**Public dialogue brief: Neural interface technologies**

**REFerence - ITT 351**

**4 October 2018**

1. **Introduction**

1.1 The Royal Society is a self-governing Fellowship of many of the world’s most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society’s fundamental purpose, as it has been since its foundation in 1660, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.

1.2 Drawing on the expertise of our fellowship, we provide expert, independent advice to policy-makers and the general public, championing the contributions that science can make to economic prosperity, quality of life and environmental sustainability. Recent policy studies have covered topics such as ocean resources, machine learning, school-business collaboration and synthetic biology.

1.3 We also provide a forum for debate, bringing together diverse audiences to discuss the impact of science on current and emerging policy issues.

1. **What are neural interface technologies (NITs)?**

2.1 NITs are a diverse set of technologies that enable signals from the brain to control an external device. For example, using brain signals to control a prosthetic limb. These devices have predominantly been used in medical settings but are now being developed in other, more consumer focussed areas, such as gaming. Researchers have made substantial developments in neural interface technologies, with much work aimed at improving health, for example through the ability to understand the movement intentions of paralysed patients and cochlear implants to restore hearing.

2.2 In the last year entrepreneurs such as Elon Musk, and companies like Facebook, have invested in NITs with ambitions for applications beyond medical. The potential benefits of the widespread application of neural interfaces are many and substantial: computers could be controlled using the mind, intelligence could be augmented and direct communication may be possible between human and artificial intelligences.

2.3 Yet significant barriers remain. The inorganic tools of modern computing do not mesh easily with human tissue. The understanding of neurons and how they work together is limited. Current neural interfaces produce movements that are much slower, less precise and less complex than those of able bodied people.

2.4 Even if the technical hurdles can be surmounted NITs could also pose risks such as opening brains to hacking or exacerbating inequalities between those with and without such augmentation. How the benefits of new technologies can be shared across society is an important factor as well as considering the opportunities, challenges, risks and benefits arising from these technologies to mitigate risks and maximise opportunities.

1. **Some examples of Neural Interface Technologies**

3.1 The use of neural interface technologies for **medical treatment inside the brain** is already well established. Deep brain stimulation has been approved in the UK to treat Tourette’s and Obsessive Compulsive Disorder. However, the link between electrical stimulation, tissue response and behaviour is not linear or predictable. As such, there is an increasing move towards developing NITs which allow adaptive or responsive stimulation. For example, cochlear implants have been developed which aim to restore hearing. These implants are partly implanted directly into the cochlea, the organ chiefly concerned with hearing, and partly implanted externally, in direct contact with the outside world. This external part captures sounds via multiple microphones, and transmits it as an electrical signal to the internal component, which acts as a ‘speech processor’. This results in a specific stimulation of the hearing nerve cells in the cochlea, with a reproduction of specific components of the sound such as loudness, pitch and frequency. These devices have proven to be highly successful in restoring hearing in a wide range of age groups (12 months - 90 years).

3.2 There is great interest in **neural interface technologies that operate outside the body** but are able to respond to central nervous system or movement activity, particularly in the field of neuro-rehabilitation for the recovery of motor function. A common use of this technology is to treat drop foot, which is the inability to lift the foot and toes when walking. It typically arises from conditions such as stroke, MS or spinal cord injury. The ‘Drop-foot stimulator’ detects when a user wants to walk and responds by applying electrical stimulation through the skin to nerves that activate the muscles that lift the foot during the swing-phase of walking. Timing of the stimulation is typically controlled by a pressure-sensitive switch worn in the shoe. Although recommended by both the National Institute for Heath and Care Excellence (NICE) and the Royal College of Physicians Clinical Guidelines for Stroke, fewer than 10% of people who could benefit currently receive this treatment.

3.3 In contrast to original brain computer interface (BCI) technologies, which were designed to allow people to control the external world by a computer, BCI systems are now being developed which allow a computer to react to a change in the estimated mental or affective state of a user and adjust an environment accordingly. This type of technology may find use in the **world of gaming**, where aspects of the game could be adjusted according to the mental state of the gamer. For instance, researchers working in this field have already found that people have a better gaming experience and make better improvements when playing Tetris if the game difficulty is adjusted according to EEG readings associated with their boredom levels, as opposed to adapting to their performance levels.

