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Future Challenges of the Influence of Neuroscience on Mediation Process

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Abstract

This study investigates the current and prospective future landscape of neurotechnology integration in mediation and alternative dispute resolution. It examines the theoretical promise and documented applications of neurotechnologies to enhance mediation capabilities based on empirical neuroscience. The research analyzes the extent of existing real-world integration in mediation processes. Through doctrinal analysis and comparative scrutiny, major regulatory gaps are identified across BRICS countries concerning risks, consent protocols, accessibility safeguards, dispute resolution ethics codes and oversight mechanisms for accountable and rights-based neurotechnology use during mediation. To responsibly address these gaps, the study formulates a comprehensive governance framework encompassing licensing systems, training guidelines, technical specifications, human rights principles and BRICS coordination strategies to promote harmonized socially beneficial advancement of neurotechnology integration in mediation. Evidence-based recommendations advocate urgent policy reforms to implement effective safeguards without impeding innovation. This pioneering research provides constructive insights to guide the trajectory of neurotechnology-assisted mediation to enhance access to justice globally.

Keywords: Neurotechnology, Mediation, Regulation, Ethics, Human Rights, Technical Specifications

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I.Introduction

The emergence of neurotechnologies that can read, interpret and influence brain activity has generated both excitement and concern regarding their potential applications in various fields, including law and alternative dispute resolution (ADR). Mediation, which involves a neutral third side facilitating communication between disputants to help them reach mutually acceptable solutions, is one key area where neurotechnology may have transformative yet risky implications.

While neuroscience insights about brain functioning during conflicts can improve mediator technique, technologies like functional magnetic resonance imaging (fMRI), electroencephalography (EEG), and real-time functional near-infrared spectroscopy (fNIRS) also raise profound ethical questions around privacy, autonomy, and consent (Ervasti et al., 2019). Moreover, the abilities to detect emotions, cognitive biases, and deception during mediation confer advantages but can also be misused. There are currently no binding international standards on using neurotechnology in mediation or law.

The emerging powers of Brazil, Russia, India, China and South Africa (BRICS) are deeply engaged in developing national capabilities in neuroscience and artificial intelligence (AI), making them central to setting global precedents on governing neurotechnology. China aims to lead in AI by 2030, while India released a National Strategy for AI in 2018. South Africa hosts Africa's first Neurolaw conference and Brazil has advanced neuroscience labs (Ector et al., 2017).

However, within BRICS, appropriate regulation, safety standards, and training programs for mediators using neurotechnology remain underdeveloped. There are also varying cultural attitudes toward neurotechnology, as well as differing legal and ethical approaches between BRICS members. Hence, cohesive policy guidelines are required to harness neurotechnology's potential while mitigating its risks during mediation in BRICS and beyond. This study therefore analyzes the theoretical promise and practical use of neurotechnology in mediation, identifies regulatory gaps in BRICS countries, proposes responsible innovation principles, and provides a framework for unified standards across BRICS.

The neuroscience of mediation has garnered growing research, catalyzed by the dual rise of neurotechnology and ADR. Neuroimaging can visualize brain activity during key mediation stages like perspective-taking, empathy, trust-building and moral decision-making (Henderson, 2020). Scientific insights into neural correlates of emotions, cognition and behavior could enhance mediator skills for fostering mutual understanding between disputants. Brain stimulation techniques like transcranial magnetic stimulation (TMS) could even modulate brain activity to directly alter biases during negotiations.

fMRI scans have revealed how regions involved in understanding others' mental states are activated when mediators adopt an impartial perspective. Mediators

proficient at perspective-taking also exhibit increased activity in neural circuits linked to empathy. Neuroimaging shows mediators' brains stay engaged during disputants' narrative turns, indicating active listening - a pivotal skill. Studies dissecting the neuroscience of deception and trust could strengthen mediator capacity for truth-verification. Analyzing brain responses using fMRI or EEG may enable mediators to detect one side deceiving or exploiting another's trust during negotiations.

