GLOBAL NEUROETHICS SUMMIT

2017

DAEGU, SOUTH KOREA / 17 - 18 OCTOBER, 2017

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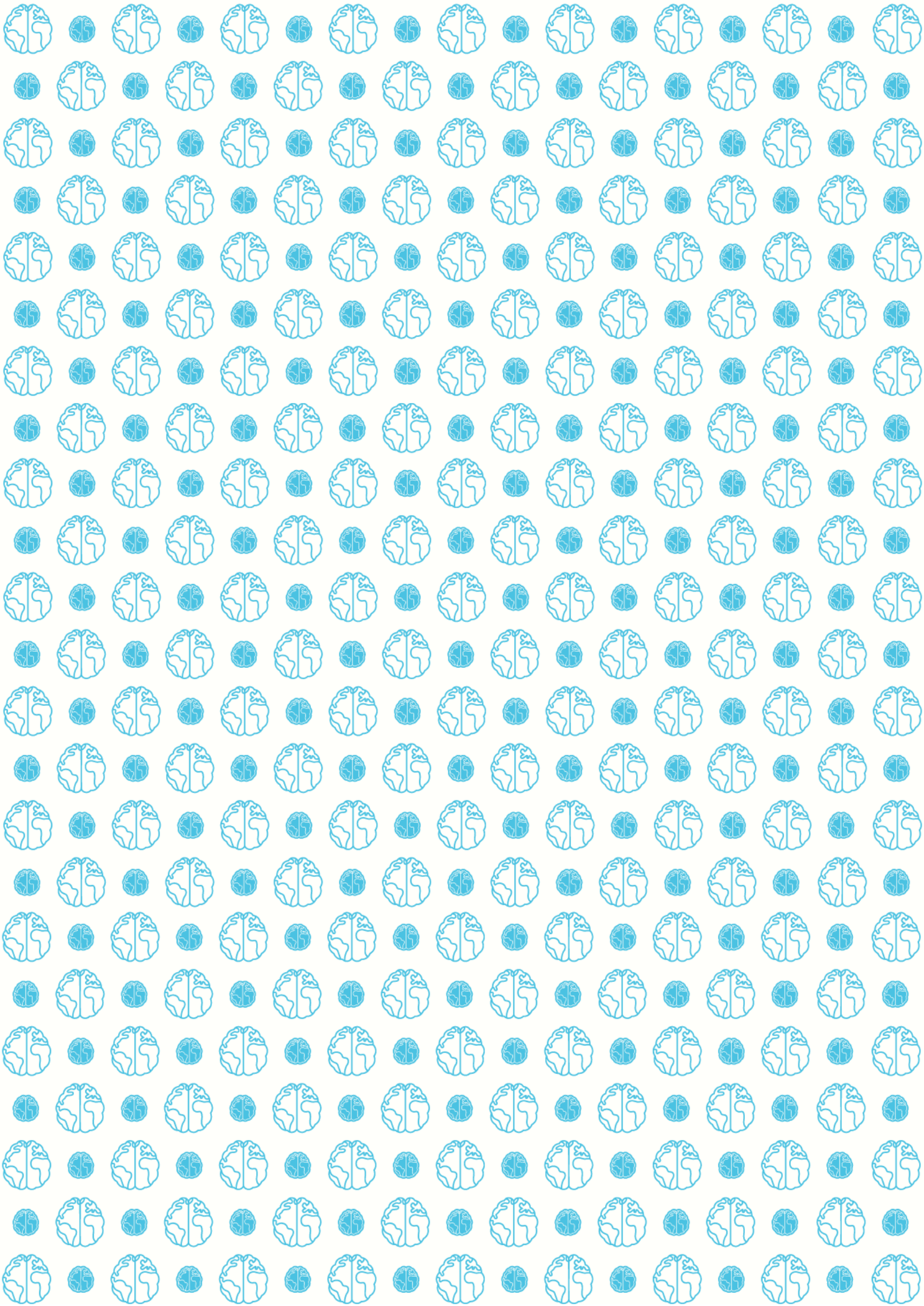

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17-18 October, 2017
Daegu, South Korea

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PROGRAM AGENDA

GLOBAL
NEUROETHICS
SUMMIT
2017

Name: Global Neuroethics Summit
Date: October 17-18, 2017
Location: Novotel Ambassador, Daegu City, 611, Gukchaebosang-ro, Jung-gu, 41913
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Khara Ramos (US BRAIN Initiative, National Institute of Neurological Disorders and Stroke)
Karen Rommelfanger (Emory University, US BRAIN Initiative Neuroethics Division) *co-chair
Arleen Salles (Uppsala University, Human Brain Project Ethics and Society Subproject)
Ilina Singh (University of Oxford, Our Brain, Our Selves, Our Lives Consortium)

Consultant
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Assisted by
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Purpose
In a world that is increasingly global – and increasingly engaged in neurosciences – how we educate scientists about the underlying values and ethics that drive brain research across cultural and continental divides is critical. The consequences of cultural misunderstandings are far from trivial for the scientific enterprise. Gaps in understanding lead to missed opportunities for collaboration to advance discoveries; limit our ability to broadly share results and reap benefits of findings; and result in a failure to recognize the unforeseen short- and long-term risks of research. As such, neuroethics has emerged as an essential tool for neuroscience serving in a horizon-scanning function to anticipate and address ethical roadblocks ahead and, ultimately, to advance and accelerate neuroscience.

We now see the proliferation of national-level neuroscience research projects across the globe; some are already integrating neuroethics into the neurosciences. Yet no project has explicitly discussed cross-cultural perspectives in engaging these neuroethics and neuroscience questions, and if they do address neuroethics, they tend to assume a Western bioethics approach.

With generous support from the Kavli Foundation and the Korea Brain Initiative, we will convene representatives from the brain projects from around the globe as well as neuroethicists (who are either already embedded in those projects or neuroethicists from their home countries).

The goal of the summit is to bring these experts together to **create a universal list of neuroethics questions**—critical concerns that arise at the intersection of human brain science and global societal

ethics—**that that could be addressed by scientists** across all brain projects. Importantly, that list could be adapted and informed by the cultural values and frameworks of each country including and beyond relying on traditionally western philosophical values. This is a very different, yet important strategy for addressing the societal and ethical implications of emerging neuroscience and neurotechnologies. As neuroscience is now a global endeavor, neuroethics must be equally prepared to address global values.

Goals and Deliverables

- Facilitate a community of multidisciplinary scholars who are attuned and inclusive to cross-cultural perspectives when engaging in neuroscience research and policy
- Serve as an idea incubator for research collaborations and future implementation
- Generate a high-profile publication that sets neuroethics priorities for research and scholarship in global neuroscience projects
- Create an online repository for global neuroethics discourse and education

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October 16, 2017

Arrival to Novotel Ambassador 611, Gukchaebosang-ro, Jung-gu (Check-in is 14:00; Checkout is 12:00)

14:00-18:00 **Visit to Palgong Mountain and Donghwasa Temple,** 1, Donghwasa 1-gil, Dong-gu
*for those who arrived early.

19:00-21:00 **Welcome Dinner** at **Dongsim Restaurant**, 194-7, Dongdaegu-Ro
Limo bus will pick up in Hotel Lobby at 18:30

October 17, 2017

Meeting Location: *Meeting will be held in Bordeaux A & B Conference Rooms in Novotel*

Continental Breakfast at hotel - 8th floor restaurant
Breakfast begins at 6:30

8:00-8:30 Today's speakers/presenters plan to upload slides to computer

8:30-9:00 **Welcome New Friends, Goals of Meeting, and Introductions**

8:30-8:40 Welcome and Goals from conference co-chairs: *Sung-Jin Jeong, Korea Brain Research Institute (KBRI), Daegu, S. Korea & Karen S. Rommelfanger, Emory Center for Ethics, Atlanta, Georgia, USA*
8:40-8:50 Remarks from partners: *Kyungjin Kim, KBRI; Suk-Joon Hong, General Future Industry Promotion Bureau*
8:50-9:00 Introductions: Brief name/affiliation self-introductions of each participant

9:00-10:45 Global Brain Projects: Goals and inherent ethical questions initially identified
10min/speaker followed by discussion
Moderator: Karen Rommelfanger, Emory University Center for Ethics, Atlanta, Georgia, USA
This session should include a discussion of the values and beliefs that informed the basis of the selected research foci. Should science primarily/only be directed toward health, toward discovery, toward community, economy & innovation, competition, and national identity? How were these factors weighted in selecting research foci?

1. China Brain Project *Jialin Zheng, Tongji University, Shanghai, China*
2. EU Human Brain Project *Arleen Salles, Uppsala University, Sweden*
3. Japan Brain/MINDS *Kiyoto Kasai, University of Tokyo, Japan*
4. Korea Brain Initiative *Sung-Jin Jeong, Korea Brain Research Institute, Daegu, S. Korea*
5. US BRAIN Initiative *Lyric Jorgenson, National Institutes of Health, Bethesda, Maryland, USA*
6. Australian Brain Initiative *Patricia Michie, University of Newcastle, Australia*

10:45-11:00 ***Break***

11:00-12:00 Discussion of existing guidelines/principles/efforts on ethics of neurotechnologies
5-10min/speaker followed by discussion
Moderator: Ilina Singh, University of Oxford, England, UK
This session will include summary of existing guidelines/principles put forward by professional organizations or workshops. This will include the summary provided prior to the meeting along with draft principles from the OECD September meeting and the NIH BRAIN Neuroethics Division. Here we will work to identity key themes for breakout groups. Speakers will also discuss recurring themes, controversies and questions that have already been asked and still need to be addressed.

11:00-11:40
1. Organization for Economic Cooperation and Development (OECD): Neurotechnology and Society
Hermann Garden and David Winickoff, OECD, International, Paris, France
2. Neuroethics in Japan
Tamami Fukushi, Agency for Medical Research and Development (AMED) Japan
3. NIH BRAIN Neuroethics Division Neuroethics Guiding Principles
Khara Ramos, National Institutes of Health, Bethesda, Maryland, USA
4. Brain Machine Interface and Enhancement in Korea
Sung-Jin Jeong, Korea Brain Research Institute, Daegu, S. Korea

11:40-12:00 Discussion on Themes/Questions from Guidelines/Principles.
This session will be a group discussion where we determine – based on the discussion of guidelines – what the key questions are.

12:00-13:00 ***Lunch (Bordeaux B Meeting Room)***
Each table discusses and selects a representative to present <2min of one key question still an area of controversy or one consistent question that came to mind from earlier discussion in day. Each table presents at 12:45pm.

13:00-16:05 Case Studies: Cross-cultural perspectives and relevance to brain projects discussion
Presenters discuss case studies of technologies/research projects and provide alternative perspectives on ethical evaluation. This will inform the breakout group work the next 1.5 days
30min/case; Each case presenter and respondent has 5 minutes.
Moderator: Arisa Ema Riken Center for Advanced Intelligence Project, Tokyo, Japan

- 13:00-13:30 China Brain Project *Guoqiang Bi, University of Science and Technology, Hefei, China.*
Respondent: Paul Root Wolpe, Emory Center for Ethics
- 13:30-14:00 EU Human Brain Project *Arleen Salles, Uppsala University, Sweden*
Respondent: Osamu Sakura, University of Tokyo, Japan
- 14:00-14:30 Japan Brain/MINDS *Eisuke Nakazawa, University of Tokyo, Japan*
Respondent: Laura Specker Sullivan, Harvard Medical School, Boston, Massachusetts, USA

14:30-14:45 ***Break***

- 14:45-15:15 Korea Brain Initiative *Inyoung Lee, Hongik University, Seoul, S. Korea*
Respondent: Syd Johnson, Michigan Technological University, Houghton, Michigan, USA
- 15:15-15:45 US BRAIN Initiative *Khara Ramos, National Institutes of Health, Bethesda, Maryland, USA*
Respondent: Hagop Sarkissian, City University of New York, USA
- 15:45-16:05 Australian Brain Initiative *Adrian Carter, Monash University, Melbourne, Australia*
Respondent: Kevin Wu, National Taiwan University, Republic of China

16:05-16:20 ***Break***

16:20-17:20 What are main questions? Mind Map Exercise
Moderators: Paul Root Wolpe & Karen Rommelfanger, Emory University Center for Ethics, Atlanta, GA, USA
This session will be a group discussion where we determine – based on the discussion of guidelines – what the key questions are.

