



Who does Neuroethics Scholarship Address, and What Does it Recommend? A Content Analysis of Selected Abstracts from the International Neuroethics Society Annual Meetings

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Abstract Much neuroethics literature concludes with a set of normative recommendations. While these recommendations can be a helpful way of summarizing a proposal for a future direction, some have recently argued that ethics scholarship has devoted insufficient attention to considerations of audience and real-world applications. To date, however, while scholars have conducted topic analyses of neuroethics literature, to our knowledge no study has evaluated who neuroethics scholarship addresses and what it recommends. The objective of the present study therefore was to provide a preliminary characterization of recommendations offered in neuroethics scholarship and an assessment of their target audiences. Rather than attempting to demarcate what constitutes “neuroethics scholarship,” we analyzed text that authors’ had self-identified as being neuroethics-related: abstracts presented at the International Neuroethics Society (INS) annual meetings and published as top abstracts in *AJOB Neuroscience* in the last decade (2011–2020). We found that a majority of abstracts utilized conceptual methods

(62.2%) and provided conceptual recommendations (68%). Roughly 77% of all abstracts did not explicitly address a target audience, yet nearly all of these were implicitly directed at other scholars. The remainder specified a target audience of scholars (12.2%), regulators (6.7%), healthcare providers (6.7%) and industry (2.6%). Only a subset of abstracts provided practical or policy recommendations (19.7%). Of those, the majority (61.5%) did not specify a target audience. Among the subset with actionable recommendations, a clarification of target audience may help increase the impact.

Keywords Neuroethics · translational bioethics · applied ethics

Introduction

Considerable attention has been devoted to defining neuroethics and engaging in debates surrounding its current and future scope as a field [1–4]. However, comparatively less discussion has been devoted to exploring the role of neuroethics in society. Should neuroethics be a purely academic field, focused on examining the ethical, legal, and social implications of neuroscience? Or should it strive to have a tangible impact on neuroscience research, clinical practice, and policy? At least some individuals and organizations envision a more active role for neuroethics: the National Institutes of Health (NIH), for example,

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describes it as a discipline that “can help guide neuroscience research and the application of neuroscience research findings” [5]. Similarly, in a recent paper advancing the notion of “translational neuroethics,” we argued that a greater focus on real-world impact could address some of the critiques that have been directed at neuroethics [6].

The question of the role of neuroethics in society parallels longstanding debates in bioethics regarding whether the field should prioritize theoretical or applied work or adopt a translational focus [7–12]. Some scholars have addressed similar questions, framing them as inquiries about the *goals* of bioethics [13] or the *value* of bioethics research [14]. Others have approached this question empirically, asking not what bioethics should do but rather how bioethicists, to date, have positioned their scholarship on the spectrum of applied vs. theoretical. For example, Mertz et al. (2019) analyzed the language utilized in a subset of 40 articles from bioethics journals, finding that approximately half aimed at “application” rather than solely “advancing knowledge” [14]. Similarly, Walker and Morrissey (2012) examined 61 articles related to the ethical, legal, and social implications (ELSIs) of genomics, finding that only a small percentage offered applied policy recommendations [15].

While to our knowledge, no similar study has analyzed language utilized in the neuroethics literature, several studies have employed thematic analysis, such as an exploration of topics in a four-part working bibliography of neuroethics [16–19] and in an unpublished analysis of neuroethics journal publications [20]. In addition, Leefmann et al. (2016) conducted a bibliometric analysis of literature in the Mainz Neuroethics Database, a “multimodal compilation of more than 4,000 articles that were added by members of their group in an ongoing fashion” [21]. Other work has characterized neuroethics literature on specific topics, such as ethical aspects of brain-computer interfaces [22], the use of the term “invasiveness” across neuroethics publications [23], and reports of personality changes following deep brain stimulation [24].

This prior work, however, has been limited in two ways. First, it has almost exclusively focused on elucidating themes across the neuroethics literature without exploring how neuroethicists articulate the implications of their work. Given the applied

role for neuroethics envisioned by multiple entities and scholars, it is important to understand how the field collectively frames its scholarship in relation to society. Specifically, a better understanding of the intended audiences of neuroethics scholarship and the recommendations it proposes can help the field more effectively identify pathways for tangible impact.

A second limitation relates to the methodological challenge of defining what constitutes “neuroethics literature.” Neuroethics is a highly interdisciplinary field, bridging philosophy, law, social science, neurology, psychiatry, psychology, and neurosurgery, among others. Merely conducting a search for the term “neuroethics” across published literature does not yield a comprehensive set of neuroethics publications, as many articles discuss ethical topics (e.g., post-trial responsibilities, privacy of neural data) without using the term “neuroethics.” The above-mentioned thematic analyses of neuroethics literature have all involved researchers making *a priori* determinations about relevant search terms and journals, or subjective judgements about perceived fit.

