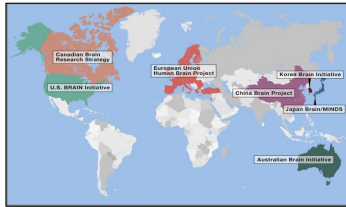


Introduction

Neuroethics: A Guide for Bridging Cross-sectoral Neuroscience

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- 5.84 billion Euros of investment into neuroscience within the 7 active/ existing international brain initiatives (1).
- Neuroethics Questions to Guide Ethical Research in the International Brain Initiatives (NeQN)
- 2020 worldwide market for neurotechnology 9-12 Billion Euros, demonstrating a simultaneous rapid development in the neuro-industry sector (2 and 3).

Do these guiding neuroethics questions apply to the private sector?

NeQN categories

1. Potential Impact of a disease model (ex: unintended consequences)
2. The ethical standards of data collection
3. The moral significance of engineered neural systems (less specific to many entrepreneurs we considered)
4. Challenges to autonomy with brain interventions
5. Contexts in which neurotechnology can be deployed and whether or not these decisions require diverse stakeholders

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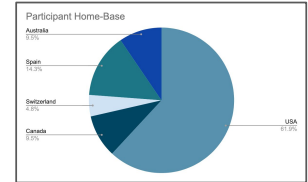
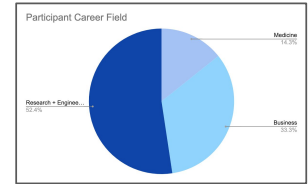
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Hypothesis and Methods

Hypothesis: Neuroethics is not contrary to, but instead can enrich neuro-innovation.

Methods:

- Empirical ethics methods to assess the perceived value and attitudes of neuro-innovators toward neuroethical issues and whether or not these issues align with the process of neuro-innovation.
- One-on-one semi-structured interviews with 21 neuro-innovators in neuro-industry until exhausted emerging themes
- Two-independent coders and iterative analysis (Grounded Theory)



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Results

Motivators to Innovate in Neuro

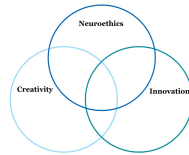
What is the purpose of neuro-innovation?

1. **Benefiting/advancing humanity:** reducing suffering and increasing happiness from disease and injury to lack of access and ability.
2. **Clinical:** to meet unmet clinical needs, improve treatment, and provide extra diagnostic accuracy/prediction, impacting how diseases are labeled, defined, and treated.
3. **Non-clinical:** Off-label use or diagnostic neurotechnology that moves into or is created for the commercial domain raises ethical concerns.
4. **Empowerment:** to enhance "autonomy" of the public, empowering them to have greater bandwidth of knowledge, choices, and behaviors.

Needs Assessment: Key Neuroethics Concerns?

What are the key (neuro)ethical tensions of neuro-entrepreneurs?

1. **Data Ownership:** Users should own their data and give consent at all times, but the business model doesn't allow for it (Small companies are more incentivized to sell data for growth).
2. **Access and Justice:** Innovations can empower society, but the tech and insights are not always shared with everyone.
3. **Neurodata and Misuse:** Current data regulations suffice, but may not be sufficient for future implications and possible uses of brain data in the commercial space.
4. **Interfacing with Societal Norms:** Unintended uses or access to data and tech may lead to stigma, discrimination, power imbalances, and other consequences, but the implications are not usually apparent to users (or the entrepreneurs who sell the data / deploy the innovation).
5. **Autonomy and Privacy:** Neurotech can provide enhanced abilities for individuals in the future, benefitting society. Neurotech can also lead to increased control over users through data, which will become a privacy concern in the future.



How to Align Ethics with Innovation and Creativity

How would ethics fit with the neuro-innovation/creative process?

1. **Ensuring/Maximizing impact:** End users/patients are the most important stakeholders. In order to maximize impact, ethics also needs to be as nimble as the tech, keeping up with the science. Ethics should mitigate harm (risk reduction) and promote innovations that benefit humanity (social impact).
2. **Guidance vs Restriction:** Ethics enforcement is viewed as restrictive and slowing; however, ethical guidelines (in any format) can be helpful tools throughout and after the innovation process.
3. **Providing incentives:** Incentivization of ethical behavior is missing and desired.
4. **ROI (return on investment), growth and ethics:** Neuro-entrepreneurs should be focusing on maximizing the uses and value of their products and company while also mitigating negative uses. This responsibility to both ROI and ethics results in tension.

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Future Directions

Overall, we hope to raise awareness and provide actionable steps toward advancing and accelerating societally impactful neuroscience.

- The next phase of our work will therefore be conducting quantitative research for generalizable data on roadblocks and potential strategies forward.
- We aim to create a common language amongst diverse stakeholders to move forward across groups with unity.
- Neuro-industry will likely drive majority of clinical and consumer neurotechnology in the future.

3 strategic initiatives within our lab are particularly integral to our goal:



Dr. Karen Rommelfanger, Director



Zone Li
Using applied machine learning and data science methodologies to identify trends and gaps in neuroethics conversations



Ankit Moss
Assessing the attitudes of neuro-innovators on existing policy and regulations identifying innovation roadblocks



Linzie Taylor
Implementing relational oriented definitions of personhood to alleviate biases within the innovation process

<https://pubmed.ncbi.nlm.nih.gov/30308169/> (1)
<https://sharpbrains.com/pervasive-neurotechnology/> (2)
<https://www.neurotechreports.com/pages/execsum.html> (3)

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