17:20-17:30 Closing: What have we learnt? What have we missed? Goals/Logistics for tomorrow.
Moderator: Karen Rommelfanger, Emory University Center for Ethics, Atlanta, GA, USA

18:00-21:00 Dinner & Reception at Novotel Ambassador
Kyungjin Kim and Sung-Jin Jeong reception remarks

October 18, 2017
Meeting Location: *Meeting will be held in Bordeaux A & B Conference Rooms in Novotel*

Continental Breakfast at hotel - 8th floor restaurant

9:00-9:15 **Welcome Old Friends:** Recap of Day One and Goals/Logistics for today
Sung-Jin Jeong, Korea Brain Research Institute (KBRI) Daegu, S. Korea &
Karen S. Rommelfanger, Emory University Center for Ethics, Atlanta, Georgia, USA

9:15-9:45 **What do we agree upon? What have we missed?**
Moderators: Karen Rommelfanger, Emory University, USA & Ilina Singh, University of Oxford, UK
This session will be an opportunity for individuals to discuss what we might still need to discuss or discuss more deeply or remark on striking areas of consensus or difference. Discuss themes and number of breakout groups and instructions for breakout groups.

9:45-10:45 **Breakout Group Part I: Write summaries of questions**
In this session, groups will write a summary about their questions that should be asked across the brain projects relevant to their topic and how they might be approached from a cross cultural perspective; each group will need to select a group reporter/leader.

10:45-11:00 ***Break***

11:00-12:30 **Presentations of Summaries and Group Feedback**
<5 min/group x 4-5 groups and group feedback/discussion – any revisions of questions needed?

12:30-13:30 ***Working Lunch*** **Discussion: How to integrate these questions into brain projects**
Each table discusses and then presents <2min best idea/table at 13:10

13:30-14:30 **Breakout Group Part II: Edit drafts and include a few words about implementation**
In this session, groups will edit their summaries and refine based on our discussions and also if applicable suggest how to integrate a process of asking these questions within their research projects. Email to Karen these paragraphs by end of summit.

14:30-15:30 **Concluding Remarks and Next Steps**
Moderator: Karen Rommelfanger, Emory University, USA and Sung-Jin Jeong, KBRI, S. Korea
One comment or take away message from each participant. Timeline for next steps. Jinni discusses evening event.

16:00-20:00 **KBRI Tour, Cultural Excursion and Dinner** in Daegu City

CASE STUDIES

GLOBAL NEUROETHICS SUMMIT 2017

Deep Brain Stimulation (Australia Brain Initiative)

CASE STUDY

Jerry is a 65-year old man who was diagnosed with Parkinson's disease in 2008. He initially responded well to the medication but his motor symptoms gradually worsened despite large increases in drug doses that caused significant side effects. His neurologist suggested that he undergo deep brain stimulation to control his freezing and tremor. Surgery in 2012 significantly reduced his motor symptoms and Jerry was able to return to all the activities that he did before the onset of Parkinson's, such as bowling with friends, bushwalking with his wife, Shirley, and socialising at parties. Jerry was energetic and highly sociable; Shirley had never known Jerry to be so gregarious and full of life. Their sex life was reignited too, after being largely celibate prior to the surgery, although Shirley found his demands for sex were sometimes a bit too much.

In 2013, Jerry was charged with a having sexual intercourse with a minor. At trial, it became apparent that he had developed hypersexuality and had used prostitutes on over 500 occasions in the 18 months after surgery, including male and transgender prostitutes. He claims that he had not previously engaged in homosexual behaviour.

His neurologist believed that the deep brain stimulation had caused his hypersexuality, arguing that around 1 in 5 people who receive this treatment develop a compulsive behaviour (e.g. shopping, gambling). His stimulator was turned off: his compulsive sexual behaviours ceased but his severe motor symptoms returned, worse than before. He became bed ridden and needed to be cared for by his daughter because his wife left him.

For further discussion:
A subsequent scan of Jerry's computer reveals a single photo of child pornography in his files that predates his Parkinson's disease.

Identity and authenticity:

- Were these behaviours an authentic expression of who Jerry was? Was he responsible for them?
- Did the stimulation create new desires, thereby altering his sense of self, or did it simply unmask a latent tendency in Jerry?

Moral responsibility and agency:

- Should Jerry be held responsible for the criminal sexual act?
- Should Jerry have noticed increased sexual desires and sought help?
- Is he responsible for not getting help?
- Does the fact a scan of Jerry's computer reveals a single photo of child pornography in his files that predates his PD make us more willing to attribute responsibility to Jerry?

Consent and coercion:

- How should the clinician treat his Parkinson's disease?
- Can the state force Jerry to have the stimulator turned off if he refuses?

Preclinical Detection (China Brain Project)

CASE STUDY

(A) New tests (cognitive-behavioral, neuroimaging, eye tracking) are in development as early diagnostics for Alzheimer's Disease (AD). As part of their development, a large group of people has been enrolled in a longitudinal study of their effectiveness. The results of the study show that some participants have significantly higher risk for AD. However, there is currently no effective therapy for patients with AD, even if it is diagnosed before the onset of symptoms. Jingqiong participated in the study, and has emailed the study coordinator to find out her results.

- Should the study coordinator inform Jingqiong of her results?
- Should the study have been designed so that individual results would not be identifiable?
- Does Jingqiong's reason for requesting her results matter? For example, she may have a grandmother with AD and just be anxious to know her status, or she might want to enroll in a clinical trial of treatment for persons susceptible to AD.
- If Jingqiong is informed of her results, must all participants be contacted and offered disclosure of their results?
- Is it ethical to conduct a study to diagnose diseases early, when no effective treatment for the disease yet exists?

(B) The study coordinator decides to inform Jingqiong of her results – she is indeed at higher risk for developing AD. The next day the director of the department in which the study was conducted receives an angry phone call from Jingqiong's mother. "How could you tell my daughter that she will develop Alzheimer's?" she asks. "Now she has broken off her engagement and says that she will never have a child. How could you do this to our family?"

- Was the study coordinator wrong to inform Jingqiong of her results?
- Is it unethical to inform participants of diagnoses for which there is no effective treatment?
- Is a higher risk of developing AD relevant to individuals alone, or this information that whole families ought to know?

Finding the right balance? (EU Human Brain Project)

CASE STUDY

Dr X is the PI for a research project that studies the neural mechanisms of behavioural and cognitive processes and brain states. Her project is part of a large scale European initiative that aims to achieve a fuller understanding of the human brain, better diagnoses and treatment of brain disorders, and the development of new brain-like technologies.

Dr X's task requires data on brain dynamics during the performance of a number of specific cognitive and behavioural tasks, from simple skills found in non human species to higher cognitive functions only found in primates. Dr X and her team do not carry out experiments themselves. However, their work requires data mining of existing human and non human animal studies in order to develop models of the neurocognitive architectures of higher cognitive functions.

Dr X and her lab are facing a challenge. When they use and analyze data produced inside the EU such data has been collected through animal research regulated by European legislation and, due to the principle of subsidiarity, is assumed to be compliant with Directive 2010/63/EU. However, the subsidiarity principle cannot be applied to data from countries outside the EU. So how to handle the issue of data coming from research that cannot automatically be assumed to match European requirements? In particular, Dr. X is working in a data integration project that has the explicit goal to make data available to all, within and without the project. While one possible option is to rule out such data in general, Dr. X is trying to find a balance.

In particular, she is concerned with non-human primate (NHP) data. European legislation is stringent regarding research with NHPs: while the relevant Directive allows for NHP research, it also states that "the use of non human primates should be permitted only in those biomedical areas essential for the benefit of human beings for which no other alternative replacement methods are yet available." Most of her colleagues and Dr X herself agree with such legislation. They share the moral intuition that research with animals in general needs strict regulation and that NHP in particular deserve special protections. At the same time, she knows that important research on NHP is carried out abroad. She is also aware that some results of this research are highly valuable, perhaps even indispensable in helping to solve the scientific questions of her own project. She wonders, will she be able to advance her research on the human brain without using such data? She is not just concerned about her specific line of research: she wonders whether a data integration project can be successful if it cannot make NHP derived data available to its users. Even further, will the project she is part of be able to engage the relevant scientific communities? How to find the right balance?

Questions:

- Is it morally acceptable to reject NHP derived data from non EU countries because it does not comply with existing European regulations?
- When is a biomedical research "essential for the benefit of human beings"? From a moral perspective if Dr X's research requires data that non-EU repositories offer, should she use it even if not collected in accordance with EU regulations?
- Is this a case in which moral considerations trump legal considerations? Considering that specific moral ideas underlie EU legislation and regulation, how to move forward?
- Considering the difference in regulatory frameworks and moral intuitions regarding issues such as NHP research (or dual use) how can international collaboration be implemented in practice in the context of brain research?

Neurofeedback (Japan Brain/MINDS)

BACKGROUND

Neurofeedback technology is being explored to treat various disorders including depression, developmental disorders, schizophrenia, and chronic pain. Recent neurofeedback, such as decoded neurofeedback (DECNEF) is characterized by intervention in human capacities using fMRI (fMRI was originally developed for observation of brain activity, not for intervention). With DECNEF, neural activation patterns are recorded. Then an individual is "trained" to match these patterns. DECNEF participants are asked to--without explicit instruction about what precisely they should do or think and without the stimulus--to induce a specific activation pattern in their brains, one that matches the "blueprint" or "template."

For example, in an experiment by Shibata et al, 2011, a template of brain activation created by individuals who had viewed a visual stimulus with a specific orientation of gratings. They describe how then, "With an online-feedback method that uses decoded fMRI signals, we induced activity patterns only in early visual cortex corresponding to an orientation without stimulus presentation or participants' awareness of what was to be learned". (Shibata et al. 2011, 1413).

DECNEF is a technique that aims to modify the state of a participant's neural network through real-time feedback with fMRI (rtfMRI) generated by machine learning (versus conscious learning on the part of the participant) of pattern analysis of voxel space of fMRI.

From Nakazawa et al, 2016, "Their study showed that neurofeedback using rtfMRI has two main advantages. First, it allowed the modification of brain activity without any pharmacological interventions in the body or brain. Thus, this novel treatment could be performed in a drug-free manner. The second advantage is that the repetition of visual stimuli was not necessary for learning. This suggests that using simple visual feedback may promote and allow better recovery of cognitive functions, such as memory retention and emotional control, or better treatment of visual disorders.

Furthermore, this technique may have further applications, such as the treatment of mental illnesses and the enhancement of human faculties. For instance, if we compare the differences in the default mode network (DMN) activity between healthy individuals and patients with mental disorders, it may become possible to adjust the DMN activity of patients with mental disorders using neurofeedback (cf. Ministry of Education 2011). This is also true of enhancement of human faculties." (Nakazawa et al, 2016, 111).