The aim of the present study was to fill these gaps by examining how neuroethicists frame their research, with a particular focus on understanding what types of recommendations (if any) are being made and to whom they are being directed. To circumnavigate the problem of defining what constitutes neuroethics literature, we analyzed a subset of abstracts presented over the last decade at the largest annual conference of neuroethics scholars. Because submitting to the conference involves authors self-identifying their own work as being neuroethics-related, this methodology eliminated researchers’ judgements about what constitutes neuroethics literature. Our approach involves certain trade-offs: on the one hand, abstracts span disciplinary fields in ways that move beyond the scope of individual journals, and they often culminate with a succinct conclusion that addresses the implications of the research. On the other hand, abstracts are brief summaries of longer papers or ongoing research, and they are frequently authored by junior scholars. Still, an analyses of conference abstracts can yield broad-brush insights into whom neuroethics research is directed towards and the specific applications it recommends.

Methods

The International Neuroethics Society (INS) is a professional association of neuroethicists [25]. Since 2008 it has held an annual meeting to which neuroethicists are invited to submit abstracts of their research for consideration as poster presentations (and more recently, as oral talks). Although the INS does not make accepted abstracts publicly available—and declined to make them available to us upon request—its official journal, *AJOB Neuroscience*, has published selected abstracts presented at the annual INS meeting since 2011 (see, e.g., [26, 27]). These abstracts are selected by the *AJOB Neuroscience* editorial staff, which blind-reviews them for “merit, based on novelty, relevance, and contribution to the field of neuroethics” [28]. While *AJOB Neuroscience* selected abstracts are not perfectly representative of all abstracts presented at the INS meetings, they still offer insights into self-identified neuroethics content over time. Our sample therefore consisted of all INS abstracts (N=270) published in *AJOB Neuroscience* since it began publishing top abstracts (2011–2020). We conducted a content analysis of these abstracts, coding for four main categories: topic of scholarship, methodological approach, type of recommendation made in the conclusion (if any), and target audience. We also gathered information about the geographical location for each abstract by extracting the country of the first author’s primary institutional affiliation.

Coding for “topic of scholarship” presented complex challenges due to the breadth and interdisciplinary nature of scholarship, the variability in analytical depth, and the overlap among kinds of technologies, approaches, and questions. For instance, while some abstracts concentrated on specific technologies and raised various ethical concerns, others focused on ethical questions and touched upon numerous technological categories. Others prioritized clinical indications but also delved into ethical and technological dimensions, whereas philosophical abstracts might have discussed clinical applications, technologies, and ethical dilemmas, all while emphasizing a theoretical framework. In other words, primary topics of abstracts consisted of everything from clinical indications and theoretical arguments to specific technologies and ethical questions, among others (Table 1).

Given the heterogeneity of topics and the difficulty of establishing a meaningful level of

Table 1 Location of the primary institutional affiliation of the first author of each abstract (N=270)

Country of first author’s primary institutional affiliation	N (%)
United States	171 (63.3)
Canada	32 (11.9)
Germany	11 (4.1)
United Kingdom	9 (3.3)
Italy	8 (3.0)
Switzerland	8 (3.0)
Australia	7 (2.6)
India	5 (1.9)
France	3 (1.1)
Spain	3 (1.1)
China	2 (0.7)
Sweden	2 (0.7)
Taiwan	2 (0.7)
Belgium	1 (0.4)
Chile	1 (0.4)
Israel	1 (0.4)
Japan	1 (0.4)
South Korea	1 (0.4)
Ukraine	1 (0.4)
Mexico	1 (0.4)

categorization, we adopted the neuroethics subject-categories identified in the Leefmann et al. (2016) bibliometric analysis [21]. While Leefmann et al. (2016)’s coding categories faced similar obstacles to the ones we encountered, they were derived through a rigorous multi-step process involving an interdisciplinary team—comprised of two neuroethicists and a computational linguist—who iteratively reviewed 400 neuroethics publications, established 15 subject-categories with corresponding keywords, and conducted reliability checks to ensure accuracy. Our initial coding phase therefore involved classifying our abstracts to these established codes and coding all those that did not match to an “other” category. Next, we reviewed all abstracts coded to “other” for thematic commonalities, which led to the creation of 11 additional categories (see Supplement 1). Since Leefmann et al.’s analysis only included the time period through 2012, and our abstracts were from a later time period (2011–2020), these additional categories reflect topics that have more recently arisen

to the conversational fore in neuroethics, such as brain-computer interfaces, artificial intelligence, consumer neuroscience, and brain organoids.