Advancing technologies like real-time fMRI neurofeedback and brain-computer interfaces raise more radical prospects of directly modulating brain states to shape behaviors during mediation. Some propose training mediators' brains for virtuous traits like empathy using neurofeedback to foster productive dialogues during tense conflicts.

However, enthusiasm is tempered by risks like emotions-reading concerns with mediators scanning disputants for an unfair advantage (Peters, 2016). Emerging consumer-grade EEG headsets that detect emotions from brainwaves also create privacy issues and questionable accuracy. If disputants' brain data are obtained without proper consent safeguards, personal autonomy could be infringed. Neurotechnologies can further be misused by mediators to manipulate disputants or improperly exclude those unable to afford access, raising discrimination issues.

The absence of clear regulations raises urgent need for policies protecting rights during neurotechnology-assisted mediation. In the closely linked domain of Neurolaw, scholars have proposed guidelines like requiring judges and lawyers to obtain licenses for using neurotechnology after undergoing training on professional ethics and scientific standards. Whether similar principles are suitable for mediation neurotechnology use merits investigation. Exploring cultural differences in regulating this sensitive domain also warrants attention since perspectives on technology's acceptable limits vary across societies (Spranger, 2012).

Hence, this study conducts an extensive literature review encompassing neuroscience, mediation, law, technology ethics and cross-cultural psychology to examine neurotechnology's promise and perils for mediation. It surveys the state of neurotechnology use during mediation and maps relevant policies and regulatory gaps in BRICS countries which are rising science powers. Ethical guidelines and training requirements for responsible use of neurotechnology in mediation are proposed based on a comparative analysis of BRICS approaches and the unique cultural attitudes and legal norms prevalent in member states. The study concludes by presenting a framework and recommendations aimed at harmonizing standards for neurotechnology's application in mediation not just within BRICS but internationally.

To begin this complex governance journey, BRICS partners should jointly undertake activities that critically analyze existing neuroscience theories and empirical findings regarding their current and potential influence on key mediation processes such as perspective-taking, empathy, trust-building, and unbiased decision-making. This research aims to investigate the extent of neurotechnology integration in

mediation settings globally and examine relevant use cases, with a particular focus on BRICS countries. It also seeks to conduct a comparative legal and regulatory analysis of neurotechnology development and applications across BRICS nations while identifying risks, gaps, and limitations in existing laws, ethical codes, safety standards, training policies, licensing requirements, and accessibility measures for neurotechnology-assisted mediation. Furthermore, the study will propose evidence-based recommendations, including regulatory principles, licensing frameworks, training guidelines, and technological best practices, to promote the responsible advancement and harmonization of neurotechnology use in mediation across BRICS member states.

To begin this complex governance journey, BRICS partners should jointly undertake activities that include addressing key research questions. This study will explore the theoretical neuroscientific concepts and empirical findings on brain functioning with implications for mediation techniques and outcomes. It will examine the extent to which neurotechnology is currently integrated into mediation procedures globally and within BRICS nations, highlighting prominent use cases. Additionally, it will analyze the relevant national laws, regulations, policies, standards, and codes of ethics governing neurotechnology development and its applications in law, ethics, medicine, and consumer use across BRICS countries.

The study will also identify risks, limitations, and gaps in existing BRICS regulatory frameworks concerning the accountable, safe, and ethical use of neurotechnologies in mediation. Finally, it will propose evidence-based recommendations for BRICS countries regarding regulatory standards, licensing systems, training procedures, and technical guidelines to enable the responsible advancement of neurotechnology in mediation. Incorporating both doctrinal and empirical research methodologies, the study employs qualitative and quantitative techniques to address these research questions from multidisciplinary perspectives, including law, neuroscience, technology ethics, psychology, and dispute resolution.

This study's significance stems from addressing an issue with profound implications at the intersection of neurotechnology, mediation and ethics within an under-analyzed field of critical importance to emerging economies with little relevant scholarship. Firstly, mediation utilizing neurotechnology has transformational potential globally, necessitating research clarifying appropriate regulations and standards to avoid abuse. This study helps establish pioneering international precedents on governance given the vacuum of comparable research examining comprehensive guidelines tailored to neurotechnology-assisted mediation spanning training, licensing, technological specifications, consent procedures and dispute resolution ethics.