The project is supported by Strategic Research Program for Brain Sciences (SRPBS), which--like as Brain/MINDS--is under the umbrella of the Japan Agency for Medical Research and Development (AMED)-supported grants. Although the underlying mechanisms that allow the improvement or modification of an individual's cognitive (and perhaps even moral) capacities have not been elucidated, this technology has a wide range of potential applications (including learning, memory, and motor rehabilitation) and these applications may impact the society. However, it is difficult to assess the safety and efficacy of

neurofeedback-based interventions in clinical trials because of a shortage of reliable preclinical data.

CASE STUDY

Professor A's group at the hospital affiliated with B university school of medicine, has decided to start a Decoded Neurofeedback study that aims at enhancing interpersonal communication abilities for individuals with autism spectrum disorders (ASD). Ten participants are scheduled to participate in this study. Were this study to demonstrate the safety and efficacy of DECNEF to improving interpersonal communication, it may suggest obtainment of a new tool to control interpersonal communication ability in the future.

Questions

- How do one evaluate the invasiveness (and associated risks) of decoded neurofeedback technology?
- What measures are required to ensure the safety of neurofeedback technology?
- Is it ethically acceptable to use neurofeedback technology for applications beyond therapy, such as for enhancement?
- Patients with autism spectrum disorders questions what is the "typical" pattern of brain development from the perspective of diversity. How will the thresholds for typically developed versus ASD brain be determined for the purposed of neurofeedback?
- Trained machine learning algorithms become difficult to understand with regard to why particular responses occur to a set of data inputs. What considerations should be taken to ensure transparency and accountability of the "black box" these algorithms create?

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Amano K, Shibata K, Kawato M, Sasaki Y, Watanabe T: Learning to associate orientation with color in early visual areas by associative decoded fMRI neurofeedback. Curr Biol. 2016 Jul 25;26(14):1861-6.

Eisuke Nakazawa, Keiichiro Yamamoto, Koji Tachibana, Soichiro Toda, Yoshiyuki Takimoto, Akira Akabayashi. Ethics of decoded neurofeedback in clinical research, treatment, and moral enhancement. American Journal of Bioethics Neuroscience 7(2): 110-117.

Shibata K, Watanabe T, Sasaki Y, Kawato M. Perceptual learning incepted by decoded fMRI neurofeedback without stimulus presentation. Science. 2011 Dec 9;334(6061):1413-5.

Establishing Brain Banks (Korea Brain Initiative)

CASE STUDY

Due to its geographical location, Korea has a long-standing tradition of East Asian culture based on Confucianism, Buddhism, and Taoism, while having gone through rapid industrialization and modernization. Under the influence of Confucianism, dissection of a human body was strictly forbidden in premodern era. Today Koreans have very conservative views on the brain autopsy and demonstrate reluctance about removing the brain from the body. Opening and exploring the inside of the cranium is hardly conducted in Korea. Donating brains for research is unfamiliar to the general public, moreover, it faces vague rejection. A public consensus on related issues is lacking, and relevant laws are not sufficient to address these issues. In contrast, there are increased demands from the researchers and clinicians for using brain tissues obtained from autopsies, which demonstrates the need for legal reform and a shift in the general consensus.
So far, some major hospitals in Korea have been autonomously collecting brain tissue. Researchers had been urging the government to set up a brain repository, for the researches on brain-related diseases in Korea. The brain bank in Korea was recently launched and has collected donated brains from patients who died from the neurological disorders such as Parkinson's disease, Alzheimer's, epilepsy, autism.

- All human material including brain (optionally spinal code) are obtained on the basis of written informed consent. According to the Korean Organ Donation Act, if a brain -dead donor does not indicate the intention of organ donation in advance, organ don ation is permitted only with the consent of the bereaved family of the brain-dead per son is obtained. Is the consent to the bereaved family of the patient is ethically accept able in the case of brain donation too?

- A patient with Alzheimer's disease wanted to let his brain to be used in his physician 's research on Alzheimer's disease. He told his intention to the physician and indicate d his consent of brain donation. After the brain donation, Can the physician transfer a part of the donated brain to another research team beyond the patient's intention? Will be his behavior ethically acceptable?

- What kind of public campaigns or incentives could be launched to encourage brain d onation in ethical and responsible way?

Research with Human Cerebral Organoids (US BRAIN Initiative)

BACKGROUND

The possibility of developing and growing human organoids typically derived from human stem cells, including cerebral organoids, is an emerging area of science that holds great promise for advancing human health and neuroscience (Di Lullo and Kriegstein, 2017; Qian et al. 2017). Researchers have long sought to understand how the human brain functions in health and disease, with much of their work constrained to studies with animal models and post-mortem or pathological human brain tissue. In contrast, human cerebral organoids, grown *in vitro* from pluripotent stem cells, offer the potential for closer approximation of dynamic human brain development and function. At present, that approximation is still fairly limited. On one hand, cerebral organoids can generate diverse cell types, and self-organize into complex structures that resemble parts of the brain. On the other hand, they exhibit heterogeneity in terms of cell types and circuitry, and they don't include all cell types involved in normal brain development (Di Lullo and Kriegstein, 2017). Scientists are still working to understand cerebral organoids and develop this early-stage model system for more widespread use.

Human cerebral organoids also raise important ethical questions. Knowing that cerebral organoids are meant to model human brains and aspects of brain development or disease, but cannot develop into full persons, what are the relevant ethical considerations? Presumably these would be related to the development of human features, rather than the creation of human life. For instance, what morally concerning features might cerebral organoids develop, such as sensory perception, sentience, pain, or cognition (Munsie et al. 2017)? What biological indictors would reveal the development of those features? How can we think about a prospective framework for mitigating ethical risks while not inadvertently stifling promising areas of research inquiry?

CASE STUDY

Scientists in the Temple Lab are growing human cerebral organoids (generated from skin fibroblast-derived induced pluripotent stem cells) to study the effects of prenatal exposure to viruses on neurodevelopment. This research cannot ethically be performed *in vivo* on human embryos or fetuses. The research could provide valuable insights into the effects and prevention of neurodevelopmental insults. Identifying critical developmental periods of exposure could require maintaining the organoids *in vitro* for extended periods of time. Abby donated skin cells for this research. She hopes that the researchers will learn something that will help babies with microcephaly, but she is concerned about 'her' cerebral organoid. How much does it resemble her brain? Does it sense or think? Since it has no way to communicate, how would anyone know if it does?

Questions:

- What features/functions would warrant concern in cerebral organoids?
- Given that, unlike a brain, a cerebral organoid exists in a disembodied state, how would researchers know if/when these features are present?
    - What are the implications of having (or not having) the ability to detect these features/functions?
- What is the moral significance of neurodevelopmental milestones for cerebral organoids?
- Does the provenance of the cerebral organoids (cell lines, fetal tissue, donated embryos) matter in terms of potential concerns?
- What are the existing ethical and regulatory frameworks for cerebral organoids used in research?
    - How should we think about consent for research with cerebral organoids?
    - Should there be limits on allowable development of cerebral organoids?
    - If limits should exist, should the limits be defined by time or by identifiable features/functions?

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BRAIN PROJECTS

GLOBAL NEUROETHICS SUMMIT 2017

EXISTING BRAIN PROJECTS

Brain Project	*Aims*	*Ethics Component*	*Duration*	*Budget*
Australian Brain Initiative [AU] http://ausbrain.org.au/	- Foster a dynamic, thriving, and globally competitive technology sector based on a sophisticated, world-class brain science capability - Research scope encompasses psychology, behavioural sciences and neuroscience - Alliance aims to foster a dynamic, thriving, and globally competitive neurotechnology sector based on a sophisticated, world-class brain science capability - Understand healthy, optimal brain function; create advanced industries based on this understanding; identify causes and develop novel treatments for debilitating brain disorders; produce sustainable, collaborative networks of frontline brain researchers with the capacity to unlock the mysteries of the brain and ensure the social, health and economic benefit of all Australians	- Neuroethics committee formed for future Australian Brain Initiative - Due to release discussion paper in October	5 – 10 years	$500 million
China Brain Project: Brain Science and Brain-like Intelligence Technology [CN]	- Study neural basis of cognitive functions - Two supplementary components: (1) improvement and development of diagnoses and therapies for major brain disorders and (2) development of brain-machine intelligence technologies	- Unknown	TBD	N/A

Brain Project	*Aims*	*Ethics Component*	*Duration*	*Budget*
Human Brain Project [EU] https://humanbrainproject.eu/	- Build a new ICT infrastructure for neuroscience and brain-related research in medicine and computing, catalysing a global collaborative effort to understand the human brain and its diseases and ultimately to emulate its computational capabilities. Three strategic focuses: **Future Medicine:** Develop an objective, biologically grounded map of neurological and psychiatric diseases to classify and diagnose brain diseases and configure relevant models; use *in silico* experimentation to understand the causes of brain diseases and develop new drugs and other treatments **Future Neuroscience:** Achieve a unified, multi-level understanding of the human brain integrating data and knowledge about the brain across all levels of biological organization **Future Computing:** Develop novel neuromorphic and neurorobotic technologies based on the brain's circuitry and computing principles	- Approximately 4.5 % of budget directed to the Ethics and Society subproject, responsible for a- research in philosophy and the social sciences, b- ensuring compliance with relevant ethical and legal and ethical norms and regulations - Primary focuses (thus far): privacy and data protection, ethics of simulation and consciousness, dual use, researchers' awareness - Ethics Advisory Board - Ethics Rapporteurs (privacy, non-human primates research)	2013 - 2023	$1.2 billion total
Brain Mapping by Integrated Neurotechnologies for Disease Studies (Brain/MINDS) [JP] http://brainminds.jp/en/	- Map the marmoset brain to gain a better understanding of the human brain and develop strategies for diagnosis and treatment of human psychiatric and neurological disorders - 3 groups of objectives: (1) The Structural and Functional Mapping of Marmoset Brain group, (2) The Development of Innovative Neurotechnologies for Brain Mapping group, and (3) The Human Brain Mapping and Clinical Research Group	- The establishment of an ethical component is in progress	2014 - 2024	$30 million/year (total of $310 million)

Brain Project	*Aims*	*Ethics Component*	*Duration*	*Budget*
Korea Brain Initiative [KR]	- Enable understanding of higher brain function and develop treatments for mental and neurological disorders - Focus on (1) constructing brain maps at multiple scales, (2) developing neurotechnologies for brain mapping, (3) strengthening AI-related R&D, and (4) developing treatment for neurological disorders	- Neuroethics committee formed	2016 - 2026	$50 million/year (total of $350 million)
Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative [US] https://braininitiative.nih.gov/	- Accelerate development and application of innovative neurotechnologies to construct a dynamic picture of brain function - Ultimately understand how dynamic patterns of neural activity are transformed into perception, emotion, cognition, and action in health and disease - Emphasis on understanding and modulating brain circuit function	- Established Neuroethics Division of the NIH BRAIN Multi-Council Working Group- NIH BRAIN strategic plan (*BRAIN 2025*) emphasizes consideration of ethical implications of neuroscience research, with specific ethics goals	2013 - 2026	$260M in FY2017 *BRAIN 2025* outlines professional judgment budget through 2026

NEUROETHICS GUIDELINES

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EXISTING NEUROETHICS GUIDELINES

A source of summarized aims and results of workshops, conferences, etc. that have provided currently existing neurotechnology guidelines

Prepared by: Sol Lee & Stepheni Uh

Abbreviations:

CED = cognitive enhancement device
HPE = human performance enhancement
DBS = deep brain stimulation
BCI = brain-computer interface

Meeting/Source

Grand Challenges for Global Brain Sciences (Global Brain Workshop, 2016) https://arxiv.org/ftp/arxiv/papers/1608/1608.06548.pdf	**Aims:** • Discussion with 60+ scientists from around the world to identify grand challenges (significant, feasible, inclusive) for global brain sciences
	Outcomes: • 3 grand challenges: (1) create virtual "NeuroZoo" by mapping brains of multiple species to determine what makes human brains unique, (2) produce multiscale models of neural systems from coordinated investigation within naturalistic environments to understand how the brain solves complex computational problems, and (3) augment clinical-decision making by incorporating neural mechanisms of dysfunction • Plans for deploying universal-cloud resource of data for the grand challenges and steps to enhance cross-cultural understanding and collaboration to fuel global brain sciences

Meeting/Source

Proceedings of the Fourth Annual Deep Brain Stimulation Think Tank: A Review of Emerging Issues and Technologies (Deeb et al., 2016) https://www.ncbi.nlm.nih.gov/pubmed/27920671	**Aims:** • Review current progress in technological advances and use of DBS to treat neurological and neuropsychiatric disorders **Outcomes:** • Updated state of research, new findings, and discussion on policy and regulatory issues; proposed optimizations • Noted that as field and applications of DPS are expanding, the future status and trajectory of DBS research and use in clinical practice my change • Future of DBS therapy relies on continuing innovation and cooperation of stakeholders (patients, scientists, engineers, physicians, ethicists, administrators, policy makers)
Human Performance Enhancement (HPE) Workshop (American Academy of Arts and Sciences, 2016) https://www.amacad.org/content/publications/pubContent.aspx?d=22348	**Aims:** • Review and analyze current state of research and policy discourse on HPE (i.e., ethical and legal framework of CED regulation) • Develop research agenda for multiyear study to enhance understanding of HPE and identify issues for further consideration **Outcomes:** • Addressed lack of clarity in regulation of CEDs (i.e., are they medical devices?); suggested public database for post-market CED surveillance data to monitor safety, efficacy, and privacy; discussed CED usage by different age groups and possible overall consequences such as social inequities and skewed workplace expectations • Future work: (1) multidisciplinary roundtable discussions for CED safety and regulation measures, (2) consideration of possible long-term scenarios of impacts of neuromodulation at individual and societal levels

Meeting/Source

Cognitive Enhancement and Beyond: Recommendations from the Bioethics Commision (Allen & Strand, 2015) http://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(15)00178-3	**Aims:** • Address issue of media claims regarding the "epidemic" rise of CE despite lack of evidence • Broaden discussion of CE to include all forms of neural modification ("neural modifiers")
	Outcomes: • Cautioned that neuroscience research is subject to media exaggeration • 5 Recommendations for Ethical Research and the Use of Neural Modifiers: (1) prioritize existing strategies to maintain and improve neural health, (2) prioritize treatment of neurological disorders, (3) study novel neural modifiers to augment/enhance neural function, (4) ensure equitable access to novel neural modifiers to augment/enhance neural function, (5) create guidance about the use of neural modifiers
Non-Invasive Neuromodulation of the Central Nervous System: A Workshop (Forum on Neuroscience and Nervous System Disorders, 2015) http://www.nationalacademies.org/hmd/Activities/Research/NeuroForum/2015-MAR-2.aspx	**Aims:** • Explore opportunities, challenges, and ethical questions surrounding the development, regulation, and reimbursement of non-invasive neuromodulation devices for both therapeutic and non-therapeutic uses with range of stakeholders (e.g., developers, researchers, clinicians, ethicists, regulators, payers)
	Outcomes: • Published report highlighting main points of presentation and discussion of workshop (https://www.ncbi.nlm.nih.gov/pubmed/26225405) • Topics included need for global collaboration and consultation to discuss device development regulations and reimbursement, to enhance understanding of safety and efficacy of non-invasive neuromodulation, and to clarify definitions of treatment vs. enhancement

Meeting/Source

Gray Matters: Integrative Approaches for Neuroscience, Ethics, and Society, Volume II (Presidential Commission for the Study of Bioethical Issues, 2015) http://bioethics.gov/sites/default/files/Gray Matter_V2_508.pdf	**Aims:** • Broadly consider ethical and societal implications of neuroscience research and its applications • Focus on 3 pertinent topics: cognitive enhancement, consent capacity, and neuroscience and the legal system **Outcomes:** • 9 public meetings with diverse experts and stakeholders • 14 recommendations to guide ethical progress of neuroscience research and its applications with regards to: justice and stigmatization of groups and individuals; research to clarify persistent questions and fill gaps in current state of knowledge; accurate communication about ethical and practical implications and application of neuroscience research results; clarity around legal requirements and new guidance where needed; and need to support and advance innovative multidisciplinary research
Gray Matters: Integrative Approaches for Neuroscience, Ethics, and Society, Volume I (Presidential Commission for the Study of Bioethical Issues, 2014) http://www.bioethics.gov/sites/default/files/Gray%20Matters%20Vol%201.pdf	**Aims:** • Analyze why and how to achieve ethics integration early and explicitly throughout neuroscience research **Outcomes:** • 3 public meetings with diverse speakers including neuroscientists, philosophers, educators, ethicists, employees in the federal and private sectors involved in the BRAIN Initiative • 4 recommendations to facilitate successful integration of ethics and neuroscience research: (1) institutions and individuals should take steps to make explicit their plans and (2) provide sufficient resources for integrating ethics, (3) institutions and researchers should evaluate existing and innovative approaches to integrating ethics and neuroscience, (4) professionals with experience in ethics should be included in BRAIN Initiative-related advisory boards and funding review committees

Meeting/Source

Consensus on guidelines for stereotactic neurosurgery for psychiatric disorders (Nuttin et al., 2014) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4145431/	**Aims:** • Elaborate on existing guidelines for safe and ethical conduct of neurosurgical procedures for psychiatric disorders and adopt a pragmatic worldwide set of guidelines to enhance patient safety
	Outcomes: • Stereotactic ablative procedures, while considered 'established' in some countries, still lack level I evidence • DBS in any brain target is still at an investigational stage • Researchers encouraged to design relevant randomized controlled trials, and noted that experienced multidisciplinary teams are required for safe and ethical conduct of any psychiatric neurosurgery
Novel neurotechnologies: intervening in the brain (Nuffield Council on Bioethics, 2013) https://nuffieldbioethics.org/wp-content/uploads/2013/06/Novel_neurotechnologies_report_PDF_web_0.pdf	**Aims:** • Identify and consider the ethical, legal and social issues that arise from the use of novel neurotechnologies to intervene in the human brain in clinical practice and non-medical settings • Explore ethical issues from the communication and representation of neuroscientific research to intervene in the brain in the media and by researchers • Make recommendations for research, policy, governance, and public engagement
	Outcomes: • 298-page report with cross-cutting themes: supporting innovation while protecting patients, providing access to novel therapies while safeguarding vulnerable individuals, maintaining trust about limits of current knowledge, collecting evidence while preserving scientific integrity, and treating brain disorders while monitoring impacts whole person • Recommended: responsible research governance, effective and proportionate oversight, high standards of care for patients, making existing evidence transparent and accessible, protecting interests of users in non-therapeutic contexts, responsible communication

Meeting/Source

Responding to requests from adult patients for neuroenhancements. Guidance of the Ethics, Law and Humanities Committee (Larriviere D, et al., 2013) https://www.aan.com/uploadedFiles/Website_Library_Assets/Documents/6.Public_Policy/1.Stay_Informed/2.Position_Statements/3.PDFs_of_all_Position_Statements/adult.pdf	**Aims:** • Provide overview of ethical, legal, and social issues regarding request of pharmaceuticals for neuroenhancement by "normal adult patients" and how to respond to these requests
	Outcomes: • 14-item guide for requests for neuroenhancement medication • Suggested that neurologists should make the ultimate decision on whether to prescribe neuroenhancement medications in accordance with the laws in their states of practice • Careful consideration needed for future issue of neuroenhancement for normal children
The Asilomar Survey: Stakeholders' Opinions on Ethical Issues Related to Brain-Computer Interfacing (Nijboer, Clausen, Allison, & Hasellager, 2011) https://link.springer.com/article/10.1007/s12152-011-9132-6	**Aims:** • Survey 145 BCI researchers on ethical issues important for BCIs and on issues such as terminology, criteria for BCI definition, expected marketability, and matters of urgency
	Outcomes: • Recommended actions: additional collaborative efforts like workshops, special sessions, web-based meetings, joint publications, and exploration of legal issues such as liability, privacy, and personal identity
Brain Waves 1: Neuroscience, society, and policy (The Royal Society, 2011) https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2011/4294974932.pdf	**Aims:** • As a part of 4 'modules,' to explore neuroscience results, implications, and potential benefits and risks • Provides a primer of current developments and highlights interesting issues and questions for science and policy
	Outcomes: • Reviewed state of development neuroimaging, neuropsychopharmacology, and neural interfaces • Recommended principles for social appraisal of neuroscience and neurotechnology: responsibility (independence from outside interests, accountability, transparency), precaution (justification and implications of applications), and engagement (access, public engagement)

Meeting/Source

Brain Waves 2: Neuroscience: implications for education and lifelong learning (The Royal Society, 2011) https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2011/4294975733.pdf	**Aims:** • Begin dialogue between research community, policy officials, and educational professionals to assess how educational policies can be enhanced with neuroscientific evidence **Outcomes:** • Recommendations: (1) neuroscience should be used as a tool in educational policy, (2) training and continued professional development should include a component of neuroscience relevant to educational issues, (3) neuroscience should inform adaptive learning technology, and (4) "knowledge exchange network" is required for neuroscientific progress
Brain Waves 3: Neuroscience, conflict and security (The Royal Society, 2011) https://royalsociety.org/~/media/Royal_Society_Content/policy/projects/brain-waves/2012-02-06-BW3.pdf	**Aims:** • Examine potential military and law enforcement applications of neuroscience including resulting opportunities and risks **Outcomes:** • 10 recommendations for the scientific and international community and the UK government, emphasizing: • Neuroscientists should be taught to be aware of dual-use challenges from an early part of their training • Developing safe incapacitating chemical weapons is not feasible because of size/health/age of the target population, secondary injury, and requirement for medical aftercare • Countries should address definition and status of incapacitating chemical weapons
Brain Waves 4: Neuroscience and the law (The Royal Society, 2011) https://royalsociety.org/~/media/Royal_Society_Content/policy/projects/brain-waves/Brain-Waves-4.pdf	**Aims:** • Discuss the important practical implications of recent neuroscience discoveries, including: risk assessment in probation and parole decisions, detecting deception, assessing memory, understanding pain, and Non-Accidental Head Injury **Outcomes:** • 5 recommendations across 3 broad topics: (1) bridging the gap between neuroscientific research and realities of legal system; (2) professionals in the legal system who might encounter neuroscience should understand its basic principles, limitations, and application challenges; (3) lack of research targeted to non-health sectors (i.e. education, law)

