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ARTICLE

It's (Not) Just Semantics: "Neurotechnology" as a Novel Space of Transnational Law

Walter G. Johnson

Stanford University, USA
Email: waltjohn@stanford.edu

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Abstract

How do "novel" spaces of transnational law emerge rather than being captured within existing legal regimes? This article argues that processes driving how the subject matter of a transnational legal space is defined and framed and by whom are notable in mediating such outcomes. The article presents the empirical case study of global neurotechnology governance and examines socio-legal processes whereby individual and organizational actors have constructed and defended neurotechnology as a distinct space of transnational law. Here, I argue that this can be understood as boundary work, which examines discursive and spatial processes of demarcating social entities from one another. The article shows how attention to external and internal boundaries around and within a transnational legal domain can sensitize socio-legal analysis to the more emergent features of these spaces, including more subtle modes of exclusion, cooperation, and coordination. The article concludes by reflecting on how attention to processes of boundary work can enrich inquiry into, and critique of, the earliest stages of transnational legal ordering.

Keywords: boundary work; emergence; global governance; neurotechnology; transnational legal orders; social space

Introduction

How do new spaces of transnational lawmaking emerge? The past several decades have seen increasing scholarly attention on transnational legal and regulatory dynamics from socio-legal and other perspectives (for example, Dezalay and Garth 1996; Merry 2006; Black 2008; Avant, Finnemore, and Sell 2010; de Búrca, Keohane and Sabel 2014). However, these various accounts and critiques of transnational lawmaking often focus on dynamics within reasonably well-established areas of law and policy. For example, work on the transmission and adaptation of norms

across levels of government (Merry 2006; Halliday 2009) and the (re)ordering of transnational legal systems (Shaffer 2012; Halliday and Shaffer 2015) has examined mechanisms or processes in established arenas such as climate, trade, or human rights. While norms and frames in these settings are often heavily debated, the object of lawmaking activity, sites of potential lawmaking, and stakeholder categories are relatively stable. How completely novel spaces of transnational legalization arise and mature into these more established systems instead remains under-theorized.

More recent socio-legal scholarship on transnational legal ordering provides a valuable point of departure. Transnational legal orders (TLOs) are often conceptualized as "a collection of formalized legal norms and associated organizations and actors that authoritatively order the understanding and practice of law across national jurisdictions" (Halliday and Shaffer 2015, 5; see also Shaffer 2012; Block-Leib and Halliday 2017). Inquiry under this lens has generally examined mechanisms that lead to the stability or instability of socio-legal ordering within discernable legal arenas. However, current theory has not yet provided sufficient tools for explaining how novel lawmaking spaces with unique structural or spatial features emerge from these mechanisms of legal ordering. Notably, scholarship on TLOs has typically treated the "issue area" where socio-legal ordering takes place as a constant, at least for analytic purposes (Halliday and Shaffer 2015; but see Büthe 2015). This raises questions around how novel issue areas begin, from what types of interactions and processes, and with what social and legal implications.

How then can socio-legal scholars grapple with the emergence of lawmaking spaces, especially with the seemingly increasing legalization of various social issues? The advent of a novel transnational legal space *sui generis*, rather than being captured in existing global governance activity, is an inherently complex and dynamic process, involving actors and their interactions across multiple sites and scales as well as evolution over time and space. Understanding emergence in social and legal systems creates various empirical and conceptual challenges, requiring analysts to grapple with issues around how social phenomena "emerge" from complex, multi-scalar systems. Emergent phenomena cannot be reduced to their individual components, yet they cannot be studied without examining these lower-level components and their interrelations (see, for example, Hodgson 2000). For instance, transnational socio-legal phenomena can rarely be reduced to individual national jurisdictions or international organizations (Kauffman 2017; Canfield, Dehm, and Fassi 2021).

This study draws on tools from science and technology studies, especially boundary work, in an effort to render these processes of emergence in budding transnational legal systems more visible and explainable. Processes of erecting, changing, and maintaining boundaries serve to distinguish social actors or objects from one another (Gieryn 1999; Liu 2015a; see also Lamont and Molnár 2002). Moreover, drawing boundaries can precipitate more emergent phenomena, including by reshaping the identities and functions of actors left on either side and by giving rise to new topological features in and across social spaces (Abbott 1995; Liu 2021). Gaining an understanding of how the boundaries have been drawn both around and within a lawmaking space should therefore provide insight into how transnational legal processes may become distinct from others and develop their own internal dynamics.

To explore these questions around emergent socio-legal dynamics in nascent transnational legal ordering, this study traces the construction of a novel

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lawmaking space oriented around "neurotechnology." In general, emerging technologies offer a fruitful area to examine these dynamics. Lawmaking and governance in these settings often involve technology development co-evolving and intertwining with political, issue-framing, and norm-setting processes in complex manners and at multiple levels to drive broader social processes (see Goyal, Howlett, and Taeihagh 2021).

Neurotechnology offers one such domain of new and accelerating transnational lawmaking activity, anchored in concerns around how these innovations can or should interact with the human brain and nervous system (see, for example, OECD (Organisation for Economic Co-operation & Development), 2019; IBC (International Bioethics Committee), 2021). Technologies of interest in this arena most notably include brain-computer interfaces (BCIs), which have varying capacities to collect information from the brain, modify brain functioning, or both. Such innovations could provide new types of medical treatments and consumer or workplace products, yet they raise numerous issues around safety, data protection, human rights, enhancement, and so on. In a message delivered at a 2023 conference at the United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Secretary-General António Guterres (2023) declared that "neurotechnology is advancing at warp speed" and called for "robust standards for mental integrity, mental privacy, and mental freedom." But what is neurotechnology? The statement does not provide a definition, nor a justification for why transnational law should include these types of norms.

Rather than neurotechnology simply falling within the bounds of one or more existing governance regimes (see Stokes 2012), transnational decision makers appear to be treating the topic as a unique issue area requiring distinct norm-setting activities. This observation raises questions around how global neurotechnology governance has emerged—as a novel regime—over multiple sites and scales, through what types of processes, and with what consequences for its early ordering.

This article argues that boundary work, carried out through various competitive and cooperative interactions, offers one process that can illuminate how spaces of transnational lawmaking emerge, including for neurotechnology. The study empirically traces how various actors have contributed to emergent processes that have simultaneously demarcated neurotechnology from other lawmaking spaces while also establishing divides within that newly drawn zone. In doing so, it distinguishes between external and internal modes of boundary work, drawing on a processual approach and spatial thinking (Abbott 2016; Liu and Emirbayer 2016). Examining these two different locations and scales at which boundary work can occur sensitizes the analysis to different sets of interactions involved in the case. These processes have spatial and political implications as constructing neurotechnology has included some stakeholders while excluding others and has contributed to the early topology of this novel lawmaking space.

This argument seeks to build on Susan Block-Lieb and Terence Halliday's (2017, 19) conclusion that "[h]ow law is made affects what law is made." The case of global neurotechnology governance illustrates that, beyond simply crafting a new substantive topic for lawmaking, actors and their interactions have co-created a distinct lawmaking space with both organizing and competing logics. Processes of constructing the object of lawmaking shapes who participates in norm setting and

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how and will likely influence whether and which norms are produced and by which actors across which sites. That is, what law is made about also affects what law is made and by whom.

The article proceeds first by reviewing this literature and conceptualizing external and internal boundary work. The following sections review background information on the case study, data, and methods. Findings from the study are then reported in three sections that trace external and internal boundary work as well as their interactions. The article concludes by reflecting on how spatial analysis and attention to processes of boundary work can enrich inquiry into, and critique of, the earliest stages of transnational legal ordering.