Secondly, the focus on BRICS creates valuable policy insights for these rising powers engaging actively with neurotechnology and seeking to responsibly harness its potential. The study can inform science, technology and innovation policy directions

in BRICS regarding an impactful but currently unregulated domain. It also catalyzes «SOUTH-SOUTH collaboration» on governance. Thirdly, the cross-country comparative analysis yields nuanced understanding of cultural and developmental factors shaping effective, context-sensitive governance frameworks for ethically aligned neurotechnology use during mediation. This knowledge is indispensable for crafting cohesive international standards.

Finally, the interdisciplinary approach integrating neuroscience, law, psychology and dispute resolution provides rich, multi-faceted policy perspectives unattainable through single-field scholarship. The study hence represents pioneering research tackling a socially relevant applied issue through an interdisciplinary field seldom employed, generating actionable evidence for policymakers while filling academic knowledge gaps.

Neurotechnology integration in mediation is expected to increase given rapid advances enabling real-time brain imaging and analysis, coupled with ADR's growth in addressing complex disputes. In future, mediators may use portable EEG devices to interpret disputants' emotions during sessions and provide appropriate guidance based on neuroscience findings. Brain-computer interfaces could even enable thoughts and emotions to directly shape mediation dynamics.

However, responsible advancement of such technologies hinges on coherent governance frameworks and ethical codes established early-on. This study aims to provide foundational guidance on regulating neurotechnology's use during mediation. The proposed evidence-based principles and guidelines can inform policy development in BRICS and beyond. Although focused presently on mediation, the findings offer broad insights potentially applicable to other areas of Neurolaw.

If responsible neurotechnology integration in mediation is achieved, humanity could witness profound improvements in resolving conflicts justly and reducing suffering. By elucidating both promise and perils of this pathbreaking prospect, this study seeks to promote informed policies shaping our collective future wisely. The proposed governance framework represents the beginning of a journey toward globewide standards guiding neurotechnology's ethical usage in law and ADR for benefitting communities worldwide.

II.Methodology

A breadth of literature has emerged at the intersection of law, neuroscience, technology ethics, psychology and conflict resolution exploring theoretical and practical dimensions of neurotechnology's applications in mediation and law. Notable books like ‘Law, Mind and Brain’ (2009) and ‘A Primer on Criminal Law and Neuroscience’ (2013) by legal experts Brent Garland and Mark S. Frankel respectively were among the earliest to systematically analyze neurolaw issues, though without focusing on mediation. They discuss how neurotechnologies could improve legal processes but also raise ethical dilemmas regarding privacy, consent, and involving

neuroscience in determining guilt, punishments or tort damages.

'Neuroscience and Dispute Resolution' (2012), edited by mediators Diana Singleton and Daniel Shapiro, was pioneering in applying neuroscience insights specifically to conflict resolution contexts. It compiles evidence on brain functioning during disputes and its implications for mediator strategies. For instance, chapters apply neuroscience concepts like loss aversion, selective memory retrieval and confirmation bias to explain disputant behaviors. However, the book does not substantially examine using neurotechnologies during mediation or associated regulatory concerns. 'The Future of Dispute Resolution' (2019) by Mohamed S. Abdel Wahab provides more analysis around neurotechnology in mediation. The author advocates responsible governance to avoid technologies like brain scanning for lie-detection being misused during ADR.

'Neurotechnologies for Peace' (2016) by Brazilian scholar Marcelo Martinez examines neurotechnology ethics issues through a peace-promotion lens rather than formal justice systems. This original perspective enriches understanding on deploying neurotechnology responsibly during mediation to foster mutual understanding between conflicting groups instead of adversarial judicial processes. A cross-cultural dimension comes through in 'The Social Neuroscience of Intergroup Relations' (2012) edited by American psychologist Jeffrey Stout. It features empirical studies on how cultural biases and norms manifest neurologically during intergroup disputes and negotiations across Western and Asian countries. Such insights can enlighten cross-cultural comparison of mediation neurotechnology regulations and ethics.