Meeting/Source

New Directions: The Ethics of Synthetic Biology and Emerging Technologies (Presidential Commission for the Study of Bioethical Issues, 2010) http://bioethics.gov/sites/default/files/PCSBI-Synthetic-Biology-Report-12.16.10_0.pdf	**Aims:** • Examine implications of emerging science of synthetic biology • Offer recommendations to ensure benefits of this developing field within appropriate ethical boundaries **Outcomes:** • Outlined five principles relevant to assessing ethical considerations related to emerging technologies: (1) Public Beneficence, (2) Responsible Stewardship, (3) Intellectual Freedom and Responsibility, (4) Democratic Deliberation, (5) Justice and Fairness
European Citizen's Assessment Report: Complete Results (Meeting of Minds; European Citizen's Deliberation on Brain Science, 2006) https://www.kbs-frb.be/en/Virtual-Library/2006/294903	**Aims:** • Provide detailed overview of deliberation process (from themes to issues to final recommendations) by 126 citizens from nine European countries on complex matters of brain sciences, not reported in final report to Parliament **Outcomes:** • Highlighted the significance of and need for the general public's participation in shaping brain science policy • After 3 national meetings in each participating country and 2 European meetings, 37 recommendations on Brain Sciences finalized within 6 broad, cross-cutting themes: (1) regulation and control, (2) normalcy vs. diversity, (3) public information, (4) pressure from economic interests, (5) equal access to treatment, (6) freedom of choice
Non-invasive research on human brain function (The Japanese Neuroscience Society, 2009) http://www.jnss.org/en/guideline/rinri/	**Aims:** • Revise 2002 guidelines on the implementation of non-invasive neurotechnology for human brain function research **Outcomes:** • Provided overview, effectiveness, risks, testing guidelines, and explanatory documents for human participants in research studies using the following neurotechnologies: MEG, TMS, PET, fMRI, NIRS, neuropsychological assessments, Brain Machine Interface, and research involving genome/genomic analysis • Addressed ethical issues directly in relation to subject participation in research studies by outlining approaches to informed consent, privacy protection, and precautions when presenting results at conferences and in academic journals

NEUROETHICS GUIDELINES ANALYSIS

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NEUROETHICS GUIDELINES ANALYSIS

An analysis of existing neuroethics/neurotechnology/neuroscience recommendations from five sources, which were commonly identified as important sources in literature reviews done by Global Neuroethics Summit and OECD members

Prepared by: Sol Lee & Stepheni Uh

Recommendations/instruments analyzed:

1. **European Citizens' Assessment Report** (Meeting of Minds, 2006)
2. **Brain Waves Module 1: Neuroscience, society and policy** (The Royal Society, 2011)
3. **Novel neurotechnologies: intervening in the brain** (Nuffield Council on Bioethics, 2013)
4. **Gray Matters, Vol. I** (Presidential Commission for the Study of Bioethical Issues, 2014)
5. **Gray Matters, Vol. II** (Presidential Commission for the Study of Bioethical Issues, 2015)

Areas of commonality:

General Themes

- Justice and equity: access and control of access to neurotechnology and its benefits
- Privacy
- Cognitive enhancement and neuropsychopharmacology
- Safety and patient protection
- Capacity and consent
- Agency and autonomy
- Legal system: criminal justice
- Dual use
- Neural and brain interfaces
- Trascranial brain stimulation and deep brain stimulation

Recommendations

- Include diverse individuals (e.g., experts, community) in advisory boards, funding review committees, etc.
- Public engagement and education of both neuroscience and neuroethics
- Accurate communication and transparency about ethical and practical implications and applications of neuroscience research results
- Incorporation and funding of ethics research

Unique points of emphasis:

1. *European Citizen's Assessment Report: Complete Results*
(Meeting of Minds, 2006)

- Advocates diversity over normalcy, avoiding medicalizing society
- Recognizes pressure from economic interests (pharmaceutical research with low-profit potential)
- Focuses more on social implications for the general public and direct interaction with them for neuroscience recommendations

2. *Brain Waves Module 1*
(The Royal Society, 2011)

- Reviews current state of development in neuroscience and neurotechnology
- Addresses neuromarketing and its role in decision making science (consumer behavior) for businesses

3. *Novel neurotechnologies: intervening in the brain*
(Nuffield Council on Bioethics, 2013)

- Details possible exploitation of intellectual property rights (e.g., more risky explorations of possible solutions) on marketable neurotechnology to meet expectations of investors
- Notes novel neurotechnologies often enter "valley of death" due to lack of funding during process of translating research into commercial products
- Recommends making existing evidence of neurotechnologies transparent for public understanding and trust
- Includes stem cell tourism as a potential result of natural stem cell therapies
- Compares beneficence vs. uncertainty
- Outlines caution vs. precautionary issues in neurotechnology

4. *Gray Matters: Integrative Approaches for Neuroscience, Ethics and Society, Volume I*
(Presidential Commission for the Study of Bioethical Issues, 2014)

- Includes societal and ethical concerns of dementia research: how dementia affects notion of self/selfhood overall, preferences (pre- vs. post-dementia), decision-making capacity
- Emphasizes distinction between treatment and enhancement

5. *Gray Matters: Integrative Approaches for Neuroscience, Ethics and Society, Volume II*
(Presidential Commission for the Study of Bioethical Issues, 2015)

- Recommends legal system and affiliated bodies to develop, expand, and promote training resources to understand application of neuroscience for jurors, judges, attorneys, and public (i.e., publish challenges/limitations of neuroscience application, provide leveled interpretation of neuroscientific evidence)

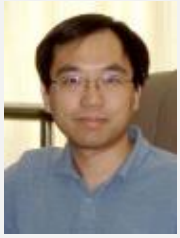
PARTICIPANT BIOGRAPHIES

GLOBAL NEUROETHICS SUMMIT 2017

PARTICIPANTS

Name	*Biography*
Karen Rommelfanger Co-chair 	Dr. Karen S. Rommelfanger received her PhD in neuroscience and postdoctoral training in neuroscience and neuroethics. Her research explores how evolving neuroscience and neurotechnologies challenge societal definitions of disease and medicine. Dr. Rommelfanger is an Assistant Professor in the Departments of Neurology and Psychiatry and Behavioral Sciences, the Neuroethics Program Director at Emory University's Center for Ethics, and Senior Associate Editor at the *American Journal of Bioethics Neuroscience.* In recognition of her leadership in the neuroethics community, Dr. Rommelfanger was appointed to the NIH BRAIN Initiative's Neuroethics Division and acts as the Division ambassador to the Human Brain Project Ethics Advisory Board. She is dedicated to cross-cultural work in neuroethics and also serves as ethicist to the China-India Mental Health Alliance. A key part of her work is fostering communication across multiple stakeholders in neuroscience. As such she edits the largest international online neuroethics discussion forum *The Neuroethics Blog* and is a frequent contributor and commentator in popular media such as *The New York Times*, *USA Today* and *The Huffington Post*. *Affiliation*: Emory University Center for Ethics; US BRAIN Initiative Neuroethics Division *Contact*: krommel@emory.edu
Sung-Jin Jeong Co-chair 	Sung-Jin Jeong is a principal Researcher at the Korea Brain Research Institute. She received her Ph.D. in Molecular Biology from Seoul National University, and then worked as a Research Fellow at Massachusetts General Hospital for seven years. She then worked as a Research Fellow and Staff Scientist at Children's Hospital Boston, before joining the Korea Brain Research Institute in 2013. Dr. Jeong recently published an article in *Neuron*, describing the history and goals of the Korea Brain Initiative. This initiative is centered on deciphering the brain functions and mechanisms that underlie decision-making, and the major goal is to map a functional connectome of the brain. The project also encourages the development of novel techniques and technologies, and should ultimately have socioeconomic ramifications that facilitate global collaboration across the world. *Affiliation*: Korea Brain Research Institute | *Contact*: jinni1970@gmail.com
Jordan Amadio 	Jordan Amadio, M.D., M.B.A. is a practicing neurosurgeon, the Innovation Fellow of the Congress of Neurological Surgeons, and a founding partner of NeuroLaunch, a pioneering neuroscience venture accelerator. A graduate of Princeton University, he was simultaneously awarded the Kusaka Memorial Prize in Physics and the Taylor Prize in Physics in 2004. He earned his M.D. degree from Harvard Medical School, where he was a research fellow in neurogenetics and was selected to complete his training in the Health Sciences and Technology (HST) program co-administered by the Massachusetts Institute of Technology. He was also among the first cohort of physicians to graduate with a concurrent Master's in Business Administration (with Distinction) from Harvard Business School. He completed his training in Neurosurgery at Emory University School of Medicine in Atlanta, where he served as Chief Resident in 2016-17. Dr. Amadio's professional experience includes leadership in neurosurgery, neuroethics, bioengineering innovation, and health entrepreneurship. His scientific publications include research on electrolyte disturbances after pituitary surgery, emerging techniques in neuromodulation, and the role of guidelines in promoting surgical quality. His popular writing and expert commentary has been featured by media outlets such as *The Associated Press*, *The Independent, Natural History, Cell, Nature Publishing Group*, and *BBC*. In 2015, as guest editor, he led the creation of the first issue of the *AMA Journal of Ethics* devoted to neurosurgical ethics. *Affiliation*: Emory University; Harvard University; NeuroLaunch *Contact*: amadio@gmail.com

Guo-Qiang Bi



Guo-Qiang Bi received his B.S. in physics from Peking University (1989), M.S. in physics from New York University (1991) and Ph.D. in biophysics from University of California at Berkeley (1996). He was postdoctoral fellow at University of California at San Diego (1996-2000). He was appointed as Assistant Professor at the Department of Neurobiology, University of Pittsburgh School of Medicine in 2000, where he was promoted to Associate Professor with tenure. In 2007, he established the Laboratory of Neurophysics at the University of Science and Technology of China, where he is Xinchuang Professor and Changjiang Scholar. He has served as Chair of the Department of Neurobiology and Biophysics at USTC, and founding co-Director of the Center for Integrative Imaging at Hefei National Laboratory for Physical Sciences at the Microscale. His research focuses on understanding the structure and function of neuronal synapses and circuits. To this end, he and colleagues are developing new microscopy tools for imaging at different scales.

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Felicity Callard

Felicity Callard is Professor of Social Science for Medical Humanities at Durham University (Department of Geography and Centre for Medical Humanities). In September, 2017, she joins Birkbeck, University of London as Professor of Social Research (and Director of the interdisciplinary Institute for Social Research). Her research focuses on the intertwinements of psychiatry, psychology, the neurosciences and the social sciences in the twentieth and twenty-first centuries. She is currently researching mind-wandering and daydreaming — conceptually, empirically, and historically — across the social sciences and neurosciences.

From 2014–16, she directed Hubbub (the first interdisciplinary residency of The Hub at Wellcome Collection, London), leading a team of social scientists, cognitive neuroscientists, humanities scholars and artists in investigations of rest (including resting state fMRI) and its opposites. She is co-author of *Rethinking Interdisciplinarity across the Social Sciences and Neurosciences* (Palgrave Macmillan, 2015), and Editor-in-Chief of the journal *History of the Human Sciences*. She also has a strong interest in mental health policy as well as practice: she was Chair of the Board of the international NGO *Validity* (previously named the *Mental Disability Advocacy Centre*); chairs the governance committee of the Clinical Records Interactive Search (which is believed to be the largest anonymized database of mental health records in Europe); and is the ethics advisor for RADAR-CNS, a collaborative research programme on the potential of wearable devices to help prevent and treat depression, multiple sclerosis, and epilepsy.