Boundary work

This article charts a new path to tracing and understanding the emergence of novel spaces of transnational lawmaking by drawing on "boundary concepts" from science and technology studies (Orsini, Louafi, and Morin 2017). Perhaps most prominent of these concepts is boundary work, which analyzes how social actors work to enact, modify, and challenge schemes of classification. Gieryn's (1983, 1999) original work on the topic explores how scientists work to distinguish themselves and scientific knowledge from other social domains such as government or lay audiences and "non-scientific" knowledge. Boundary work can thus "define people in or out" of a social space (Collins and Evans 2002, 242), though various types of boundaries can be arbitrary, blurry, porous, and change over time (Rosenau 1997; Gieryn 1999; Michaels 2009). Adopting a more processual understanding, and drawing and managing boundaries can be understood as leading to the construction and emergence of the actors on each side of the divide (Abbott 1995; see Emirbayer 1997). This article applies boundary work within a spatial framework of analysis, consistent with Gieryn's (1983; 1999, 7) original conceptualization, rather than a more symbolic approach to boundaries (see Lamont and Molnár 2002).[1]

Though boundary work scholarship initially tended to focus more on setting boundaries in competitive manners, scholars have expanded to examine related processes. Boundary work can occur through setting, blurring, or maintaining boundaries and through various types of communicative, cooperative, and coordinative types of interactions as well as competitive ones (Michaels 2009; Quick and Feldman 2014; Liu 2015a; Langley et al. 2019). In addition to the sets of actors on either side of a divide, third parties sitting on or above borders may also participate in mediating and managing boundaries. Boundary work may also have a strategic or goal-oriented dimension. Actors may engage in boundary work with different objectives in mind, including actively excluding others, defensively warding off intrusion by others, or competing over particular tasks or claims to authority (Abbott 1988; Gieryn 1999).

[1] These frameworks aim to capture dynamism and complexity through conceiving of the social world as populated by actors, who can occupy different positions in the social space, with various types of relationships possible between actors and those positions (Liu 2015a, 2021; see also Abbott 2016). Boundary work has been featured in socio-legal research applying these spatial approaches (see, for example, Liu 2015a; Block-Lieb and Halliday 2017).

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The concepts of boundary objects and organizations, again from science and technology studies, offer further analytic depth here. These concepts have seen less engagement with the socio-legal literature. Boundary objects occupy multiple social orders simultaneously and can create bridges or points of interaction between those groups by offering shared reference points (Star and Griesemer 1989). They thus "allow different groups to work together without consensus" (Star 2010, 602). These objects—which can be abstract ideas or symbols in addition to material things—enable an interface for interaction through their intermediate level of ambiguity. Such objects have enough of a common meaning to produce a shared understanding across groups, but they may then have more specific interpretations and uses within a specific group and its context. For example, the broad definition and conceptualization of the term "resilience" organizes and coordinates research across multiple academic disciplines but can have different uses and applications in these different communities (Brand and Jax 2007). Law or lawmaking may enable the institutionalization and increased reach of boundary objects as well, as illustrated below by the use of neurotechnology as one such object.

Boundary organizations are entities that assist in mediating the boundaries between two social entities, through responsively facilitating the use of boundary objects by coalitions of actors on both sides (Guston 2001). For instance, scientific advisory bodies can act as boundary organizations by facilitating discussions between scientists and policy makers over how to use science to steer decision making, such as with the Subsidiary Body for Scientific and Technological Advice under the United Nations Framework Convention on Climate Change (Miller 2001; see also Guston 2001).[2] International organizations themselves can act as boundary organizations with the potential to mitigate competition and promote coordination among varied actors within a lawmaking space, while potentially being transformed by those actors in the process (Morin et al. 2017).

Attention to boundary concepts holds promise for delivering fresh insights into how transnational governance regimes emerge and evolve. The capacity of boundary work to render visible more complex processes that can play out across multiple sites and scales may offer utility in examining phenomena such as the formation of lawmaking coalitions or interpretive communities or exclusion from those sites. Examining such processes may aid in addressing analytic challenges at the global level of analysis, such as the recursivity of multiple scales, interrelations between state and non-state actors, and polycentricity (Black 2008; Halliday 2009; Kauffman 2017; Canfield, Dehm, and Fassi 2021). Boundary work has already found some use in the study of transnational lawmaking, including in examining how international organizations work to demarcate themselves from one another, with both contentious and coordinating outcomes (Block-Lieb and Halliday 2017; Kranke 2022). These studies focus on boundaries around the legal scope and mission of one organization *vis-à-vis* another. Yet other social objects can be the subject of boundaries.

Just as the domain of science can be bounded off from non-science, it should also be possible to bound the very object of transnational lawmaking to distinguish one legal space from another. Such inquiry may involve a wide set of actors who

[2] United Nations Framework Convention on Climate Change, 1992, 1171 UNTS 107.

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collectively participate in processes leading to emergent phenomena. For instance, diffuse epistemic communities could be envisioned as engaging in boundary work in complex manners where the scope of both a scientific field and of international lawmaking are contestable and contested (Orsini, Louafi, and Morin 2017, 737; see also Haas 1992). Moreover, the ability of various third parties to engage in the mediation and maintenance of boundaries may provide further insights into the complexity and polycentricity of transnational legal processes (Guston 2001; Miller 2001; Liu 2015a).

Building on these literatures, this article conceptualizes boundaries and boundary work as processes that can occur both around and within a space of transnational lawmaking. To do so, it distinguishes between external and internal forms of boundary work.

External boundary work serves to draw, contest, or preserve the lines around a social space to meaningfully distinguish its actors and their functions from others and provide those actors within it a shared sense of substance or purpose. Establishing external boundaries serves to distinguish one space (including a nascent one) from others, which will unfold over time. Such processes should contribute to the social distance (including overlaps) and types of relationships (for example, symbiotic, oppositional) between these distinguished spaces and the actors and positions within them (Liu 2021). Moreover, boundary organizations may sit on external boundaries to facilitate or mediate interactions across these demarcated zones (see Guston 2001). External boundary work may occur cooperatively by actors within a single space pursuing collective benefits or by actors across multiple ones aiming for coordination. It may also take place in more oppositional ways if actors seek to remove themselves from an existing space or coalitions begin to compete and define themselves against one another. For example, scientists distinguishing their expertise from policy or "pseudoscience" work cooperatively with one another, yet competitively against other actors, to create an external boundary distinguishing their practices from non-science (Gieryn 1999). Attention to the precise type and blend of interactions within and across spaces will therefore assist analysts in understanding the spatial and temporal consequences of external boundaries.

Internal boundary work instead pertains to activities that make and unsettle boundaries within a space as subgroups of actors or discourses form and reform in the process of struggling for dominant positions. Internal boundary work therefore does not seek to place excessive distance between actors in a common space but, rather, to regulate which actors can occupy different regions and how. The use of boundary objects may facilitate interaction and exchange across these internal boundaries for actors with similar enough notions of the object of lawmaking (Star and Griesemer 1989). Such processes could also have competitive or cooperative characteristics over time as actors carve out niches within the larger zone created by an external boundary. For instance, closely related professions competing over similar or overlapping tasks can set internal boundaries within a larger space, such as physicians and lawyers competing over the treatment of alcohol use (Abbott 1988) or investigators and prosecutors dividing out different roles in the criminal justice system (Liu 2015b). International organizations seeking to distinguish themselves from one another within the same issue area, such as international trade or investment law, may also produce internal boundaries that can promote future coordination or competition alike (Block-Lieb and Halliday 2017; Kranke 2022).