Codes for “methodological approach” were informed by Walker and Morrissey [29], who identified ten methods that bioethics publications used to establish or further their ethics-related claims. Category definitions for “legal” and “empirical” were adopted into our own codebook, whereas other categories (e.g., philosophical, principles, historical, feminist, theological) were collapsed into an overarching “conceptual” category. We created a new category for “experimental” methods to account for abstracts describing experimental interventions, such as vignette studies or behavioral interventions.

Codes for “target audience” and “recommendation” were developed inductively from the data. We defined recommendations as suggestions, action-items, or proposals put forward by the author(s) offering guidance or direction on the topic being discussed. Two authors conducted four rounds of coding with a randomly selected subset of abstracts, and iteratively revised the codebook through group discussions with all authors. The codebook was piloted within the research group to ensure accuracy and reliability.

To ensure the reliability of codes, coding for each category was conducted by a single author, with a second coder randomly selecting and double-coding 20% of abstracts. All disagreements were resolved through discussion. Codes were entered and cleaned in Excel (Microsoft Corp., Redmond, WA, USA).

Codes were analyzed by overall frequency of appearance (i.e., how often a topic appeared across the entire data set), as well as for variation over time from 2011 to 2020. Sample characteristics were generated through descriptive statistics, and simple inferential statistics were used to explore differences between subcategories (SPSS, Version 26 [IBM]).

This study was deemed exempt from review by the University of Pennsylvania’s Institutional Review Board as it did not meet the regulatory definition for human subject research and utilized publicly available data. Neither the INS nor *AJOB Neuroscience* participated in any part of the study.

Results

On average, approximately 27 selected INS abstracts were published annually in *AJOB Neuroscience* between 2011 and 2020, though the exact number varied from 18 to 30. As shown in Table 1, most abstracts (n=171; 63.3%) were authored by those with a primary institutional affiliation in the United States, followed by those in Canada (n=32, 11.9%) and Germany (n=11, 4.1%). Table 2 presents a detailed view of the most common topics addressed by abstracts in our sample. The most dominant topic was legal studies (n=36; 13.3%), which were abstracts primarily focused on law or regulation.

Table 2 Distribution of abstracts by topic of scholarship (N=270). Topics were derived from those identified by Leefmann et al. (2016) and supplemented with additional ones (denoted by *) to reflect the breadth of contemporary topics; see Supplement 1 for coding categories and definitions. Abstracts could be coded to more than one audience category

Topic of Scholarship	N (%)
Legal studies	36 (13.3)
Medical research and medicine	35 (13.0)
Psychiatric and neurodegenerative diseases	32 (11.9)
Enhancement	30 (11.1)
Brain stimulation	29 (10.7)
Neuroethics-related*	25 (9.3)
Neuroimaging	20 (7.4)
Moral theory	15 (5.6)
Philosophy of mind and consciousness	15 (5.6)
Brain-computer interfaces*	15 (5.6)
Neuroscience and society	13 (4.8)
Brain death/severe disorders of consciousness	10 (3.7)
Other*	10 (3.7)
Psychopharmacology	9 (3.3)
Critiques of neuroscience research*	8 (3.0)
Addiction	7 (2.6)
Memory modification*	7 (2.6)
Molecular neurobiology and genetics	6 (2.2)
Neural data*	6 (2.2)
Consumer neuroscience*	6 (2.2)
Animal ethics*	5 (1.9)
Neurosurgery	5 (1.9)
Dual use*	5 (1.9)
Artificial intelligence and machine learning*	3 (1.1)
Organoids*	2 (0.7)
Social and economic neuroscience	1 (0.4)

Medical research and medicine ($n=35$; 13.0%) was the second-most common topic, including a broad variety of studies related to the ethics of both clinical care and research. Psychiatric and neurodegenerative disease, enhancement, and brain stimulation were also frequently appearing topics. Whereas some codes (such as legal studies and medical research and medicine) remained relatively stable in numbers across the time period analyzed, others (such as those related to moral theory) decreased over time, and in later years, new topics emerged (such as those related to brain-computer interfaces, consumer neuroscience, and neural data). The most commonly co-occurring codes were “medical research and medicine” and “brain stimulation.”

Regarding methodology utilized, the largest number of abstracts employed conceptual methods (62.2%), such as drawing upon philosophical concepts and theoretical frameworks. Others utilized empirical methods (26.7%), such as quantitative or qualitative research (e.g., interviews, focus groups, surveys, or case studies) that examined participants’ attitudes or experiences, and content analyses

that explored the presence of themes or trends in text. Others utilized legal analysis (7.0%), such as the examination of regulations, case law, or legal decisions; or experimental methods (3.3%), such as studies assessing participants’ perceptions or behaviors following the presentation of stimuli (e.g., vignette studies examining responses following the presentation of hypothetical scenarios). As shown in Fig. 1, there was an increase in the use of empirical methods over time and a comparative decrease in abstracts utilizing conceptual methods.

