scottish and UK Governments and DEFRA on the impact of pesticides on the nervous systems of bees, receiving international media attention and influencing advice on the use of neonicotinoid pesticides. **Matthews** advised on the development of the UK NICE guidelines on the management of depression and OCD and the Technology Appraisals for Electroconvulsive Therapy, Vagus Nerve Stimulation and Transcranial Magnetic Stimulation. **Coghill** is a member of the Health Improvement Scotland ADHD review group. **Kidd** Chairs the Scottish Government Drug Strategy Delivery Commission. **Swan** contributed to the NHS Education Scotland 'Matrix' for psychological therapies.

Health practitioners: The Unit organises and hosts meetings aimed at educating health care practitioners, raising awareness of problems associated with addiction and analgesic prescribing. For example, the annual CARES Conference informs practitioners of research within the Unit and throughout the world on drug addiction. The unit also co-hosts the annual Scottish Pain Community (SPaRC) meeting, founded with sponsorship from Healthcare Improvement Scotland to advance scientific communication between pain practitioners, researchers, patients and government. Matthews is clinical advisor to the UK Charity OCD Action and to the World Society for Stereotactic and Functional Neurosurgery. Coghill acts as clinical advisor to the ADHD Charity ADDISS. **Swan** and **Goodall** established, direct and deliver parallel postgraduate training programmes for psychological therapists to support the delivery of such clinical services in NHS Scotland.

Pharmaceutical and manufacturing: The Unit has been successful in translating research into product development. Research by **Schweiger**, **Lambert** and **Langston** with the Drug Development Unit of the College of Life Sciences into the molecular mechanisms underlying cognitive deficits in a mouse model of Huntington's disease is producing a high-throughput assay to identify novel therapies. They aim to develop new treatments for this debilitating disorder, exemplifying impact via industrial collaboration with potential for diagnosis and treatment. This approach is facilitated by the University's Research and Innovation Services, which manage the GlaxoSmithKline collaboration and negotiated a shared intellectual property arrangement.

In an MRC funded collaboration with the Division of Imaging and Technology, academic anaesthetist **McLeod** designed an ultrasound probe for needle placement during regional anaesthesia. This device was patented and licensed by Zonare, USA. Ultrasound guided needle

placement is revolutionising regional anaesthesia reducing local anaesthetic doses, minimising systemic toxicity and motor impairment enabling patients exercise soon after joint replacement.

Public outreach: The Unit encourages communication with a broad audience through mechanisms including Café Science and invites public attendance of CARES and SPaRC Conferences. Unit members regularly give public talks at the Sensation Science Centre in Dundee and have contributed to public exhibitions at the College of Art (**Tatler**).

Education: Duncan and **Potter** work with Fife Learning and Education Services and Fife Early Years practitioners investigating reading development and dyslexia, raising awareness of methods for monitoring and fostering language development in 3-5 year olds; **Duncan** conducted the standardisation of a new suite of Reading Comprehension tests among Scottish Primary and Secondary school children for educational and healthcare professionals.

Collaborations with the police: Tatler conducts research into monitoring CCTV footage and **Hopkins** was funded by a grant from the Scottish Institute for Policing Research to report on findings concerning interactions between Muslims and the authorities in airports.

Staff support enabling these impacts: The unit provides space and administrative assistance so staff can engage in impact-related activities. It houses the CARES office and administrative support is provided for this annual meeting and that of SPaRC. The annual objective setting and review process within the unit recognises and encourages activities that will lead to increasing impact. Impact-rich research and public engagement are rewarded in the workload model.

Institutional facilities/expertise/resources in undertaking these activities: The Café Science initiative was developed by **Vincent**. The University's Research and Innovation Services supports industrial collaborations, intellectual property arrangements and licensing. The University provides space for public engagement talks and its Press Office facilitates media coverage.

c. Strategy and plans

Plan to enable and/or facilitate the achievement of impact: The unit's approach to encourage translational research with a high probability of impact involves focusing on and creating critical mass by recruiting to strategic themes that achieve international excellence. The unit is already well served by molecular and cellular neuroscientists, psychologists and academic clinicians; recognising that the areas of behavioural neuroscience and clinical neuroimaging required recruitment, psychiatrist and neuroimager Prof **Steele** was recruited in 2009 and behavioural neuroscientists **Langston** and **Martin** were recruited as lecturers in 2010 and 2013. The success of **Willatts** and other developmental researchers has resulted in the appointment in Psychology of two new staff members, **Ross** and **Booth**. Our plans for enabling impact include the use of internal pump priming funds to organise workshops and strengthen collaborations in our strategic themes.

d. Relationship to case studies

Two contrasting cases exemplify our approach to major problems affecting society, using evidence to raise awareness, engage with the pharmaceutical industry, government and regulators and, ultimately, change behaviour and treatment. Both have informed the Unit's approach to impact.

- Directing changes in government policy to address illicit drug-related deaths (**Baldacchino, Kidd**): This case shows the approach to raising awareness of a key public health issue and engaging Government to influence policy addressing the rate of Scottish drug related deaths.
- The role of long-chain polyunsaturated fatty acids in the health and development of children (**Willatts**): This case illustrates how research on populations is translated into a change in recommendations affecting composition of infant feeding formulae worldwide.

Cognitive development is the key theme exemplifying the approach to collaborative projects across the unit. **Willatts'** research has spawned an investigation of the influence of diet on cognition which continues in the new Behavioural Neuroscience Core Facility. The Drug Deaths study provides a foundation for the addiction theme; establishment of the means to assess drug deaths allows us to evaluate the Unit's impact on this important healthcare burden and shapes research on neural mechanisms involved in addictive behaviours and their clinical correlates.