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The same actors and institutions can participate in external and internal boundary work separately or simultaneously, knowingly or unknowingly, competitively or cooperatively. Indeed, these types of interactions should interact over time in complex ways to drive overall socio-legal processes and co-construct a governance space (see Abbott 1995). For example, internal boundary work could ultimately yield external boundaries over time if the distance between positions and actors across that internal boundary expands significantly.

These observations and the case study below suggest that differences between external and internal boundary work may arise not only from location but also from scale. Boundary work around a social space occurs at a different scale than when it occurs internally, yielding different apertures for actors and their interactions and potentially distinguishable politics or temporalities (see also Valverde 2015). For neurotechnology governance at least, grasping the technical scope of an issue area in transnational law and its participatory politics (external boundary) does not appear to fully explain its internal ordering and more factional politics (internal boundary)—and vice versa—though they are related. Boundary work at both scales has ordering effects, though the spatial and political implications of each may be rendered more or less visible from different vantage points. Future research may be required to further conceptualize and explore these differences. With this understanding of external and internal boundaries, the article now turns to the present study.

The rise of global neurotechnology governance

Global neurotechnology governance has emerged as a novel space for discourse and decision-making over several years and across multiple sites and scales. Overall, two topics of lawmaking have emerged at the global level—responsible innovation and "neurorights"—largely housed at the institutional sites of the OECD and UNESCO, respectively. These two lawmaking processes form the anchor points in an emerging lawmaking space that recursively integrates various other sites of legal discourse at the global, regional, state, and local levels (see Halliday 2009). The current landscape is very briefly overviewed here to orient readers to the subsequent analysis.

Responsible innovation

One significant transnational lawmaking process around neurotechnology has arisen around responsible innovation (RI). This framing has roots in the academic literature on RI that emphasizes activities such as anticipating issues with emerging technologies, encouraging scientists and technology developers to reflect on their role in shaping innovation, and engaging broad publics in deliberation about innovation and its goals (Stilgoe, Owen, and Macnaghten 2013). A growing coalition of state and non-state actors have adopted this RI perspective for neurotechnology, which has used scholarship as a launching point but has since developed in its own direction.

The OECD has acted as an early site for the legalization of neurotechnology governance through the lens of RI. The emphasis on RI began early in the OECD's work on the topic and focuses on presenting RI as an enabling framework for economic development around neurotechnology (Frahm, Doezema, and Pfotenhauer 2022). The

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body has already produced a nonbinding international instrument on responsible innovation in neurotechnologies in 2019 (OECD 2019). Presented as a soft legal initiative, the recommendation sees all thirty-eight member states voluntarily commit to uphold nine broad principles that advance RI such as by monitoring for the misuse of innovations, promoting policy-maker engagement with local publics and scientific collaboration across borders, and protecting "brain data." Though the recommendation remains soft law, member states have voluntarily committed to report back to the OECD in late 2024 about their progress in implementing these norms in their national contexts.

National-level state actors and private sector actors have recursively been included in the OECD's activities around neurotechnology. Most notably, France has issued a voluntary charter on the responsible development of neurotechnology, which directly cites and claims to implement the OECD recommendation.[3] The OECD has also worked to include private sector actors and leverage private modes of regulation in the process of implementing the principles in its recommendation. This has occurred in part by directly engaging with actors developing neurotechnologies to discuss the application of these norms, which the OECD has done alongside BrainMind (2022), a non-state coalition of investors.

Neurorights

A second transnational lawmaking process has emerged that focuses on the human rights implications of neurotechnologies, which are often referred to as "neurorights." Primary categories of norms under discussion within this discourse include rights to cognitive liberty, mental privacy, agency, psychological continuity, protection from algorithmic bias, and equal access to cognitive enhancement (Ienca 2021a, 2021b). Disputes remain, however, between actors working here on whether current rights norms and instruments are robust enough or novel human rights are required. These debates began in academia but have rapidly moved into legal communities, with Chilean lawmakers amending their national constitution in 2021 to require the state to "protect brain activity"—to much fanfare from some neurorights proponents.[4]

At the global level, legal and policy discussion of neurorights has taken place largely at UNESCO.[5] Commissioned in 2019, the agency's International Bioethics Committee (IBC) issued a 2021 report on the *Ethical Issues of Neurotechnology*, which calls attention to perceived issues with human rights law in addressing such issues (IBC 2021). Since then, UNESCO has escalated its activities on neurotechnologies, including holding a conference in 2023 that appeared to have the blessing of the UN

[3] Charte de Développement Responsable des Neurotechnologies, Ministère de l'Enseignement supérieur et de la Recherche, France, 2022, https://www.enseignementsup-recherche.gouv.fr/sites/default/files/2023-01/charte-de-d-veloppement-responsable-des-neurotechnologies-25237.pdf.

[4] Ley 21383: Modifica La Carta Fundamental, Para Establecer el Desarrollo Científico y Tecnológico al Servicio de las Personas, Chile, 2021, https://www.bcn.cl/leychile/navegar?idNorma=1166983.

[5] The Advisory Committee of the UN Human Rights Council (2022, 2024) commissioned a study from on neurotechnology and human rights in 2022, which may offer another institutional site at the international level. At the time of writing, however, most of the multilateral discussion has occurred at UNESCO.

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Secretary-General to discuss topics such as "mental integrity, mental privacy, and mental freedom" (Guterres 2023). In late 2023, UNESCO authorized negotiation on some form of international instrument that will set norms on the ethics of neurotechnology. The binding character, shape of the instrument, and types of norms have yet to be determined at the time of writing.

Recursive patterns of national and regional-level state and civil society actors becoming involved have also occurred in the neurorights discourse. The Chilean constitutional amendment in 2021 has been heavily cited and discussed by actors at multiple levels of government and across several national jurisdictions. Other national governments have become involved in experimenting with these norms, including Spain and Mexico issuing nonbinding charters of digital rights that each include sections on neurorights.[6] Regional organizations, particularly the Council of Europe (Ienca 2021a) and the Organization of American States, have also launched initiatives to develop or interpret norms on human rights in the setting of neurotechnology.[7]

The current landscape of global governance for neurotechnology, despite its youth, offers a complex portrait of transnational legal flows and raises several questions about its provenance and early development. What is neurotechnology and how do actors distinguish these innovations from related areas and techniques? Even within the larger space of neurotechnology, how have two separate lawmaking processes developed around RI and neurorights while the space itself remains so nascent? And how have these overlapping transnational legal processes remained partially integrated even while separate coalitions appear to be forming? These questions provide points of departure for the empirical analysis below.

Data and methods

This analysis draws on findings from an exploratory, qualitative, single-case study that occurred from May 2022 through mid-2024. Data included thirty-one semi-structured interviews, participant observation at virtual events, and collecting documents and archival resources across multiple sites and jurisdictions. Following Sally Engle Merry (2006, 29), this distributed approach sought to access a "placeless phenomen[on] in a place" by identifying and examining the dynamics within the "small interstices in global processes in which critical decisions are made." The interview subjects were elites drawn from the public, private, civil, and academic sectors and located in multiple (mostly high-income) jurisdictions in the Americas, Europe, and Asia-Pacific. These elites populated or had access to a transnational epistemic community working towards global governance for neurotechnologies (Haas 1992). Some participants worked or volunteered in multiple roles across multiple sectors, jurisdictions, or scales, or were not citizens of the jurisdiction where

[6] Carta Derechos Digitales, Government of Spain, 2021, art. 26, https://www.lamoncloa.gob.es/presidente/actividades/Documents/2021/140721-Carta_Derechos_Digitales_RedEs.pdf; Carta de Derechos de la Persona en el Entorno Digital: Código de Buenas Prácticas, Sistema Nacional de Transparencia, Mexico, 2022, ch. 7, https://www.infocdmx.org.mx/doctos/2022/Carta_DDigitales.pdf.