Each abstract was assessed for whether it explicitly identified a target audience (e.g., “*federal regulators should...*”). Target audiences were often, but not always, mentioned in the context of a recommendation, and some abstracts addressed more than one target audience. As shown in Table 3, the majority of abstracts (76.6%) did not *explicitly* specify a target audience; the remainder specified scholars (12.2%), regulators (6.7%), healthcare providers (6.7%) or industry (2.6%). Further analysis of the abstracts not specifying a target audience revealed that nearly all

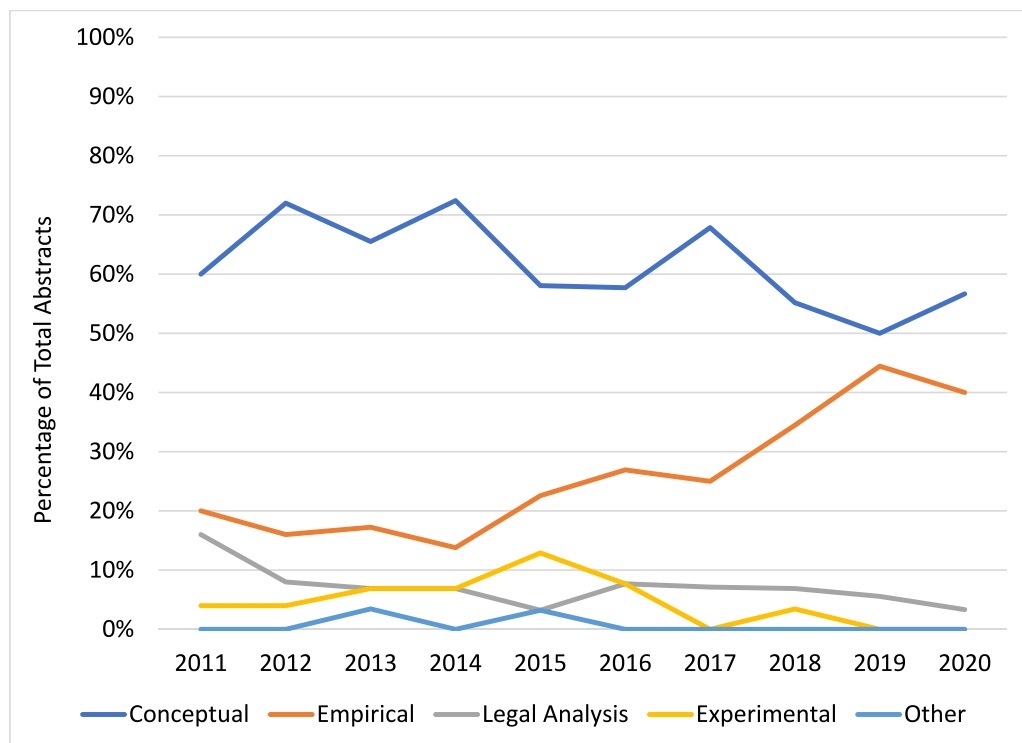


Fig. 1 Methodological approaches utilized by abstracts in our sample ($N=270$) distributed over time (2011–2020)

Table 3 Distribution of abstracts (N=270) by target audience. Abstracts could be coded to more than one audience category

Type of Audience	N=270 (%)	Definition and notes	Example
Unspecified	206 (76.6)	No audience <i>explicitly</i> specified. Nearly all of these abstracts (93.7%; n=194) <i>implicitly</i> addressed other scholars. The remainder <i>implicitly</i> addressed regulators (2.6%), healthcare providers (1.1%) and industry (1.1%)	"Hence these two forms of dehumanizing operate via complementary mechanisms that influence the different sides of the two antagonistic networks."
Scholars	33 (12.2)	Academics (e.g., neuroscientists, ethicists, legal scholars)	"Neuroscientists are encouraged to engage in the ongoing dialogue of neuroethics"
Regulators	18 (6.7)	Policymakers and government agencies	"This project sets out a proposal for new FDA regulations..."
Healthcare Providers	18 (6.7)	Physicians, nurses, and other healthcare providers	"Clinicians may consider several unresolved issues to guide the clinical benefit of..."
Industry	7 (2.6)	Device and software manufacturers; pharmaceutical companies	"We offer four practical recommendations to guide... the neurotechnology industry..."

of them (93.7%; n=194) *implicitly* addressed other scholars in the field.

There was a steady decline in the number of abstracts without a specified target audience over time, from 88.0% in 2011 to 53.3% in 2020. Similarly, there was a trend towards diversification of audience categories: between 2011–2013, the only explicit audience addressed was "scholars," but after 2014 other audience categories emerged (i.e., healthcare providers, policymakers, and industry).