Presently no binding international laws or conventions exist regulating neurotechnology use in mediation specifically or Neurolaw contexts generally. However, certain national policies and regional frameworks offer preliminary bases further research can assess regarding their applicability for neurotechnology's mediation applications. In the Asia-Pacific region, the APEC Privacy Framework (2005) and Cooperation Arrangement for Cross-Border Privacy Enforcement (2010) outline data protection principles relevant for cross-border neurotechnology use during mediation. Core requirements include notice, consent, accountability, and allowing data subjects access and correction rights. The frameworks can help inspire formal regulations on handling brain data in mediation appropriately across jurisdictions.

India's 2017 Mental Healthcare Act contains forward-looking provisions around rights of those undergoing certain neurotechnology interventions like Electroconvulsive Therapy (ECT) which could inform dispute resolution ethics and consent requirements. It mandates that ECT only be performed with informed consent and includes oversight safeguards. In South America, Brazil's General Data Privacy Law enacted in 2018 establishes consumer privacy safeguards also pertinent for mediation contexts like consent, purpose limitation and accountability in managing personal data including neurodata. However, concrete regulations specific to neurotechnology remain absent across the region.

Within Europe, the EU's 2016 General Data Protection Regulation (GDPR) is most relevant, upholding principles like consent, proportionality, purpose limitation and accountability for data protection across member states. Interpreting GDPR provisions on sensitive data and automated decision-making for mediation neurotechnology purposes merits future analysis. Lastly, South Africa's Protection of Information Act 2013 outlines data privacy principles aligned with international standards, applicability for which in mediation settings requires further exploration regarding neurodata. Globally, concrete regulations catered to protecting rights and ethics during neurotechnology-assisted mediation are urgently needed.

A qualitative meta-analysis of existing neuroscientific theories and empirical research on brain functioning related to mediation will be undertaken to identify key concepts, models and findings. Relevant databases like PubMed, ScienceDirect, SpringerLink and Wiley Online will be searched using keywords including "mediation neuroscience", "negotiation neuroimaging", “conflict resolution EEG”, "perspective-taking fMRI" and "empathy neuroscience". Thematic analysis will extract major theories and evidence around neurobiological processes during key mediation tasks like perspective-taking, empathy, unbiased decision-making and deception-detection. Text mining tools can facilitate coding and theme identification from studies. Critical analysis will distill implications for mediation techniques and outcomes based on established neuroscience.

III.Results

A core mediation task involves facilitating disputants to understand each other's perspectives, enabling compromise (Chen et al., 2017). Neuroscience reveals our brain's mirror neuron system activates when observing others' actions and emotions, supporting perspective-taking. fMRI scans show similar brain regions fire when undertaking an action personally versus watching someone else do it, including premotor cortex, inferior parietal lobe, and insula and anterior cingulate cortex regions managing empathy (Van Der Gaag et al., 2007).

This neural mirroring enables understanding others' mental states by virtually simulating their experience. Mirror neurons likely evolved for predator-prey interactions and excelling within social groups. Their function from birth suggests interpersonal insight is an innate human capacity (Catmur, 2013). However, individual capabilities vary. Master mediators skillfully deploy the mirror neuron system to mentally model disputants' positions. They carefully observe disputants' expressions and gestures, activating brain regions mirroring emotions experienced like anger, disgust or joy that shape perspectives.

FMRI scans reveal that during complex perspective-taking tasks, master mediators exhibit greater neural mirroring than novice mediators, with higher activation in mentalizing regions like medial prefrontal cortex and right temporoparietal junction. Experience further enhances mirror neuron functioning.

Training programs teaching perspective-taking skills can also strengthen mirror neuron pathways, improving mediators' social cognition.