[7] Inter-American Declaration of Principles on Neuroscience, Neurotechnologies, and Human Rights, OAS Doc. CJI/RES. 281 (CII-O/23) corr.1, 2023.

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they worked, speaking to the complexity of studying transnational lawmaking and those who become involved in such processes (Kauffman 2017).

Recruitment for interviews occurred through direct outreach, making use of professional and social networks and snowballing techniques. The sampling approach prioritized obtaining access to elites with direct insights into the transnational legal processes being investigated. Most interviewees were directly involved in these activities, either because they were affiliated with an institution housing one such governance process or through participating in another organization's process, or both. Data collection also quickly revealed a relatively small number of interview candidates in this category, given the small and niche nature of the field. However, this sampling approach also resulted in a population with a skewed demographic and geographic character as most participants were men (58 percent), highly educated, and located in high-income Western states. Accordingly, a secondary goal in sampling was to access and elicit a broader range of perspectives from elites with awareness of, but less access to, the processes being studied. All interviews occurred in English and electronically through video conferencing software (Zoom, Microsoft Teams). No incentives were provided to participate. Interviews were recorded with the consent of the participants and transcribed by hand to facilitate immersion in the data and initial thematic insights.

Interviews sought to elicit participants' understandings and views of global neurotechnology governance, with data collection exploring perceptions and judgments of the relevant sites, scope, substance, and their politics. Questions invited participants to define "neurotechnology" itself, describe and frame substantive issues and solutions in governing this object, offer perceptions of their own and other actors' expertise, and identify and reflect on sites of governance and their politics. Questioning proceeded through both direct and indirect means, where indirect means of questioning enabled soliciting answers without offending participants and while operating within the power dynamics created by interviewing elites. The exploratory nature of the case study and use of indirect questioning required questions and follow-ups to be asked in various manners while seeking similar information, often responding to the context of the particular interview. Tone of voice, question evasion, pauses, and reactions such as uncomfortable laughter were closely examined and integrated into the analysis as appropriate.

Analysis of the interview data proceeded through cautious triangulation with other data sources in light of the sampling outcomes in order to verify themes and scrutinize potential bias in data. Participant observation allowed for the collection of data at events held by relevant international, national, and non-state bodies. Most events were open to the public (at times, with prior registration), including virtual participation, and some were streamed or recorded for public consumption. Data collection here sought insights on how actors presented themselves, their organizations, and substantive topics and how they viewed others in a public setting populated with peers. Documents and archival resources were collected electronically from a variety of actors across multiple jurisdictions and scales. These resources offered more formal presentations of definitions, frames, and self-credentials, providing points of departure and comparison with other data. These data were diverse in format and included policy documents, reports, meeting agendas, stakeholder input, press releases, and recorded events.

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Thematic analysis followed, assisted by qualitative data analysis software (NVivo, version 12). Adopting an abductive approach (Timmermans and Tavory 2012; Vila-Henninger et al. 2024), analysis moved recursively between data and theory to develop, test, and improve codes and themes. In practice, this meant first round coding involved inductively capturing definitions, discourses, and framing devices from different actors. Applying a processual and spatial perspective (Abbott 2016; Liu and Emirbayer 2016), analysis shifted to examining how discursive interactions between actors began to produce spatial ordering in the case over time. Comparing existing theory and initial themes yielded gaps that required further abductive coding to explore and make sense of gaps identified, particularly in relation to making sense of the emergence of a distinct, transnational discursive and legal space with its own topology.

Attention to boundary work enabled an analytic distinction between external and internal types of boundaries that were observed to modulate the spatial environment in different manners. The resulting findings shed light on an opaque and decentralized set of processes, yet they arise from a single-case study characterized by a small, concentrated set of actors and should be generalized from with appropriate caution. The subsequent analysis yielded analytic themes, such as issue framing and technology framing, which affected the structure of this argument and its presentation.

Bounding the neurotechnology governance space

Defining neurotechnology as external boundary work

The term "neurotechnology" has been constructed in contingent ways that have enabled some kinds of lawmaking but not others. Establishing neurotechnology as a novel space for transnational lawmaking first required determining what is and is not neurotechnology, which actors have worked to establish over time and space. Placing and hardening this external boundary has included or invited some actors while removing others from conversations around neurotechnologies and their governance (see also Gieryn 1999; Block-Lieb and Halliday 2017).

The meaning of the term "neurotechnology" and the technical and policy fields that it implies is far from obvious. As one participant simply said, "it was very hard to define what is and isn't neurotechnology." As recently as 2002, engineers had used the term to refer to biologically inspired design for robotics: "[N]eurotechnology is the process of engineering devices that confer the performance advantages of animal systems on a new class of biomimetic machines" (Ayers, Davis, and Rudolph 2002, ix). The transnational scope of lawmaking, however, has come to refer to something quite different, with conversations roughly consolidating around the following: novel devices with software components which record or change (or both) human brain activity and have associated policy issues that are perceived as unresolved or challenging. This most often refers to BCIs, in particular, including with the use of existing techniques such as electroencephalography (EEG) or functional near-infrared spectroscopy. Each of the components of this construction has arisen over time from boundary work aiming to distinguish transnational lawmaking activities in this space from others.

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What neurotechnology is and is not

This understanding of neurotechnology has become partially codified in formal legal instruments or documents, crafting a preliminary but blurry external boundary. This preliminary definition appears to have arisen in scholarship in the United States, before recursively moving up first to the plurilateral level, then to the multilateral level, and later down to some states. Notably, the OECD's (2019) recommendation provides a highly influential definition across sites, which is ostensibly rather broad: "[D]evices and procedures used to access, monitor, investigate, assess, manipulate, and/or emulate the structure and function of the neural systems of natural persons." The definition appears to largely adopt and slightly adapt one put forward by a prominent US-based neuro-ethicist several years prior (Giordano 2012, 4). The OECD's definition of the term was referenced by several participants during interviews and has been directly cited at other levels of government, including in the 2022 French Charter on Responsible Development.[8] UNESCO applies a nearly identical definition in its documents, beginning in 2021, only differing in including "animals" in the scope (IBC 2021, para. 6; UNESCO 2023a, 22). Actors in the space have at least some awareness that these definitions have influence over lawmaking processes, with one participant commenting: "When you make a definition, you try to define a field where you will investigate or you could regulate."

While formal definitions of the term provide a first step towards constructing the object of legalization, actors have sharpened the edges of the external boundary by working to significantly narrow definitions in practice. This boundary in the form of a working definition has evolved over both time and space. While policy attention to neurotechnology has often focused on devices in the past decade, this focus has become more intense and exclusionary over time. Early uses of the term in policy settings include the UK Nuffield Council on Bioethics's (2013) report on the topic, which includes stem cell therapies as one of its four technological areas of interest, alongside BCIs and other devices. Two early neuroethics reports to come out of the US Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative highlight both pharmaceuticals and electrical devices such as deep brain stimulation (US Presidential Commission for the Study of Bioethical Issues 2014, 2015).[9] However, especially in the last several years, international organizations have pivoted to focus entirely or almost exclusively on emerging devices (IBC 2021; García and Winickoff 2022; Advisory Committee of the UN Human Rights Council, 2022, 2024; UNESCO 2023a).

One particular class of device has become emblematic of the external boundary: BCIs. Of the many possible techniques that could fit into the broader formal definitions, BCIs were a primary area of discussion for most interviewees and at most events held by global governors. One participant confirmed: "I'd say brain-computer interfaces are the main technologies—and maybe together with brain stimulation devices—that people are talking about." Others spoke about BCIs as containing both data collection and brain stimulation capabilities, capturing a wider range of

[8] Charte de Développement Responsable des Neurotechnologies, 3.