Table 4 depicts a breakdown of abstracts by the type of provided recommendation. The majority (68.1%) provided conceptual recommendations, such as proposals of revisions to normative frameworks, reflections on ethical issues, and suggestions regarding new areas of inquiry. The second most common recommendation type was practical, and consisted of

actionable next steps, usually pertaining to clinical or research practices (11.9%), such as proposals for modifying study design and dissemination of research results. Only a small number (7.8%) provided policy recommendations, which were next steps pertaining to policies at the local, institutional, state, or federal levels (i.e., suggesting legal reforms or amendments to regulations). Approximately 12.2% of abstracts did not provide any recommendation.

Of the abstracts with practical or policy recommendations, 61.5% (n=32) did not explicitly address a target audience (Table 5). Additionally, there were method-specific differences regarding the types of recommendations being made. Specifically, a majority of abstracts (57.1%) with policy recommendations utilized legal analysis methods; and of the abstracts

Table 4 Types of recommendations provided by abstracts (N=270). Abstracts were coded to a single category only

Type of Recommendation	N=270 (%)	Definition	Example
Conceptual	184 (68.1)	Changes to normative framework or system of thinking; ways to improve or add to an existing model	"We offer a theoretically-grounded approach to understanding how these dimensions are interwoven..."
Practical	32 (11.9)	Actionable next steps pertaining to clinical or research practices	"I suggest modifications to current neuroimaging practices to begin addressing these problems"
Policy	21 (7.8)	Actionable next steps pertaining to policies at the local, institutional, state, or federal levels	"This project sets out a proposal for new FDA regulations that better fit the particular nuances of cognitive enhancement technologies..."
No Recommendation	33 (12.2)	Does not provide recommendation	General reporting of results without implications

Table 5 Audiences addressed by the subset of abstracts with practical and policy recommendations (n = 53). Abstracts could be coded to more than one audience category

Type of Audience	N = 53 (%)
Unspecified	32 (61.5)
Regulators	8 (15.4)
Scholars	7 (13.5)
Healthcare Providers	5 (9.6)
Industry	3 (5.8)

utilizing legal methods, 89.5% (n = 17) made practical or policy recommendations.

The COVID-19 pandemic resulted in a unique opportunity to check the representativeness of our data: in 2020 the INS annual meeting was held virtually and all accepted abstracts were posted publicly on the INS website. We therefore coded all 2020 accepted abstracts (N = 84) for methods, recommendations, and audience; we did not code for “topics of scholarship” due to the large number of coding categories relative to the sample size. We assessed representativeness by comparing results for our data (30 *AJOB Neuroscience* selected abstracts published in 2020) relative to all accepted abstracts in the same year. Differences were found in the proportion of abstracts coded to empirical methods (57% in our data vs. 38% for all 2020 abstracts) vs. conceptual methods (40% in our data compared to 58% for all abstracts), indicating that *AJOB Neuroscience* selected abstracts in 2020 were more heavily weighted towards empirical papers than conceptual ones. Differences greater than 5% between selected and all abstracts were not found across any of the other coding categories.

Discussion

Our study offers a preliminary assessment of the topics, methods, audiences, and recommendations made in a subset of abstracts presented over the last decade at the INS annual meetings. The distribution of authors’ institutional affiliations closely aligns with the membership demographics reported by the INS [30], with the United States representing approximately two-thirds of all membership, followed by Canada, Germany, and the United Kingdom. The vast majority of neuroethics abstracts in our sample

utilized conceptual methods and made conceptual recommendations directed implicitly at other academics. This likely reflects the fact that neuroethics emerged from scholarly traditions in the social sciences and humanities, which have a more robust tradition of critique and argumentation rather than practical application.

As neuroethics is a diverse field, comprised of philosophers, legal scholars, social scientists, neuroscientists, and clinicians, it is not surprising that our findings revealed considerable heterogeneity among methods, with approximately a quarter of abstracts utilizing empirical methods and others utilizing legal and experimental ones. Our data indicate an increase in the use of empirical methods in this subset of neuroethics over time. Although the reasons for this trend are not immediately apparent—and further investigations are warranted to confirm if this trend is reflective of the broader neuroethics literature—it is possible that the commencement of neuroethics funding in 2018 through the NIH’s BRAIN Initiative, which typically supports empirical rather than conceptual research, played a direct or indirect role in promoting empirical research. This notion is supported by the predominance of U.S.-based authors in our sample.

As noted above in the Methods section, categorizing “topics of scholarship” was challenging, but our analysis yielded several key insights. First and foremost, the fact that we had to develop new coding categories to capture emerging topics points to the evolving nature of topics of discussion. New areas of focus included brain-computer interfaces, consumer neuroscience, neural data, critiques of neuroscience for failing to adequately address gender or racial considerations, AI, brain organoids, and debates around the scope of neuroethics and how it should be taught. Conversely, some topics that were highly represented in Leefmann et al. (2016) were less present in our sample: moral theory, for example, was the topic of many abstracts in 2011 but trailed off in later years. Some topics that were present but not dominant in Leefmann et al. (2016), such as legal studies and brain stimulation, were more highly represented in our sample as compared to theirs. However, given that our work involved assessing abstracts and Leefmann et al. (2016) examined complete publications, any conclusions should be interpreted cautiously, and future work should examine neuroethics scholarship

over an extended timeframe to better understand the changing landscape of topics of discussion.