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Adrian Carter

Dr. Adrian Carter is an NHMRC Career Development and Senior Research Fellow and Head, Neuroethics and Public Policy Group at the School of Psychological Sciences and Monash Institute of Cognitive and Clinical Neurosciences, Monash University. He is also Director, Neuroethics Program, Australian Research Council Centre of Excellence for Integrative Brain Function and Chair, Australian Brain Alliance Neuroethics Subcommittee, Australian Academy of Science. His research examines the impact of neuroscience on our understanding and treatment of addiction and other compulsive behaviours, including: agency, identity, moral responsibility, the use of coercion and the capacity for voluntary control of addictive or compulsive behaviours; and the use of emerging technologies such as brain stimulation and neuroimaging, to treat addiction. He received the Australasian Professional Society of Alcohol and Other Drugs "Early Career Award for Excellence in Research and Science" (2012) and the Australian National Drug and Alcohol Award for Excellence in Research (2010). He has over 120 publications, including the book 'Addiction Neuroethics: The Promises and Perils of Addiction Neuroscience' (Cambridge University Press, 2012). Dr Carter has been an advisor to the World Health Organization, the European Monitoring Centre for Drugs and Drug Addiction, the Australian Ministerial Council on Drugs Strategy and United Nations Office on Drugs and Crime. He is also Deputy Chair of the Australian Academy of Science Early and Mid Career Research Forum Executive.

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Anna Devor

Dr. Anna Devor received her initial research training at the interface between the experimental and computational neuroscience at Hebrew University of Jerusalem, Israel. Her PhD thesis focused on biophysical mechanisms of the membrane potential oscillations in a network of electrically coupled neurons. After defending her PhD thesis in 2002, she went on to specialize in brain imaging technology at Martinos Center for Biomedical Imaging at MGH. In 2005, she established an independent research laboratory at UC San Diego. Dr. Devor's research program is focused on real time detection of brain activity across scales: from cellular and molecular activity of neuronal circuits in animals to noninvasive brain imaging in humans. To this end, the Devor laboratory and their collaborators assemble a suite of micro- and nanoscopic technologies that, collectively, allow precise and quantitative probing of large numbers of the relevant physiological parameters. These multimodal measurements are then combined with system-level analysis/modeling, commonly used in engineering disciplines, to understand how specific patterns of microscopic brain activity (and their pathological departures) translate into noninvasive macroscopic observables obtained with functional Magnetic Resonance Imaging (fMRI) and magnetoencephalography (MEG). The overarching goal is to develop a single estimation framework for inference of neuronal network activity from multimodal human fMRI/MEG imaging data.

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Kenji Doya

Kenji Doya received his BS in 1984, MS in 1986, and Ph.D. in 1991 at U. Tokyo. He became a research associate at U. Tokyo in 1986, U. C. San Diego in 1991, and Salk Institute in 1993. He joined Advanced Telecommunications Research International (ATR) in 1994 and became the head of Computational Neurobiology Department, ATR Computational Neuroscience Laboratories in 2003. In 2004, he was appointed as the Principal Investigator of Neural Computation Unit, Okinawa Institute of Science and Technology (OIST) and started Okinawa Computational Neuroscience Course (OCNC) as the chief organizer. As OIST established itself as a graduate university in 2011, he became a Professor and served as the Vice Provost for Research. He serves as the Co-Editor in Chief of Neural Networks since 2008 and a board member of Japanese Neural Network Society (JNNS) and Japan Neuroscience Society (JNSS). He served as the Program Co-Chair of International Conference on Neural Information Processing (ICONIP) 2007 and 2016, the Program Chair of JNSS meeting in 2010, and the General Chair of JNNS meeting in 2011. He received Tsukahara Award and JSPS Award in 2007 and MEXT Prize for Science and Technology in 2012, and joined the College of Fellows of International Neural Network Society in 2013. He lead the MEXT project on "Prediction and Decision Making" project from 2011 to 2016 and currently leads a new MEXT project "Artificial Intelligence and Brain Science". He is interested in understanding the functions of basal ganglia and the cortical circuit based on the theory of reinforcement learning and Bayesian inference.

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Arisa Ema

Arisa Ema is Assistant Professor at the University of Tokyo and Visiting Researcher at RIKEN Center for Advanced Intelligence Project in Japan. She is a researcher in Science and Technology Studies (STS), and her primary interest is to investigate the benefits and risks of artificial intelligence by organizing an interdisciplinary research group. She is co-founder of Acceptable Intelligence with Responsibility Study Group (AIR) established in 2014, which seeks to address emerging issues and relationships between artificial intelligence and society. She is a member of the Ethics Committee of the Japanese Society for Artificial Intelligence (JSAI), which released the Japanese Society for Artificial Intelligence Society Ethical Guidelines in 2017. She is also one of the organizers of "IEEE Ethically Aligned Design, Version 1 Workshop in Japan" in the spring 2017. She obtained Ph.D. from the University of Tokyo in 2012 and previously held position as Assistant Professor at the Hakubi Center for Advanced Research, Kyoto University.

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Tamami Fukushi

Tamami Fukushi is the Deputy Manager in the Department of Research Infrastructure at Japan's Agency for Medical Research and Development (AMED). She started her career in Neuroethics in 2005 at the Research Institute of Science and Technology for Society (RISTEX), Japan Science and Technology Agency (JST) after 10 years of research in neural control of movement. Her current interest is ELSI of advanced technology of neuroscience in the context of science policy and regulatory science. She recently published a book titled "Social Implementation of Nepourodegenerative Disease Research and Neuroethics" In: Wada, K., (ed.) Neurodegenerative Disorders as Systemic Diseases. Pp.295-304, Springer and "Neuroethics in Japan" In: Rommelfanger, K., (ed.) Handbooks in Neuroethics. Routledge.

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Hermann Garden

My research and health policy interests are the development of innovative therapies and diagnostics for unmet medical needs and cross-sectoral collaboration. I trained in Biology and Pharmacy at the University of Düsseldorf, Germany: PhD in Biology (2003); graduation in Pharmacy (2004). I worked several years as the Deputy Head of the Pharmaceutical Medicines Unit at the Swiss Tropical and Public Health Institute, Basel. My passion for health system strengthening and product development partnerships stems from frequent work assignments in Sub-Saharan Africa. Subsequently I moved to the World Health Organization (WHO) where I coordinated the Better Medicines for Children project and the Paediatric medicines Regulators Network (PmRN). In 2011 I joined Novartis Vaccines and Diagnostics (Siena, Italy) as a Senior Clinical Research Scientist where I led clinical development programmes in pandemic and paediatric vaccines. In my current position as a Health Policy Analyst at the OECD (Science and Technology Policy Division) I support the Working Party on Biotechnology, Nanotechnology and Converging Technologies (BNCT); foci of my work are: the development and use of novel technologies in biomedical research and clinical application; advancing regulatory science; and, ethical, legal and social implications of emerging technologies.

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Judy Illes

Dr. Illes is Professor of Neurology and Canada Research Chair in Neuroethics at the University of British Columbia. She is Director of the National Core for Neuroethics at UBC, and faculty in the Centre for Brain Health at UBC and at the Vancouver Coastal Health Research Institute. She also holds affiliate appointments in the School of Population and Public Health and the School of Journalism at UBC, and in the Department of Computer Science and Engineering at the University of Washington in Seattle, WA. USA, and is a Life Member of Clare Hall, Cambridge University. Dr. Illes' research focuses on ethical, legal, social and policy challenges specifically at the intersection of the sciences of the central nervous system and biomedical ethics. This includes empirical studies in stem cells and regenerative medicine, neurogenetics, brain injury, aging and neurodevelopmental disorders, mental health and addictions, and the commercialization of neuroscience and personalization of health. Her research results in actionable practical guidance, frameworks for empowering the ethical development and communication of science, and evidence for informed policy-making. She also leads a robust program of research and outreach devoted to improving public literacy about brain research and engaging stakeholders on a global scale. technologies.

Dr. Illes is President of the International Neuroethics Society that she founded with others in 2006, and Vice Chair of the Standing Committee on Ethics for the Canadian Institutes of Health Research. She is a member of the Dana Alliance for Brain Initiatives and a Canadian representative to IBRO US-Canada Committee. Dr. Illes was elected to the Royal Society (Life Sciences) in 2012), to the Canadian Academy of Health Sciences in 2011, and to the American Association for the Advancement of Science (Neuroscience) in 2013. Her latest book (Oxford University Press, 2017) is *Neuroethics: Anticipating the Future.*

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Lyric Jorgenson

Lyric A. Jorgenson, Ph.D., is the Deputy Director for the Office of Science Policy at the National Institutes of Health. In this position, she provides senior leadership in the development and oversight of policies and programs associated with emerging, high-impact issues of importance to the biomedical research enterprise and the United States Government. Most recently, she was also the Deputy Executive Director of the White House Cancer Moonshot Task Force in the Office of the Vice President in the Obama administration, where she directed and coordinated cancer-related activities across the Federal government and worked to leverage investments across sectors to dramatically accelerate progress in cancer prevention, diagnosis, and treatment.

Prior to joining the Office of Science Policy, Dr. Jorgenson was a Health Science Policy Advisor and Analyst under the Deputy Director for Science, Outreach, and Policy at the National Institutes of Health, where she served a central role in creating new signature initiatives such as the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative and the National Center for Advancing Translational Sciences (NCATS). She was also an AAAS Science and Technology Fellow and has received numerous awards in recognition of her accomplishments and service.

Dr. Jorgenson earned a doctorate degree from the Graduate Program for Neuroscience at the University of Minnesota-Twin Cities where she conducted research in neurodevelopment with a focus on learning and memory systems. She earned a Bachelor's degree in Psychology from Denison University.

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Bang-Ook Jun

Bang-Ook Jun has been a Professor of Biology at Gangneung-Wonju National University since 1986. He received his Ph.D. in Seoul National University, Department of Botany in 1986. He completed Post-Doctoral course in University of Florida, Department of Botany. He had been a Visiting Professor of University of Calgary, Faculty of Communication and Culture and now he is a Visiting Professor of American University of Sovereign Nations, Arizona. He was the President of Gangneung-Wonju National University in 2012-2015. He had been the President of Korean Bioethics Association in 2008-2009. He has contributed to Asian Bioethics Association as Vice-President for Korea in 2010-2014 and as President since 2016. He wrote articles including "Ethical Issues on the Human Embryonic Genome Editing", "The Ethics of Therapeutic Gene Editing Research." His Main Research Focus is on the Ethics of Emerging Biotechnologies.

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Kiyoto Kasai

Kiyoto Kasai received his M.D. from The University of Tokyo (1995) and his Ph.D. in psychiatry from The University of Tokyo (2004). After a clinical residency in psychiatry at The University of Tokyo Hospital and National Center of Neurology and Psychiatry, he was appointed as Instructor at the Graduate School of Medicine, The University of Tokyo in 1999. Then he did his postdoctoral research training at the Department of Psychiatry, Harvard Medical School (2000-2002). After coming back to Japan, he was appointed as Lecturer at the Department of Neuropsychiatry, The University of Tokyo in 2003, and he was promoted to Professor and Chair in 2008. His research focuses on understanding the pathophysiology of psychiatric disorders using multi-modality neuroimaging techniques including MRI, EEG, MEG, and near-infrared spectroscopy (NIRS). He has published more than 260 international peer-reviewed papers. He has served as an Editorial Board Member for Lancet Psychiatry and npj Schizophrenia. He has also served as the Clinical Research Group Leader, Brain/MINDS.

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Kyungjin Kim

Kyungjin Kim is the president of the Korea Brain Research Institute (KBRI). KBRI is a government-funded research institute that strives to enhance the welfare of citizens and national competence by centralizing research on brain-convergence technologies. Dr. Kim received his Bachelor's and Master's at Seoul National University, as well as a doctoral degree for neurobiology at the University of Illinois.