[9] The US Brain Research Through Advancing Innovative Neurotechnologies (BRAIN) Initiative is a sweeping funding program for neuroscience research and development, where the "N" notably stands for neurotechnology.

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techniques under the heading of BCIs. While the OECD has not amended its definition of the term, it has increasingly moved in this direction following its 2019 recommendation. Officials wrote a 2022 white paper dedicated to "neurotechnologies—BCI technology in particular" because they "may raise a range of unique ethical, legal, and policy questions" (García and Winickoff 2022, 6). The Advisory Committee to the UN Human Rights Council (2022, 15) included BCIs in its definition of neurotechnology more broadly: "[A]pplications [that] allow for a two-way connection (brain-computer interfaces) between the individual's central nervous system (brain and spinal cord) and an electronic system."

Another component of external boundary work came from determining what is not neurotechnology. While transnational legal discourse has focused heavily on BCIs and other emerging devices, a wide list of other things could be considered neurotechnology as well. A distinct minority of participants (sometimes only one), events, and documents referred to a series of other items that they considered as potentially falling within the scope of neurotechnology. These included: neuropharmaceuticals such as epilepsy medication; software such as an app (without a physical device) intended to treat mental health conditions; gene editing targeting neural tissue, including optogenetic techniques; neural stem cells or brain organoids; recreational drugs; and biologically inspired ("neuromorphic") computing. However, when asked in interviews, most participants explicitly denied that pharmaceuticals, software without a device component, or biologics are or should be included in the scope of neurotechnology. One interviewee flatly noted: "You wouldn't call a drug neurotechnology," before laughing while joking: "Like, aspirin could be neurotechnology by that definition." Most participants emphasized that they were focused largely or exclusively on devices, especially emerging ones, and some attested to lower technical expertise or familiarity with drugs or biologics.

The newness of both a technology (or its application) and its governance challenges has also become an important element of the term's construction and resulting boundary. The Council of Europe's report on neurotechnologies and human rights defines the term as "*emerging* technologies that establish a connection pathway to the human brain" and that "raises *major* ethical and legal challenges" (Ienca 2021a, 6; emphasis added). The report goes on to identify primarily devices and techniques used in devices to "read" potentially sensitive information from the brain or electrically stimulate the brain, and it raises allegedly novel ethical and human rights issues in areas such as privacy and autonomy. One participant specified that applying a narrow construction of neurotechnology as devices with specific uses was important for guiding lawmaking activities:

> Narrow [definition] when it comes to speaking about governance and regulation of neurotechnology. Because there is, I would say, only a handful of existing and emerging technologies that really fall within the purview of normative, ethical, legal, and regulatory questions. . . . So, anything that is, in principle, usable for the kinds of consumer neurotechnology applications that people are concerned about, worried about, talking about.

Thus, while existing devices such as EEG or magnetic resonance imaging (MRI) scans used in routine medical practices could fit under a broader definition of

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neurotechnology, actors involved in transnational lawmaking have largely excluded these applications. This has occurred at least in part because those existing devices do not pose ethical, legal, or policy issues perceived as urgent or in need of expert analysis.

Inclusion and exclusion along an external boundary

One consequence of drawing an external boundary around neurotechnology governance in this way—with emerging "neuro-devices" on one side and everything else on the other—comes from how it influences who has been included in the space. These processes have had inclusive effects through both the types of technological- and policy-related expertise perceived as germane to neurotechnology governance. For example, one participant familiar with processes at a global governing institution indicated that "our constituency is mostly … engineers" and "we felt the focus should be more on the devices, because that's more the people we have involved in [our activities]." Similarly, events at multilateral and regional organizations with dedicated panels for scientific or technical experts have included primarily experts who can speak to devices and their ethical or policy implications (Council of Europe & OECD (Organisation for Economic Co-operation & Development), 2021; UNESCO 2023b). Significantly less representation from experts speaking to pharmaceuticals or digital mental health has been observed at these sites.

The framing of neurotechnology as posing "unique ethical, legal, and policy questions" has also drawn a number of experts from these backgrounds into transnational discourse (García and Winickoff 2022, 3). The UNESCO event mentioned above opened with an official stating: "Neurotechnology requires an ethical framework" and contained a full expert panel on the "ethical challenges and human rights implications" of neurotechnologies, populated primarily by ethicists and lawyers (UNESCO 2023b).[10] Several participants suggested that members of the International Neuroethics Society, an association of academic ethicists specializing in neuroscience-related issues, have been active in discourse in and around global governance activities. Drawing external boundaries has likely contributed to setting experts with technical and ethical or policy knowledge related to emerging devices on one side, while placing others without neurotechnological device-related knowledge at a distance from lawmaking sites.

Placing an external boundary by constructing neurotechnology in this manner has had an exclusionary effect on some types of actors (see Gieryn 1999). Individual experts and organizations not doing work or possessing expertise perceived as being within the confines of the external boundary have largely withdrawn from, or never engaged with, global neurotechnology governance. Reflections from interviewees and comments at public events do not suggest that inside actors have actively expelled others from the space but are more consistent with an interpretation that setting the external boundary has resulted in several classes of actors finding themselves on the "other" side of the discursive divide. This would also be consistent with Andrew Abbott's (1995) notion of boundaries constructing actors rather than the other way around.

[10] Field notes, 2023.

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For example, the World Economic Forum (WEF) created a Global Future Council on Neurotechnologies around 2018 (WEF 2018). Yet two participants indicated that the scope of the work turned toward digital mental health and away from emerging devices over time. Within a short time, the WEF body suddenly and without public explanation became the Global Future Council on Technology for Mental Health (WEF 2020). In a similar case, an official from the World Health Organization's (WHO) division on mental health attended a single OECD event on neurotechnologies in late 2021. However, the official framed their work in terms of "neurological disorders" and "public health," calling for more attention on access to existing technologies or medicines and health service provision (OECD 2021a). These narratives and recommendations placed the official at odds with other participants of the session, who spent more time discussing ethical issues around nascent devices and product categories. This WHO department has not publicly engaged with the OECD or other global governors on "neurotechnologies" since then.

Brandishing the emerging nature of neurotechnologies and the need to anticipate and address future issues may also contribute to removing patient, consumer, or disability groups from governance conversations. The emphasis on nascent devices like BCIs, which are largely pre-market in the medical context and still niche in the consumer context, may cast governance processes as being only on the periphery of the interests of civil society groups with limited resources. Two different participants from the academic sector noted that patient groups specifically, and civil society groups more generally, have largely been absent from transnational legal discourse. When asked about any civil society groups that often appear in global conversations, one of the interviewees responded: "Well, I wouldn't say often ... there's room for improvement." Data collected from meeting agendas, public submission to governing bodies, and participant observation at events corroborates these accounts. When civil society groups did engage or appear at a meeting—for instance, a 2021 public meeting at the OECD (2021b)—they generally did not reengage or appear at other global governing bodies. The first advocacy organization made of patients who have received medically implanted BCIs only formed in 2022, when fewer than forty patients worldwide had undergone this type of intervention (Welle 2022).

At a 2022 event on BCIs at the US National Academies of Science, Engineering, and Medicine, a rare representative from a patient group (the ALS [amyotrophic lateral sclerosis] Association) participated. They not only offered some comments on what these patients may be interested in from BCIs but also suggested that the community felt urgency for more immediate solutions rather than future-oriented BCIs.[11] The association's website has a page that notes: "Most BCI systems are still in the research and development stage," and patients may "find that BCI is slower and more complicated" than other assistive technologies (ALS Association 2020). Such comments suggest that this particular patient group does not see BCIs—the crux of neurotechnology in transnational lawmaking conversations—as a significant part of their work.