Only a small percentage of abstracts in our sample (19.7%) made practical or policy recommendations. That applied work represents a minority of ethics scholarship is in line with findings from Mertz et al. (2019) related to general bioethics scholarship, as well as a scoping review of ethics literature on brain-computer interfaces, which found that there were a larger number of discussions about ethics as compared to proposals for practical recommendations [14, 22]. Similarly, our finding that 7.8% of abstracts made policy recommendations is not dissimilar to Walker and Morrissey (2012)'s findings that just 10% of articles related to the ELSIs of genomics articles made policy recommendations [15]. While here, too, comparisons should be interpreted with caution—as we analyzed abstracts rather than complete papers—in a broad sense, policy and practice recommendations seem to be present only in a minority of scholarship.

On the one hand, the fact that abstracts with actionable recommendations are in the minority suggests that a vision of neuroethics as “guiding” neuroscience or policy may not be representative of the majority of neuroethics work. On the other hand, it is worth noting that even scholarship without explicit actionable recommendations can indirectly guide research and policy, for example by building an empirical evidence base on a particular topic or elucidating theoretical frameworks that can inform future work in the field. Neuroethics scholarship can be translated to audiences in numerous ways, not just through abstracts but through other conferences, journals, meetings, the media, as well as public-facing publications. Further research is needed to explore these various channels of dissemination and how factors such as specifying recommendations and target audiences might influence translation.

Regarding audience, most neuroethics abstracts in our sample were implicitly directed to other scholars, discussing debates and questions within the field itself. Regulators, healthcare providers, and industry emerged as the other audiences, pointing to those who may be interacting with neuroscience or using neuroscience technology. Interestingly, the general public did not emerge as an audience category, suggesting that neuroethicists do not typically envision their work as speaking directly to a public audience. This finding is salient in light of recent calls for increased

public engagement with neuroethics [31] and bioethics [32].

As Buchbinder et al. (2022) note, the identification of audiences is an important step for translating findings into real-world impact [32]. Yet we found that among abstracts making practical or policy recommendations, the majority did not explicitly specify a target audience. This finding lends tentative support to critiques expressed by us and others [6, 11], that neuroethics and bioethics often do not often attend to considerations of audience and downstream applications. On a positive note, however, our study revealed that in at least some contexts, neuroethicists are indeed making actionable recommendations to audiences other than neuroethicists. We and others have recently suggested that neuroethicists (and bioethicists) take a more proactive and translational approach by not only providing normative recommendations but also actively engaging in their implementation [6, 10, 13]. The identification of a distinct subset of neuroethics scholarship focused on making recommendations to targeted audiences suggests that this subset of research may hold promise for translation to real-world applications.

Notably, the present study is not intended to be prescriptive—it does not offer an indication as to the directions that neuroethics *should* follow, rather it provides a characterization of how a subset of neuroethics scholarship positions its findings and broader implications. Understanding how neuroethicists frame their work is a key starting point for further critical reflection on the values and goals of neuroethics, as well as its potential role in having a greater practical impact on society. Such analyses are crucial for fostering empirically grounded conversations about the nature of the field and its future trajectory. Thus, this research provides foundational data to stimulate dialogues concerning the identity of neuroethics and its varied dimensions, from addressing precise, immediate issues to engaging in broader, anticipatory ethical considerations.

The main significant limitation of our study is that *AJOB Neuroscience* selected abstracts may not be representative of all INS abstracts; indeed, it is not clear how *AJOB Neuroscience* selected abstracts may differ from all INS abstracts. Furthermore, as compared to peer-reviewed journal articles, abstracts may be more likely to be conceptually underdeveloped and/or authored by students or junior scholars, and thus may

not be reflective of peer-reviewed neuroethics scholarship published by more senior authors. They also reflect only a summary of the content of the accepted poster or talk, and our sample represents only those abstracts presented at a single neuroethics conference. Another limitation is the space constraints imposed on INS submitted abstracts, which could have limited authors' abilities to specify their target audiences or conclude with actionable recommendations. On the other hand, many abstracts typically contain conclusions or implications, which might have increased the likelihood of including a recommendation or identifying a target audience.