Having served as the head of the Brain Function Exercise and Brain Illness Treatment Research Consortium, a part of the 21st Century Frontier Research & Development Project, Dr. Kim has made large contributions to legislation to encourage neuroscientific research, which has led to the foundation of KBRI. Before his appointment, Dr. Kim was the president of the Korea Brain Society and the president of the Korean Society for Brain and Neural Science. He has published more than 200 papers in domestic and international science journals and received the National Academy of Sciences Award in 2011.

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Inyoung Lee is Professor at Hongik University, College of Law. She received B.A, M.A, and Ph.D. degrees in Criminal Law in 1983, 1986 and 1994 at Yonsei University. She was a member of Korean National Bioethics Committee and the former president of the Korean Bioethics Society. She is a Chief of Editorial Board of Korea National Institute for Bioethics Policy. She is one of the organizers of Korean Neuroethics Study Group established in 2017. She has broad interest in ethical, legal and social implications of neuroscience. This includes the impact of neuroscientific research on human, neurogenetics, brain injury, adolescence brain science, and neurological evidence.

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Pat Michie

Dr. Pat Michie is currently Emeritus Professor of Psychology at the University of Newcastle, Australia. She is an experimental psychologist whose research has focussed on the neural basis of normal and abnormal cognition. She is a Fellow of the Academy of Social Sciences of Australia and is the 2016 recipient of the Australian Psychological Society's Distinguished Contribution to Psychological Science Award. Her research has been characterised by application of theories and methodologies from basic research in cognition and cognitive neuroscience to understand the nature of cognitive deficits and their neural basis in individuals diagnosed with schizophrenia and those at risk. Her research spans auditory processing deficits, impaired inhibitory control and cognitive control more generally and uses both psychophysical methods to assess performance as well as functional brain imaging methods such as event-related potentials (ERPs) of the brain. She was a key member of the Australian group who were the first to demonstrate that individuals with schizophrenia exhibit impaired automatic change detection in a background of auditory regularities, an ERP-derived observation replicated many times and one of the most robust findings in the schizophrenia literature. She has published a number of seminal papers on ERP indices of attention and change detection.

Pat currently chairs the Research Committee of Orygen, the National Centre of Excellence in Youth Mental Health, and the National Committee of Brain and Mind (NCBM) of the Academy of Sciences of Australia. She is a joint chair of the Australian Brain Alliance, an initiative of the NCBM and the Academy. The Alliance, which is supported by the Australian Psychological Society, the Australasian Neuroscience Society and major research organisations, aims to secure investment in Australian brain research comparable to other international initiatives.

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Tsuyoshi Miyakawa

Tsuyoshi Miyakawa is a Professor and the director of Division of Systems Medical Science at Fujita Health University. He is also the Group Leader of Genetic Engineering and Functional Genomics Unit, Kyoto University Graduate School of Medicine and an Adjunctive Professor and the director of Section of Rodent Behavior Analysis at National Institute for Physiological Sciences. He received B.A, M.A, and Ph.D. degrees in Psychology, in 1993, 1995 and 1997 respectively, at the University of Tokyo (Advisor: Hiroaki Niki). After being a Research Scientist at Niki's lab at Riken Brain Science Institute, he moved to the US in 1998 and received postdoctoral training from Jacqueline Crawley in Section on Behavioral Neuropharmacology at National Institute of Mental Health. In 1999, he became a Research Assistant Professor of Pharmacology at Vanderbilt University. He then moved to Picower Center for Learning and Memory, directed by Susumu Tonegawa, at MIT in 2001 and was a Research Scientist and the supervisor of behavior core facility there.

He has been investigating the relationships between genes, brain and behavior by utilizing a "comprehensive behavioral test battery" on genetically engineered mice since 1993. At MIT, he found that forebrain specific calcineurin knockout mice show multiple abnormal behaviors related to schizophrenia with the strategy and that a calcineurin gene, PPP3CC, is associated with schizophrenia susceptibility in human. This made him believe that a systematic investigation of the behaviors of mutant mice is useful in understanding the pathophysiology and pathogenesis of neuropsychiatric disorders. Since coming back to Japan in 2003, Miyakawa and his colleagues have assessed more than 70 different strains of mutant mice and they are trying to find what is happening in the brains of the mice models of psychiatric disorders. He is directing a bioinformatics project, involving more than 15 institutions in Japan, of Japan Science and Technology Agency for developing a "Mouse Behavioral Phenotype Database".

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Dr. Khara Ramos is a Senior Science Policy Analyst in the Office of Scientific Liaison within the Office of the Director of the National Institute of Neurological Disorders and Stroke, a part of the National Institutes of Health. She is leading efforts to integrate neuroethics into the NIH BRAIN Initiative. A neuroscientist and former AAAS Science and Technology Policy Fellow, she has broad interest in neuroscience research, with specific focus on how advances in neuroscience intersect with society.

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Osamu Sakura

Dr. Osamu Sakura is Professor and Dean of Interfaculty Initiative in Information Studies, The University of Tokyo, Japan. His research centers on the general and theoretical aspects of science communication. His main interests are neuroethics and social aspects of AI and robotics. He has also been engaged in the relation between experts and local people in the Fukushima disaster area. After attaining a PhD in primatology focused on behavioral ecological research of wild chimpanzees, he has moved into the field of science studies, including the history of the theory of evolution in Japan. He still maintains an interest in evolutionary biology, which informs his evolutionary psychological approach to understanding human attitudes to robots and AI. He taught in Yokohama National University (1993-2000) and worked as visiting scholar on the University of Freiburg (1995-96) before moving to current position. He published some hundreds of journal papers and several books, included are: *How "Convenience" Makes People Unhappy: Modern Technology and Its Social Value* (2013, in Japanese), "A view from the Far East: neuroethics in Japan, Taiwan, and South Korea" (*East Asian Science, Technology and Society,* vol. 6, 2012), "Launching a Two-front war against anti-intellectualism and expert paternalism: lessons from the Fukushima nuclear disaster" (*5: Designing Media Ecology*, vol. 3, 2015).

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Arleen Salles

Arleen Salles is the Director of the Neuroethics Program at CIF (Centro de Investigaciones Filosoficas) in Buenos Aires, Argentina and a Senior Researcher in the Centre for Research Ethics and Bioethics, Uppsala University, Uppsala, Sweden. She is also a task leader and research collaborator in the Ethics and Society subproject (SP12) of the EU-flagship Human Brain Project. Salles received her M.A and Ph.D in philosophy from SUNY Buffalo, USA. Her research interests include the impact of neuroscientific research on human and personal identity, ethical issues raised by simulation and consciousness, the nature and methodology of neuroethics, and the impact of cultural context on the development of the field.

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Hagop Sarkissian

Hagop Sarkissian is Associate Professor of Philosophy at the City University of New York, Baruch College, and CUNY Graduate Center. His research is located at the intersection of cognitive science, ethics, and classical Chinese philosophy: he draws insights from the cognitive and behavioral sciences to explore topics in moral psychology, agency, and the status of morality, with an eye toward seeing how culture shapes cognition in these domains. In addition to drawing from the empirical sciences, he also uses the tools of experimental psychology in some of his research. He has authored or co-authored papers in these areas for journals such as The Annual Review of Psychology, Philosophical Studies, Philosopher's Imprint, Mind & Language, Cognitive Science, Behavioral and Brain Sciences, Ethical Theory and Moral Practice, Religion, Brain, and Behavior, Philosophy Compass, Review of Philosophy and Psychology, History of Philosophy Quarterly, and The Journal of Chinese Philosophy, as well as numerous anthologies. He is also co-editor of Advances in Experimental Moral Psychology (Bloomsbury 2014) and The Oneness Hypothesis: Beyond the Boundary of Self (Columbia, forthcoming). Sarkissian holds a B.A. (Philosophy and East Asian Studies) and M.A. (East Asian Studies) from the University of Toronto, and a Ph.D. (Philosophy) from Duke University. His work has been translated into Chinese and Korean.

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Ilina Singh

Ilina Singh is Professor of Neuroscience & Society at the University of Oxford, where she holds a joint appointment between the Department of Psychiatry and the Faculty of Philosophy (Oxford Centre for Neuroethics and Oxford Uehiro Centre for Practical Ethics). Her work examines the psychosocial and ethical implications of advances in biomedicine and neuroscience for young people and families. Recent projects include the ADHD VOICES project (www.adhdvoices.com); Neuroenhancement Responsible Research and Innovation (www.nerri.eu); and the Urban Brain Project (www.urbanbrainlab.com). In 2014, Professor Singh received a Wellcome Trust Senior Investigator Award for a study entitled: Becoming Good: Early Intervention and Moral Development in Child Psychiatry.

Professor Singh has published widely in eminent journals, including *Nature, Nature Reviews Neuroscience, Social Science and Medicine*, and the *American Journal of Bioethics*. She is the lead editor of a new volume: *BioPrediction, Biomarkers and Bad Behavior: Scientific, Ethical and Legal Challenges* (co-edited with Walter-Sinnott Armstrong and Julian Savulescu), published by Oxford University Press. She has acted as an advisor to the Nuffield Council on Bioethics, NICE, NIMH and other organisations. She is co-editor of the journal *BioSocieties* and on the editorial board of the *American Journal of Bioethics-Neuroscience* and *Qualitative Psychology*.

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David Winickoff 	David E. Winickoff, JD, MA, is Senior Policy Analyst and Secretary of the Working Party on Bio -, Nano- and Converging Technology at the Organization for Economic Cooperation and Development (OECD) in Paris. He came to the OECD from a tenured professorship in bioethics and biotechnology policy at University of California, Berkeley. The work he leads at the OECD addresses policies for the responsible development of emerging technologies in areas such as synthetic biology, neurotechnology, gene editing, the bioeconomy, and convergent production technologies such as robotics and cyber-physical systems. He has over fifty publications in academic journals and other outlets. His articles have appeared in *Science*, *New England Journal of Medicine*, *Nature Climate Change* and the *Yale Journal of International Law*, among others. Winickoff served as a working group member on a U.K. Royal Academy panel on geoengineering and a National Academies of Science expert study on Gene Drives. He holds degrees from Yale University, Cambridge University, and Harvard Law School and was a fellow for two years at the Harvard Kennedy School. *Affiliation*: Organization for Economic Cooperation and Development *Contact*: david.winickoff@oecd.org

Paul Root Wolpe

Paul Root Wolpe, Ph.D. is the Asa Griggs Candler Professor of Bioethics, the Raymond F. Schinazi Distinguished Research Chair in Jewish Bioethics, a Professor in the Departments of Medicine, Pediatrics, Psychiatry, and Sociology, and the Director of the Center for Ethics at Emory University. Dr. Wolpe also serves as the first Senior Bioethicist for the National Aeronautics and Space Administration (NASA), where he is responsible for formulating policy on bioethical issues and safeguarding research subjects. He is Co-Editor of the American Journal of Bioethics (AJOB), the premier scholarly journal in bioethics, and Editor of AJOB Neuroscience, and sits on the editorial boards of over a dozen professional journals in medicine and ethics. Dr Wolpe is a past President of the American Society for Bioethics and Humanities; a Fellow of the College of Physicians of Philadelphia, the country's oldest medical society; a Fellow of the Hastings Center, the oldest bioethics institute in America; and was the first National Bioethics Advisor to Planned Parenthood Federation of America.