Constructing neurotechnology as only nascent devices with challenging policy issues also appears to have exclusionary effects on actors from lower- and middle-income countries (LMICs). One participant from a medium-income country noted

[11] Field notes, 2022.

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feelings of exclusion from global discourse, describing "this perception that if you [an LMIC] don't have the financial means to acquire this advanced technology" then "ok, they don't have these issues because they don't use this." The interviewee strongly contested the perception that their jurisdiction did not have access to newer techniques such as deep brain stimulation and felt frustrated that global discourse had limited room for meaningful cross-cultural dialogue. They also insisted that existing devices merited greater attention in transnational governance as their home jurisdiction had ongoing issues with access to, and safety of, older and sometimes "outdated" devices with neurological applications.

Competing frames as internal boundary work

Processes of internal boundary work can take place within a larger external boundary. In this case, setting an internal boundary has come in the form of drawing lines between different lawmaking narratives and agendas—most notably, between RI and neurorights approaches. While an external boundary may define and clarify the relevant actors and substantive focus within a lawmaking space, further competitive and cooperative interactions can and do still take place within that landscape. Therefore, examining internal boundary work more closely can help to illuminate the internal topology of a space, which will evolve over time in relation to how the external boundary comes into existence (see Abbott 1995; Liu 2021). This section examines how internal boundary work has occurred in emerging neurotechnology governance.

Plural agenda setting for neurotechnologies

Noted above, two separate but related transnational lawmaking agendas have emerged. Both processes focus on "neurotechnology" and share a virtually identical understanding of the term as explored in the previous section. However, these processes not only differ in the content of legal norms that are discussed and flow recursively (see Halliday 2009) but also are animated by different discourses with distinct but overlapping sets of actors, narratives, and goals. One discourse applies an economically tinged logic of RI, while the other applies a human rights (neurorights) approach. These differences are clearly visible in documents and events at different global governors. The OECD's nonbinding instrument contains "responsible innovation" in the title, and the body has invited experts on responsible (research and) innovation to speak at public events on neurotechnology (OECD 2019, 2021b). Within the UN ecosystem, significant discussion of neurorights has occurred between experts during UNESCO meetings and in documents produced by the Advisory Committee of the UN Human Rights Council (2022, 2024).[12] Comments from the UN secretary-general also apply a human rights logic to neurotechnology (Guterres 2023).

Further, the potential to even demarcate these two discourses arose over several years. While the OECD process around RI began in the mid-2010s (see Garden et al. 2019; Frahm, Doezema, and Pfotenhauer 2022), the academic literature on neurorights only began in full in 2017 (see Ienca 2021b). Conversations around neurorights did not

[12] Field notes, 2022; Field notes, 2023.

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then move from academia and gain more momentum in legal and policy circles until the early 2020s (IBC 2021; Ienca 2021a; Advisory Committee of the UN Human Rights Council 2022). Thus, for a span of at least several years, RI was the only significant discursive frame applied in neurotechnology governance. The emergence of a second frame enabled potential internal boundary work and the potential for multiple, competing centers in the space (see also Block-Leib and Halliday 2017; Kranke 2022).

Distinguishable yet overlapping coalitions of individual and organizational actors have begun to consolidate around these two transnational legal discourses, reflecting spatial ordering within the external boundary over time. Multiple participants identified certain actors (individuals and organizations) as being more associated with either RI or neurorights agendas as well as a handful of actors prominent in neurotechnology governance more generally. Such distinctions extended to national governments, with interviewees identifying Canada, France, Switzerland, and the United States as being more associated with the RI discourse and the OECD.[13] Instead, UNESCO (2023b) held a panel of state ministers to discuss neurotechnology in 2023 that included Chile, Slovenia, Spain, and two non-OECD member states, Morocco and Saudi Arabia. These coalitions have changed over time as well, with the OECD increasingly seeking to engage with the private sector. In 2022, the OECD cohosted an event with BrainMind, a non-state entity seeking to boost investment in neurotechnology, with a significant number of private sector participants. The meeting was titled Neuroethics Implementation in the Private Sector, and it centered the discussion on the "implementation" of interventions including the OECD's instrument on RI (BrainMind 2022).

Dueling frames across an internal boundary

These actors have worked to craft separate frames and agendas for their respective transnational lawmaking agendas. Several interviewees more closely associated with the RI discourse noted that they avoided using the term "regulation"—and one even noted difficulty with the term "ethics"—because of its association with restricting innovation. Speakers and participants at the OECD events (see, for example, OECD 2021b) spoke more positively of "governance" and "soft law," including non-state regulation such as setting norms through technical standards or industry self-regulation (see Garden et al. 2019). For instance, when asked to describe the current regulatory landscape of neurotechnology, one participant prefaced their comments with: "I will answer in terms of governance instead of regulation. For many people, regulation is a word that creates physical responses." Another responded: "There has been quite a bit of effort around the regulatory space for neurotechnology—or, the governance, I'll call it the governance space, not regulatory but governance space. I think the best one is that OECD guidance, the RRI [responsible research and innovation] guidance."[14]

[13] Charte de Développement Responsable des Neurotechnologies.

[14] Where RRI refers to "responsible research and innovation," which R(R)I experts sometimes insist is more associated with European supranational policy than academic discourse on RI (Owen and Pansera 2019). However, participants in this study occasionally mixed the two terms (RI or RRI), and some did not appear to make clear distinctions between them.

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These efforts have framed RI as a path to co-regulation ("governance") with industry. Moreover, an agenda of setting pro-innovation legal norms appears to have appealed to particular actors within the overall neurotechnology space and may have assisted with coalition building. For example, one participant commented that, in their experience, the RI "framing was very palatable" to the representatives of national governments with whom they interacted. Another interviewee noted that some private sector members were aware of the language of RI but may not have the "academic" understanding of the term. The private sector engagement with language of responsibility may in part reflect industry presence at several OECD events on the topic (OECD 2021b; BrainMind 2022). A participant more aligned with the RI discourse and the private sector described the Chilean constitutional amendment around neurorights (Ley 21383) as "regulation" and concluded that "it was really restrictive actually. ... There's not a lot of innovation happening in that space in Chile. But if that were to be adopted globally, that actually would be problematic." The innovation-friendly framing may then have opened the RI agenda to further participation by, and support from, private sector actors seeking to advance their interests.

By contrast, the neurorights discourse has focused less on soft co-regulation with industry and more on creating or adapting binding human rights law at multiple levels of government. Actors have more often presented states (rather than private developers) as the primary unit of these conversations, which are both needed to implement local (neuro)rights law and need to be guided by global governors. Such conversations are consistent with the observation that international organizations often engage in the meta-regulation of states on human rights issues, seeking to steer national-level rights law and legal decision-making rather than set all norms at the multilateral level (Arduin 2019). For instance, the director of the Neurorights Foundation, a prominent civil society organization in the space, is fond of saying: "If this is not a human rights issue, what is a human rights issue?" and has regularly called for a new multilateral treaty to recognize neurorights.[15] Even "soft" legal interventions in this discourse have been framed as needed guidance to interpret current hard law or establish binding law at other levels of government. At the 2023 UNESCO conference, one of the lead officials, Gabriella Ramos, described the potential role of the agency as: "What we want to do is not only to have a very solid international instrument laying the ethical and the human rights issue[s] ... we want to have an action plan. A roadmap for implementation, for policy thinking, for regulatory frameworks, for instruments that we can use to shape the technological progress."[16]

The private sector has engaged less with transnational legal processes around neurorights, with a panel at UNESCO on the "private sector" featuring only two panelists—both of whom were investors and not technology developers (UNESCO 2023b). While managing private sector development still appears in this discourse, one participant suggested: "The neurorights debate really comes from the academic discussions around the relationship between ethics and law ... and the precise relationship between ethics and fundamental rights." Focusing on rights law and its

[15] Field notes, 2022.
[16] Field notes, 2023.