In conclusion, this study offers a preliminary assessment of how neuroethicists frame their research in a subset of abstracts presented at INS annual meetings. While limited in scope, it provides insight into topics of scholarship, methodological diversity, implicit and explicit audiences, and the nature of recommendations of neuroethics abstracts. As the field of neuroethics continues to evolve, we urge researchers to engage in critical reflection on its potential future directions, with an eye towards considering who our audiences are, what we are recommending, and if relevant, how our recommendations can be translated into practical applications.

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Data and Code Availability The data supporting the findings of this study will be made available by the corresponding author upon reasonable request.

Declarations

Conflict of Interest Disclosure The authors have no relevant financial interests to disclose. LSS and AW are members of the Board of the Directors of the INS and AW is an Associate Editor at *AJOB Neuroscience*.

Ethics Approval This study was deemed exempt from review by the University of Pennsylvania Institutional Review Board as it did not meet the regulatory definition for human subject research and used publicly available data.

Consent This study is a content analysis of publicly available data and did not require informed consent.

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References

1. Racine, Eric. 2010. *Pragmatic Neuroethics: Improving Treatment and Understanding of the Mind-Brain*. The MIT Press. <https://doi.org/10.7551/mitpress/8027.001.0001>.
2. Chiong, Winston. 2020. Insiders and Outsiders: Lessons for Neuroethics from the History of Bioethics. *AJOB Neuroscience* 11: 155–166. <https://doi.org/10.1080/21507740.2020.1778118>.
3. Koroshetz, Walter J., Jackie Ward, and Christine Grady. 2020. NeuroEthics and the BRAIN Initiative: Where Are We? Where Are We Going? *AJOB Neuroscience* 11: 140–147. <https://doi.org/10.1080/21507740.2020.1778119>.
4. Delegates, Global Neuroethics, Jordan Amadio Summit, Guo-Qiang, Bi, Paul Frederick Boshears, Adrian Carter, Anna Devor, Kenji Doya, et al. 2018. Neuroethics Questions to Guide Ethical Research in the International Brain Initiatives. *Neuron* 100: 19–36. <https://doi.org/10.1016/j.neuron.2018.09.021>.
5. National Institutes of Health. Undated. The Brain Initiative: Neuroethics. Accessed January 8, 2023. Available at: <https://braininitiative.nih.gov/research/neuroethics>.
6. Wexler, A., and Specker Sullivan, L. 2023. Translational Neuroethics: A Vision for a More Integrated, Inclusive, and Impactful Field. *AJOB Neuroscience*, 14 (4): 388–399. <https://doi.org/10.1080/21507740.2021.2001078>
7. Børøe, Kristine. 2014. Translational ethics: An analytical framework of translational movements between theory and practice and a sketch of a comprehensive approach. *BMC Medical Ethics* 15: 71. <https://doi.org/10.1186/1472-6939-15-71>.
8. Sisk, Bryan A., Jessica Mozersky, Alison L. Antes, and James M. DuBois. 2020. The “Ought-Is” Problem: An Implementation Science Framework for Translating