Dr. Wolpe moved to Emory University in the summer of 2008 from the University of Pennsylvania, where he was on the faculty for over 20 years in the Departments of Psychiatry, Sociology, and Medical Ethics. He was a Senior Fellow of Penn's Center for Bioethics, and directed the Scattergood Program for the Applied Ethics of Behavioral Health and the Program in Psychiatry and Ethics at the School of Medicine.

Dr. Wolpe sits on a number of national and international non-profit organizational boards and working groups, and is a consultant to academic institutions and the biomedical industry. In July, 2010, he testified to the President's Commission on the Study of Bioethical Issues in Washington, DC on ethical issues in synthetic biology. A dynamic and popular speaker internationally, Dr. Wolpe has been chosen by The Teaching Company as a "Superstar Teacher of America" and his courses are distributed internationally on audio and videotape. He has won the World Technology Network Award in Ethics, has been featured in a TED talk, and was profiled in the November 2011 Atlantic Magazine as a "Brave Thinker of 2011." Dr. Wolpe is a frequent contributor and commentator in both the broadcast and print media, recently featured on 60 Minutes and with a personal profile in the Science Times of the New York Times.

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Kevin Chieng-Chang Wu

Kevin Chien-Chang Wu, M.D, LL.M., Ph.D., a forensic psychiatrist, neuroethicist and mental health policy scholar from Taiwan, is an associate professor at National Taiwan University College of Medicine with joint appointments at College of Law and College of Public Health. He was awarded excellent tutorship four times at the university. Since 2015, he has been the director of Department of Psychiatry at National Taiwan University and the chair of the Department of Psychiatry at the National Taiwan University Hospital. He also serves as the deputy director of the Biomedical Ethics at the university. For six years (2007-2013) he was the chair of the Forensic Psychiatric Committee at the Taiwanese Society of Psychiatry and has conducted more than 400 forensic examinations including those of more than 10 high-profile criminal cases in Taiwan. In the past 12 years, he has been the expert involved with drafting revised statutes of the Taiwan Mental Health Act.

His research interests are bioethics (including medical ethics and public health ethics), mental health law and policy (including human rights and compulsory measures, competency, criminal responsibility, dementia, and suicide prevention), neuroethics (including enhancement, free will and moral responsibility), and pharmaceutical policy (including addicted drugs and vaccines). He authored more than 70 publications in English and Mandarin, including original papers, book chapters, and one book in Forensic Psychiatry (in Chinese). Using philosophical anthropology as the core theme, he hopes to explore how different disciplines could contribute at multiple levels to the governance of human affairs with various ways of understanding and seeing human conditions. He is now the PI of several national research grants from the Taiwan Ministry of Science and Technology, topics of which comprise mental health law and policy regarding the governance suicide, addiction and psychopath; the ELSI and policy of dementia diagnosis and management; and international comparisons of mental health law.

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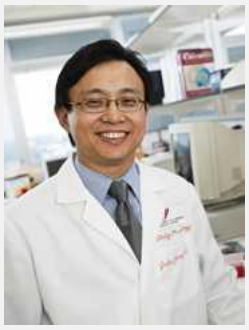
Jialin Charles Zheng 	Jialin Zheng is Dean of the Tongji University School of Medicine, where he is a Professor of Neuroscience and Regenerative Medicine. He is simultaneously a Professor of Pharmacology and Experimental Neuroscience at the University of Nebraska Medical Center (UNMC). Dr. Zheng's research focuses on the understanding and treatment of neurodegenerative disorders such as Parkinson's Disease. Ultimately it is the mission of his lab to develop drugs that will inhibit neurotoxin production and enhance neuronal repair in the brain. Dr. Zheng has been at the fore of UNMC's collaborative efforts in China. He is the Director of UNMC's Asia Pacific Rim Development Program and has worked to create more than 10 partnerships in China, including the formation of the first joint U.S./Chinese M.D./Ph.D. program. Dr. Zheng received his M.D. from Xuzhou Medical College in China and served as a visiting scholar at the State University of New York at Buffalo prior to joining UNMC. *Affiliation:* China Brain Project; Tongji University of Medicine; UNMC *Contact*: jialinzheng@tonji.edu.cn

MEETING MANAGERS

Jamila Garrett-Bell

Jamila Garrett Bell is a member of the management team at the Emory Center for Ethics and the project manager for the Global Neuroethics Summit. At the Center, she collaborates with senior divisional leadership to manage and execute multiple projects including those related to fundraising and program development. On the GNS project, Jamila tracks action-item progress, monitors the budget, and coordinates meeting logistics.

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Prior to joining the KBRI in 2016, she has worked in the Department of Climate Change Action at the Korea Environment Corporation(Keco) and participated in 2014 United Nations Climate Change Conference COP20 as a government delegate.

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Sol Lee is the assistant manager for the Global Neuroethics Summit and works at Emory University's Center for Ethics. He graduated from Emory University with a degree in Neuroscience and Behavioral Biology. His research at the Yerkes National Primate Research Center focused on Parkinson's Disease, and as a writer, he has made contributions to *The Neuroethics Blog*. Having past experiences in clinical settings and handling finances, his interests lie in the management and analysis of the U.S. healthcare system.

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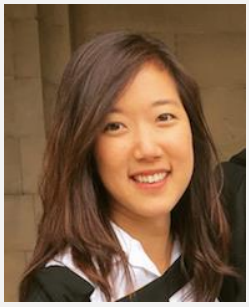

Stepheni Uh is a Clinical Research Assistant at the Center for Autism Research (CAR) within the Children's Hospital of Philadelphia. She graduated from Emory University with degrees in Neuroscience and Behavioral Biology and Ethics. As the 2014-15 recipient of the Bobby Jones Fellowship, she completed her MPhil in Behavioural and Neural Sciences at the University of St Andrews, Scotland. Her research experiences have spanned across the domains of social and cognitive neuroscience, the focus of both her honors and master's theses being the neuroscientific basis and role(s) of moral disgust. Since completing her studies, she has engaged in various human translational neuroscience work in both exploratory scientific and clinical settings at University of Pennsylvania's Center for Neuroscience & Society and currently at CAR. Her primary interests lie in the ethical, social, and legal implications of human neuroscience research and the intersection of science with policy across diverse populations.

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OBSERVERS

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Miyoung Chun	Miyoung Chun's career spans a wide range of experience in academia, industry, and philanthropy. She was a Professor of Biochemistry at Boston University School of Medicine, where she taught and performed research in the areas of cell biology and molecular medicine. As a scientist and project leader at Millennium Pharmaceuticals Inc. (now The Takeda Oncology Company), her research focused on functional genomics and molecular imaging in drug discovery and development, leading to over 30 U.S. and internationally issued/published patents. As the Executive Vice President of Science Programs at The Kavli Foundation, Dr. Chun has spearheaded many scientific initiatives and dynamic large-scale projects, including the development and launch of the BRAIN Initiative. Announced in 2013 by President Obama as the White House's centerpiece Grand Challenge, BRAIN represents scientific collaboration in its truest form, marshaling private and public sectors and scientists from across disciplines to work together in order to accelerate innovative technologies that will revolutionize our understanding of the brain.
Caroline Montojo	Caroline Montojo is a Science Program Officer at The Kavli Foundation, where she has been involved in efforts to advance basic science, including a global movement to create an International Brain Initiative. Prior to joining the Foundation, Dr. Montojo served as a postdoctoral research fellow in the Semel Institute for Neuroscience and Human Behavior at the University of California, Los Angeles (UCLA). Her research at UCLA focused on investigating neural biomarkers for psychiatric illness using functional magnetic resonance imaging techniques, for which she was awarded the Arnold Scheibel Distinguished Postdoctoral Fellow in Neuroscience Award and the Stephen R. Mallory Schizophrenia Research Award. Dr. Montojo received her B.A. from the University of California, Berkeley, and completed her M.A. and Ph.D. at Johns Hopkins University.
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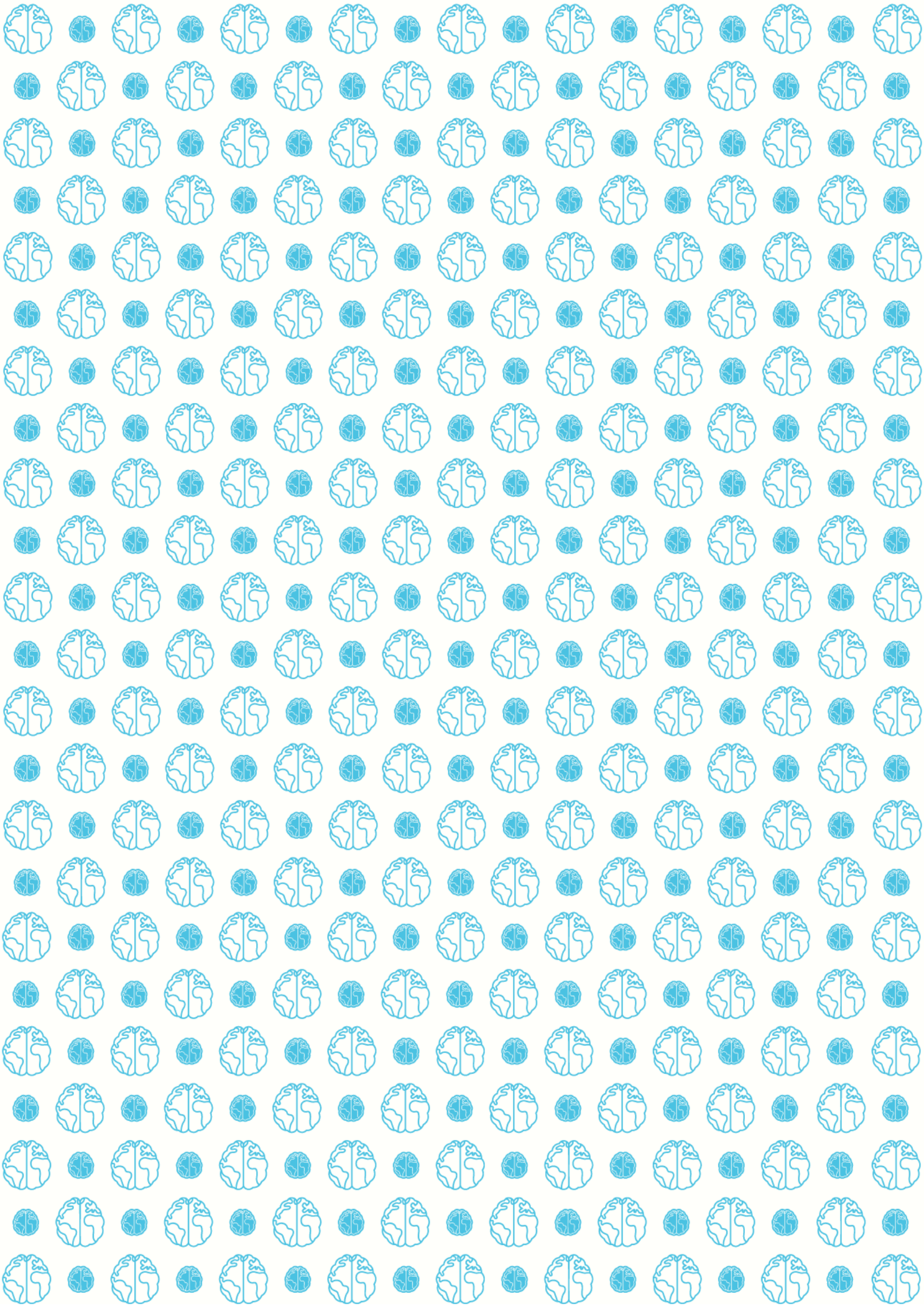
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