1. **Background to the neural interface technologies programme**

4.1 The Society’s NIT project aims to address the following questions:

1. What are the scientific and technological opportunities and challenges of the development of neural interface technologies, including beyond medical? How might these be overcome?
2. Are there downsides? And how can these be mitigated?
3. What decisions could be made by industry and government to maximise the benefits and minimise the risks of neural interface technologies?

4.2 To address these questions, the project team at the Royal Society will work with scientific experts to produce a written NIT ‘Perspective’, which will have three components:

1. a synthesis of the subject and potential of the science and technology;
2. a commentary on opportunities and risks; and
3. calls to action for policymakers, business or others.

4.3 This expert group will include researchers from academia and industry who develop applications for NIT in different fields as well as people who bring a policy perspective, and experts in ethical and economic issues.

4.4 As part of the Perspectives process the project team will:

1. Engage with a wider group of experts through an insights workshop including social scientists and industry to gain a wider view.
2. Identify and analyse issues that need to be addressed to ensure the societal benefits of the technologies are maximised and risks minimised, with a focus on the UK.
3. Make evidence-based recommendations for policymakers, industry and the research community in the UK.
4. Engage in a public dialogue to improve understanding of public attitudes and explore more broadly the potential implications of these technologies.
5. **Audiences**

5.1 The outcomes of the programme will be tailored to the following audiences:

1. UK policymakers: Make recommendations about future research and policy actions that may be necessary for the exploitation of future opportunities, for the UK to be at the forefront of this field, and for risks and uncertainties to be addressed.
2. The NITs research community (academia and industry): Provide information about how best academia and industry can drive the development of NITs.
3. The UK public: The emphasis will be on discussing the technologies, the benefits that they could deliver, the concerns that people have about them, and what is needed to address risks and maximise public benefit.
4. **Agency brief**

6.1 We are looking for an agency or agencies to engage with **public audiences** in order to inform the wider programme of work on neural interface technologies and encourage proposals from social enterprises. We anticipate a two stage process comprising one qualitative and one quantitative element both to be completed by early 2019:

**Part One -** **Qualitative**: A deliberative element (‘the dialogue’) which will explore questions related to the development of NITs and wider implications. Society reserves the right not to proceed with the quantitative. It would be the intention to do both however.

1. **Part Two -** **Quantitative**: A statistically representative survey of the UK population on NITs (‘the survey”)

6.2 Part One and Part Two of the elements may be awarded to one or multiple agencies and Suppliers are asked to indicate which Part/s they are bidding for in the ITT.

1. **The dialogue (Part One):**

7.1 We envisage a series of workshop formats over two stages that follow best practice principles and standards, involve at least 100 individuals, in at least three locations across the UK, including devolved regions. We are keen to take advice on exact methodology and other ways we might best engage the public and welcome innovative ways to explore the issues.

7.2 The development of NITs – particularly at this early stage of their development – raises many questions. The dialogue will seek to explore the following, among other:

1. Co-create desirable visions for the future of NITs, enabling dialogue between scientists and the public and shaping the development of the technologies in mutually desirable directions.
2. Explore what type of engagement with user communities is necessary to develop effective NITs.
3. Gain public opinion on the development/deployment of NITs.
4. Establish the public perception of what is possible today and what the public think the different types/categories of applications are, including medical versus consumer applications.
5. Explore the acceptability of levels of invasiveness (e.g. for which applications would surgery/risk be acceptable) and differences in attitudes depending on applications and contexts.
6. Explore the line between treatment and enhancement using these technologies.
7. Provide insight into the criteria used to distinguish between enhancement and non-enhancement applications for NITs.
8. Provide insight into the criteria used to distinguish between acceptable and unacceptable enhancement applications.
9. How society will define desirable, or undesirable uses of NITs.
10. Examine issues of privacy and equality.
11. Identify who is trusted to work on NITs or applications, why, and with what implications e.g. public vs. private researchers; for profit vs. not for profit commercial organisations.