- Ethical Norms Into Practice. *The American Journal of Bioethics* 20: 62–70. <https://doi.org/10.1080/15265161.2020.1730483>.
9. Parsons, Jordan A., Harleen Kaur Johal, Joshua Parker, and Elizabeth Chloe Romanis. 2023. Translational or translationable? A call for ethno-immersion in (empirical) bioethics research. *Bioethics*. <https://doi.org/10.1111/bioe.13184>.
 10. Danis, Marion. 2022. A Translational Role for Bioethics: Looking Back and Moving Forward. *Perspectives in Biology and Medicine* 65: 596–603. <https://doi.org/10.1353/pbm.2022.0050>.
 11. Mathews, Debra J.H., D. Micah Hester, Jeffrey Kahn, Amy McGuire, Ross McKinney, Keith Meador, Sean Philpott-Jones, Stuart Youngner, and Benjamin S. Wilfond. 2016. A Conceptual Model for the Translation of Bioethics Research and Scholarship. *Hastings Center Report* 46: 34–39. <https://doi.org/10.1002/hast.615>.
 12. Cribb, Alan. 2010. Translational ethics? The theory–practice gap in medical ethics. *Journal of Medical Ethics* 36: 207. <https://doi.org/10.1136/jme.2009.029785>.
 13. Mertz, Marcel, Tobias Fischer, and Sabine Salloch. 2019. The value of bioethical research: A qualitative literature analysis of researchers’ statements. *PLoS ONE* 14: e0220438. <https://doi.org/10.1371/journal.pone.0220438>.
 14. Walker, Rebecca L., and Clair Morrissey. 2012. Charting ELSI’s future course: Lessons from the recent past. *Genetics in Medicine* 14: 259–267. <https://doi.org/10.1038/gim.2011.60>.
 15. Buniak, Liana, Martina Darragh, and James Giordano. 2014. A four-part working bibliography of neuroethics: Part 1: Overview and reviews defining and describing the field and its practices. *Philosophy, Ethics, and Humanities in Medicine* 9: 1–14. <https://doi.org/10.1186/1747-5341-9-9>.
 16. Darragh, Martina, Liana Buniak, and James Giordano. 2015. A four-part working bibliography of neuroethics: Part 2 – neuroscientific studies of morality and ethics. *Philosophy, Ethics, and Humanities in Medicine* 10: 2. <https://doi.org/10.1186/s13010-015-0022-0>.
 17. Martin, Amanda, Kira Becker, Martina Darragh, and James Giordano. 2016. A four-part working bibliography of neuroethics: Part 3 – “second tradition neuroethics” – ethical issues in neuroscience. *Philosophy, Ethics, and Humanities in Medicine* 11: 7. <https://doi.org/10.1186/s13010-016-0037-1>.
 18. Becker, Kira, John R. Shook, Martina Darragh, and James Giordano. 2017. A four-part working bibliography of neuroethics: Part 4 - Ethical issues in clinical and social applications of neuroscience. *Philosophy, Ethics, and Humanities in Medicine* 12: 1–32. <https://doi.org/10.1186/s13010-017-0043-y>.
 19. Gooray, Elena, and Cat Ferguson. 2023. *Neuroethics as a Field: How much has it grown, about what, and by whom?* International Neuroethics Society; UPenn Center for Neuroscience and Society. <https://ns.memberclicks.net/assets/neuroethics%20as%20a%20field%20survey.pdf>. Accessed July 3.
 20. Leefmann, Jon, Clement Levallois, and Elisabeth Hildt. 2016. Neuroethics 1995–2012. A Bibliometric Analysis of the Guiding Themes of an Emerging Research Field. *Frontiers in Human Neuroscience* 10: 251–319. <https://doi.org/10.3389/fnhum.2016.00336>.
 21. Burwell, Sasha, Matthew Sample, and Eric Racine. 2017. Ethical aspects of brain computer interfaces: A scoping review. *BMC Medical Ethics* 18: 60. <https://doi.org/10.1186/s12910-017-0220-y>.
 22. Collins, Benjamin, and Eran Klein. 2023. Invasive Neurotechnology: A Study of the Concept of Invasiveness in Neuroethics. *Neuroethics* 16: 11. <https://doi.org/10.1007/s12152-023-09518-1>.
 23. Gilbert, Frederic, J.N.M. Viaña, and C. Ineichen. 2021. Deflating the “DBS causes personality changes” bubble. *Neuroethics* 14: 1–17. <https://doi.org/10.1007/s12152-018-9373-8>.
 24. Society, International Neuroethics. 2023. International Neuroethics Society. <https://www.neuroethicssociety.org/about>. Accessed July 3.
 25. Selected Abstracts from the. 2011. International Neuroethics Society Meeting, Washington, DC. 2012. *AJOB Neuroscience* 3: 34–46. <https://doi.org/10.1080/21507740.2012.687800>.
 26. Top 25 Abstracts from. 2012. Annual International Neuroethics Society Meeting in New Orleans. 2013. *AJOB Neuroscience* 4: 63–75. <https://doi.org/10.1080/21507740.2013.782925>.
 27. Selected Abstracts From the. 2016. International Neuroethics Society Annual Meeting. 2017. *AJOB Neuroscience* 8: W1–W17. <https://doi.org/10.1080/21507740.2017.1293191>.
 28. Walker, Rebecca L., and Clair Morrissey. 2014. Bioethics Methods in the Ethical, Legal, and Social Implications of the Human Genome Project Literature. *Bioethics* 28: 481–490. <https://doi.org/10.1111/bioe.12023>.
 29. International Neuroethics Society. 2020. International Neuroethics Society Membership Distribution 2020. Accessed February 4, 2024. Available at: <https://www.neuroethicssociety.org/assets/reports/ins-membermap-2020.pdf>
 30. Das, Jayatri, Cynthia Forlini, Darrell M. Porcello, Karen S. Rommelfanger, Arleen Salles, Global Neuroethics Summit. Delegates, Nargis Akter, et al. 2022. Neuroscience is ready for neuroethics engagement. *Frontiers in Communication* 7: 909964. <https://doi.org/10.3389/fcomm.2022.909964>.
 31. Rieder, Travis N., Lauren Arora Hutchinson, and Jeffrey P. Kahn. 2022. Why the World Needs Bioethics Communication. *Perspectives in Biology and Medicine* 65: 629–636. <https://doi.org/10.1353/pbm.2022.0054>.
 32. Buchbinder, Mara, Nancy Berlinger, and Tania M. Jenkins. 2022. Protecting Practitioners in Stressed Systems: Translational Bioethics and the COVID-19 Pandemic. *Perspectives in Biology and Medicine* 65: 637–645. <https://doi.org/10.1353/pbm.2022.0055>.

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