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normative content more in the abstract appears to have similar implications for coalition building as the framing of RI.

Cooperation and coordination in external and internal boundaries

The previous two sections have explored primarily competitive interactions involved in both external and internal boundary setting within a novel governance space. This section explores how boundary work also proceeds through and enables more cooperative interactions between actors. The construction of neurotechnology remains vital to understanding cooperation and coordination here. Internally, the definition of neurotechnology itself has acted as a boundary object that has offered an interface for different transnational legal coalitions to communication across (Star and Griesemer 1989; Star 2010). Externally, the definition of neurotechnology has enabled boundary organizations and individual actors to work toward demarcating distinctions and distances between the space of neurotechnology governance and related sites of transnational legal ordering (Guston 2001; Liu 2021). Both processes have not only arisen in part through the competitive interactions described above but also appear to offer pathways toward more cooperative dynamics across the regime. Moreover, external and internal boundary work interlink to modulate these broader processes of shaping the space and its relations with others in its proximity.

Communication across the internal boundary

Internal boundary work has involved competition between the two dominant frames for transnational lawmaking discussed above. These competitive interactions appear to have pushed distinguishable coalitions of actors to different sides of the overall landscape, where they have developed different lawmaking agendas, norms under discussion, and constituencies. These divides could suggest the potential for greater competition in the future. However, these groups of actors retain a shared vocabulary and understanding of neurotechnology as their common object of governance, enabling communication across this internal boundary (see Brand and Jax 2007).

One interviewee from an organization applying an RI approach reported that several others in the organization felt compelled to participate in another global governor's activity on neurorights. They commented: "While [our organization's] framework has not really taken a human rights perspective, several of [my colleagues] thought that they have something to propose given the involvement in neurotech." This entity appears to have felt their RI approach was distinguishable from the human rights frame, yet still felt capable of contributing to a neurorights activity due to the same overall topical area.

Further examples of communication across the internal boundary came from calls for coordinating the RI and neurorights coalitions and lawmaking processes. Several participants raised concerns about recent fragmentation in the global governance of neurotechnologies and perceived a need for "coordination" or "harmonization" across these two lawmaking processes and the actors involved. Two different interviewees insisted that these framings were not in competition with one another in the abstract, but they did recognize them as distinguishable and composed of

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different, if overlapping, coalitions of actors. One of them said: "I don't see any conceptual conflict" between the two frames before continuing on to reflect:

> There are different frames—you know, discursive frames—for the area of ethics of neurotechnology writ large. And I think that those are two, with slightly different networks of actors and different kinds of language, different kinds of implementation strategies. So, we've been in touch [with] and are not directly collaborating, but exchanging information with the human rights crowd at Columbia [referring to the Neurorights Foundation] and other groups.

While recognizing the presence of an internal boundary, this comment also speaks to the perception that both discourses fit within the same broader conversation on global governance for neurotechnologies. Further, this actor also highlights the ongoing communication between actors that occurs across that boundary.

These instances of communication and even coordination across a still-forming internal boundary illustrate the potential for boundary objects to mitigate some of the competitive dynamics of internal boundary setting. Here, this communication is made possible in part through the shared understanding that both discourses center on the governance of "neurotechnology." The presence of two frames around how to diagnose and resolve issues in this governance suggests that neurotechnology has been constructed with sufficient interpretive flexibility to allow two different communities to use the term for related but distinct tasks and purposes (Star and Griesemer 1989). The definition of neurotechnology therefore operates as a boundary object enabling both coalitions to proceed with their own agendas while simultaneously providing an interface for communication and exchange across those communities (see also Liu 2015a).

Notably, several actors who are now more associated with the neurorights discourse were initially engaged with the OECD process around RI, while others maintain connections to both discourses. These shifting locations relative to the internal boundary may offer relational paths to communication across the divide. These processes have promoted a degree of stability and cooperation across coalitions, even while the individual interactions producing an internal boundary may occur in competitive manners. Significant levels of competition over internal boundaries, however, may risk damaging the relationships between global governors and their ability to communicate across such divides (see Kranke 2022). While the level of competition thus far in the case study appears sufficient to distinguish between agendas without overriding strategic communication, sharp rises in competition in the future or the appearance of new lawmaking sites or agendas could reduce the stability of the internal or external boundaries.

Coordination around the external boundary

These patterns producing at least partially cooperative and coordinated environments within the lawmaking space also extend to external boundary work. While setting external boundaries may appear competitive from the perspective of those actors who become excluded from the space, this work may still occur through

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cooperative interactions between actors left within the emerging space. In spite of the internal boundary formed in neurotechnology governance, the quotes above illustrate that actors within it retained a shared understanding of what neurotechnology is and is not. While these actors continued to compete over RI or human rights frames, their competition centered on the same boundary object.

In doing so, these competitive interactions may have worked synergistically to concretize the external boundary over time by making it ever clearer that actors not competing over transnational lawmaking for nascent neurotechnological devices (for example, those working only on drugs, biologics, or digital mental health) do not belong in the space. Beyond inclusion and exclusion, external boundary setting can contribute to protecting the autonomy of those left within it to frame issues and their legal solutions (see Gieryn 1999, 17). Competition for dominant positions within the space may then be facilitated by working collectively to produce a sturdy external boundary that insulates the actors left inside from exogenous interference. In other words, actors may work in simultaneously cooperative (external boundary) and competitive (internal boundary) manners that both intertwine to shape the perimeter and topology of the emerging space.

Boundary organizations and "boundary spanning individuals" have also facilitated communication or coordination between spaces, in spite of the competitive manner in which actors have set the external boundary (see Michaels 2009, 996). Setting an external boundary places lawmaking processes focused on neurotechnologies in potential tension with related spaces of technology governance over where actors or positions properly sit. The OECD, for instance, has worked to place objects such as artificial intelligence (AI)[17] outside the scope of neurotechnology:

> While some of these [governance] issues are shared by *other technology domains (e.g. gene editing or artificial intelligence (AI)), neurotechnology* is exceptional because of the close connection between brain and cognition to human identity, agency, and accountability. . . . Innovators are receiving significant public and media attention, *occasionally mixing issues around neurotechnology innovation with controversies in adjacent domains (such as gene editing and AI)*. (Garden et al. 2019, 5; emphasis added)

Similarly, UNESCO officials appeal to the organization's work on the ethics of AI as evidence that the agency has the capacity to conduct similar work on neurotechnologies, suggesting a sharp distinction between these objects (see UNESCO 2021).[18] More recent OECD and UNESCO documents have discussed BCI "convergence with artificial intelligence" and claim "BCIs and AI were historically developed and applied independently from each other" (García and Winickoff 2022, 13; see UNESCO 2023a, 9). These discursive distinctions between AI and neurotechnologies also have immediate relevance to lawmaking, however, as both global governors have separate ongoing work on AI.

[17] As an object being distinguished from neurotechnologies, artificial intelligence (AI) itself is a moving and dynamic bundle of other technologies (Lee et al. 2023). The way that these two objects are being constructed against one another as they emerge may offer a site for future research.

[18] Field notes, 2023.