7.3Expected outputs*:*

1. An insights paper that demonstrates and explores the outcomes of the neural interface technologies dialogue.
2. **The survey (Part Two):**

8.1 The aim of the survey is to demonstrate the prevalence of attitudes identified through the dialogue. Survey questions will be developed in partnership with the agency but expected outcomes include:

1. Clarity on the knowledge of what NITs are and what people think they are used for.
2. Clarity on applications that a majority of the public support and why.
3. Clarity on whether the public support particular applications e.g. medical versus gaming/entertainment.
4. Clarity on which actors are trusted to work on which applications.
5. Clarity on the benefits e.g. cost, safety, efficacy, that the public feel should be considered alongside the risks.

8.2 Expected outputs: An insights paper supported by visual material, data, and infographics that provide clear information on the attitudes and knowledge of the public identified in the survey.

1. **Proposals**

9.1 We are looking for proposals that showcase the best way to meet the programme aims that allow us to gain input from a cross section of the public. The Society is able to provide expertise and materials to inform all elements of the dialogue

9.2 We would welcome advice on:

1. The number and range of participants in the dialogue phase e.g. representative samples or particular interest groups
2. Geography e.g. survey to be representative of both UK and devolved regions
3. How we describe NITs to the public in a more user friendly way

9.3 We are looking for agencies that will allocate experienced senior staff to the project

9.4 Suppliers are asked to respond to this Invitation to Tender providing clear statements against the criteria and indicating if you are tendering for Part one, Part two or both

9.5 Alternative tenders are permitted. Please refer to the Supplier Instructions on the Pricing Schedule for more information in regards to alternative pricing proposals

9.6 We are looking for agencies to work with that will allocate experienced senior staff to the project.

9.7 Technical offer: Suppliers are asked to respond to the Invitation to Tender providing clear statements against the criteria and indicating if you are tendering for the following:

1. Part one
2. Part two or
3. Part one and two

**10. Proposal evaluation:**

10.1 All proposals will be shortlisted according to the mandatory criteria.

10.2 Proposals will be evaluated on the following criteria. The highest possible score for a bid will be 100 points. This total is made up of the technical proposal and financial proposal.

10.3 The maximum score for the technical part of the offer is 65 points and the maximum score for the financial offer is 35 points. Five (5) points are awarded to social enterprises.

10.4 The technical proposals will be evaluated on the following criteria:

| **Criteria No.** | **Criteria Question** | **Weighting** |
| --- | --- | --- |
| Mandatory A | Have you demonstrated experience of delivering large scale public dialogue projects within the last 5 years? Yes or No? | Pass/Fail |
| Mandatory B | Have you had experience of delivering dialogue projects on science based subjects? Yes or No? | Pass/Fail |
| 1 | Understanding of the brief requirements  | 5% |
| 2 | Detail how you will achieve the delivery of Services including any innovative approaches in consideration of the audience and subject matter | 40% |
| 3 | Demonstrate experience over the past five years of delivering large scale dialogue projects | 10% |
| 4 | Experience of the individuals proposed for the project team | 10% |
| Pricing Schedule | Pricing and demonstrating value for money | 35% |
| **Total** | **100%** |

1. **Timings**
	1. The following dates apply to the tendering, evaluation and contract awarding of Part One and Part Two of the programme.

|  |  |
| --- | --- |
| **Stage** | **Date** |
| Open ITT | Thursday 4 October 2018 |
| Manage clarification questions | Friday 5 October to Monday 22 October 2018 |
| Close ITT | 2pm Thursday 25 October 2018 |
| Evaluation  | Thursday 26 October 2018 – 6 November 2018 |
| Contract Award | Approximately 8 November 2018 |
| Undertaking Part one  | Qualitative from Jan to mid-February 2019 |
| Decision on Part two | End of February with a view to commence work in March 2019 |
| Completion of Project | No later than Mid-April 2019  |

11.2 Final delivery of Part Two will be discussed in partnership with the agency but completion is expected by mid-April 2019.