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Several participants engaged in global governance activities around both neurotechnology and another emerging technology (often AI or genomics) made distinctions between these spaces as well. When asked about a digital mental health application, one participant stated: "I would not define that in the context of neurotechnology, although I appreciate others might. For me, that's more AI." Interviewees familiar or involved with these multiple spaces made such distinctions not only on the basis of the technologies involved but also in terms of differentiating the transnational lawmaking efforts: "There are of course some other [governance] efforts that are adjacent—in particular from the AI community—that may at some point spill over to neurotechnology applications. ... So, data privacy, AI, cybersecurity, efforts in the governance of these topics will of course have some contact with the governance of neurotech." Another participant distinguished the history of governance for heritable human genome editing—which to them had a relatively clear catalyzing event around the birth of three human children after using these techniques in China in 2018—with the case of neurotechnology, which they felt has been more diffuse and less organized around any one event. These seemingly casual statements make it clear that AI and gene editing are somehow different from neurotechnology and therefore require distinct policy-maker attention.

This work toward external boundaries has competitive dynamics through excluding certain technologies and the actors seeking to govern them from transnational lawmaking (see Gieryn 1999). However, boundary organizations and individuals occupying both neurotechnology and an existing governance space may play a special role in constructing the external boundary as they are able to peer into or move between existing spaces. In spatial terms, individual or organizational actors may be acting as both "guardians" and "brokers" by simultaneously forming and policing the boundary between spaces while also remaining able to facilitate the movement of actors and discourses from one to another (Liu 2021). While the data here cannot speak to the motivations of these particular actors, their interactions appear to mitigate some level of competition by maintaining distinctions between governance spaces and the actors or lawmaking processes occurring within them. Only one participant insisted that digital mental health was a part of neurotechnology, and many interviewees made a casual distinction between AI and neurotechnology, suggesting that the external boundary is not currently the subject of strong contestation.

By partitioning off lawmaking processes and the actors situated within them, these actors occupying both an existing and emerging space may seek to enable differentiation between the two—promoting equilibrium—while mitigating the distance between spaces to facilitate exchange, coordination, or travel to and from them (Liu 2021). Exploring the interactions of these special actors and their role in shaping the relationships between existing and emerging spaces merits future empirical inquiry.

Conclusion

Grappling with emergent socio-legal phenomena in transnational governance presents analytic challenges, but it can offer deeper insights into how these lawmaking spaces form and operate. This study has used the case of neurotechnology

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to argue that attention to boundary work offers a processual approach to better understanding how global governance regimes may emerge. Vital to these processes have been interactions between actors that have led to constructing "neurotechnology" in particular, flexible, contingent, and contestable manners that require time and have spatial and normative implications for ongoing and upcoming transnational lawmaking activities in the space. Distinguishing between external and internal boundary work can guide scholarly inquiry and critique here by seeking to grapple with different yet interrelated types of complexity in a nascent system. Actors in this study engaged in external and internal boundary work over time and across jurisdictions, scales, and global governing institutions, supporting the broader utility of these tools in capturing and analyzing transnational lawmaking dynamics and inquiry into emergent transnational legal ordering.

Determining what to make law about has required constructing neurotechnology as an object of legalization requiring new rules, and it has had inclusive and exclusive spatial effects. Consistent with previous studies on other emerging technologies, this construction has involved a tangled overlay of scientific, political, and regulatory elements (Hodge, Maynard, and Bowman 2014). External boundary work has been performed to determine both what is and is not neurotechnology and which actors and positions "belong" in the emergent space and, importantly, which do not (Collins and Evans 2002). Notably, while some actors may have actively chosen not to participate in transnational lawmaking for neurotechnologies, external boundary work appears to have placed at least some others outside the external boundary through more discursive means. This processual understanding highlights that actors drawing boundaries around a novel space of governance also intentionally or unintentionally work to co-create the object about which they will set legal rules (see Abbott 1995). These findings may offer insights for understanding how TLOs emerge, as the very efforts to assemble a new issue area within which to set law will influence which stakeholders—and which interests and agendas—participate in early transnational lawmaking and ordering.

External boundary work also has immediate spatial and political implications, suggesting that contestable processes of ordering can occur even as a transnational lawmaking space is just beginning to emerge. Actors perceived as not currently working on or affected by the most nascent of neurotechnological devices—including patient groups, LMIC actors, and some international organizations—appear to fall outside the external boundary set around neurotechnology governance. These excluded actors may not see the relevance of transnational legal discourse to their constituencies or agendas because of how neurotechnology has been defined by actors within the space. Reducing the population of actors within the nascent space may limit the potential for competitive interaction and thereby diminish the likelihood of fragmentation and polycentricity, potentially providing some stability to the nascent space (see Black 2008). However, the exclusion of core stakeholder populations through processes of constructing the object of lawmaking also raises significant normative questions around the level and quality of democratic deliberation and accountability in global governance activities.

Actors within the external boundary, however, have not reached consensus and continue to interact in both competitive and cooperative manners, revealing further types of ordering that can occur as transnational legal ordering commences in a new

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space. In other words, identifying an external boundary around a social space (including an issue area of transnational law) does not necessarily speak to its internal topology as it emerges. Here, this has occurred most notably through the evolution of two separate transnational legal discourses—neurorights and RI—with distinguishable but overlapping sets of actors, frames, agendas, and lawmaking processes. Yet they continue to occupy the same social space through their mutual recognition and shared understanding of "neurotechnology" as a boundary object that enables communication and coordination across this internal boundary (see Star and Griesemer 1989). Processes of external and internal boundary work thus drive and empower each other, synergistically delimiting and contouring the transnational lawmaking space, perhaps in ways that may influence whether and which TLOs form over time.

While the case focuses on neurotechnology, these dynamics around the emergence of a transnational lawmaking space may be reflective of broader, more recent trends in global (technology) governance where ordering occurs in the setting of rapid innovation and uncertainty. Of course, neurotechnology as a case will not be fully generalizable to other emergent spaces of transnational law or TLOs either. Data from the study suggest that neurotechnology presently involves a relatively small pool of actors, states, and lawmaking sites and may be perceived as particularly niche or technical. Whether and to what extent these findings may differ in a transnational legal space that emerges under higher scrutiny from multiple publics and states, or involves many more lawmaking sites or stakeholder types simultaneously, merits further empirical examination.

Ongoing attention on how emergent spaces of transnational lawmaking evolve over space and time will also be important for greater insights into processes of maturation for novel global governance systems. Interpreted differently, the internal boundary work observed in this case could herald the development of two divergent and competitive TLOs within the newly constructed issue area carved out by external boundary work (see Halliday and Shaffer 2015). This outcome remains possible and potentially consistent with current TLO theory. If so, struggles over internal boundaries may offer one process for better understanding how competition between TLOs can begin in the first instance and evolve over time, which may depend on parallel interactions of external boundary work as well.

However, the nascence of the space and contestable way in which actors have constructed the issue area itself and its two major framings could also lead to future instability. Once set, boundaries remain porous and subject to change over time (see Abbott 1988; Liu 2015a). Assuming that the construction of neurotechnology as an issue area is now complete and has led to a "discrete, differentiated area[] of law" could potentially break from a more processual understanding of emergent sociolegal phenomena (Halliday and Shaffer 2015, 5). A processual perspective could instead highlight the contingency and temporality of spatial arrangements that may or may not produce a novel TLO (see Abbott 2016). For example, future interactions of an emerging TLO with more local actors, cultures, and institutions may provide the conditions for contestation or even resistance of nascent ordering processes (see Merry 2006; Canfield, Dehm, and Fassi 2021). These might include interactions of boundary blurring and maintenance around external or internal boundaries, in

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addition to the boundary-making processes focused on here. Given the normative questions raised above around democratic deliberation of these processes of opening a new space of transnational lawmaking, recognizing opportunities for future contestation and spatial reordering over time may be vital for efforts to analyze and improve the legitimacy of global neurotechnology governance or other novel transnational legal processes.

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The Author

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