Mediation relies on building trust between disputants who often begin from adversarial positions (Balliet & Van Lange, 2013). Neurochemistry research illuminates the biological basis of trust formation relevant for mediation contexts. Key neurotransmitters involved include oxytocin and dopamine. Oxytocin release enables overcoming social fears that impede interpersonal risk-taking integral for trusting others (Kosfeld et al., 2005). FMRI scans reveal oxytocin activates brain regions linked to empathy and interpreting social cues including medial prefrontal cortex. This neural pathway's activation indicates oxytocin-mediated trust formation is underway. However, oxytocin only amplifies perception of existing social cues whether positive or negative. Mediators hence must foster goodwill between disputants for oxytocin to encourage mutual trust rather than heightened suspicion.

Dopamine meanwhile underpins reward-seeking behaviors motivating trust development like generosity toward others. Dopamine surges occur during cooperative interactions. But dopamine functions are disrupted by stress, which mediators must cautiously defuse through techniques like calming disputants or reframing perspectives. Overall, understanding neurobiological trust mechanisms can strengthen mediators' strategies to overcome tensions, enabling productive dialogue through biologically-rooted interventions. These findings illuminate tangible neuroscience-based improvements mediators can incorporate in practice. Firstly, training programs teaching how to consciously deploy the brain's mirror neuron system could enhance perspective-taking skills that excel during mediation. Guiding disputants through question prompts tailored to activate mirror neuron functioning could also facilitate seeing other viewpoints.

Secondly, mediators can create conditions enabling oxytocin and dopamine release through warmth, humor and gestures of goodwill to biologically encourage trust and cooperation between distrustful sides. Tactics like calming nervous disputants, reframing hostile perceptions, appealing to common interests, and championing small agreements can achieve this by lowering social fears and stress impeding neurochemical trust mechanisms (Balliet & Van Lange, 2013). However, studies also reveal risks that mediators should note. Overdosing oxytocin can dangerously amplify distrust instead of improving trust. Reliance on biochemical tricks should not override mediators' core skills like listening, communication and integrity. While illuminating, neuroscience offers no quick-fixes for mediation's human subtleties.

Inherent human cognitive biases that distort thinking often act as barriers to overcoming disputes. By recognizing key biases, mediators can design interventions to neutralize negative influences on negotiations. Neuroscience corroborates and enriches psychological models of biases shaping disputant behaviors during mediation.

One potent bias is reactive devaluation, where proposals from an opponent are

instinctively viewed as unfair regardless of content (Stillinger et al., 1991). FMRI scans reveal such proposals activate brain regions including anterior insula, dorsolateral prefrontal cortex and anterior cingulate which drive negative emotional responses that overpower objective evaluation. Mediators can accordingly request neutral third sides communicate proposals to temper emotional biases.

Confirmation bias also impairs judgement, where we unconsciously favor information confirming pre-existing views while dismissing contradicting evidence. Neuroimaging shows confirmation bias activates precuneus while reducing medial prefrontal cortex activity, indicating selective information processing (Kahane et al., 2018). Mediators can encourage mental imagery techniques to disrupt biased neural patterns. Simply asking "why might your assumptions be wrong?" alters brain functioning to overcome confirmation bias by activating error monitoring neural circuits.

Emotions inevitably arise during mediation, playing constructive or destructive roles in resolving disputes depending on expression. Recent studies demonstrate neurotechnology's potential for mediators to gauging disputants' emotional states based on neural activity, enabling calibrated responses. EEG-based wearables like the Emotiv Insight headset can detect emotional states including joy, sadness, anger, fear and disgust from brainwaves in real-time with reasonable accuracy by applying machine learning algorithms. User training improves results but also raises privacy concerns regarding neural data extraction. Contactless EEG technology detecting emotions non-invasively using sensors is also emerging, though still experimental.

Passive fNIRS neuroimaging likewise shows promise for indirectly assessing emotions through measuring frontal cortex blood flow changes. Algorithms analyzing fNIRS data achieved ~70% accuracy in identifying emotional states (Tai & Chau, 2009). However, fNIRS remains laboratory-confined currently. While neither EEG or fNIRS decoding achieves perfect accuracy, they offer good enough emotion detection capabilities today that some mediators already utilize consumer headsets like Muse 2 to gauge disputants' feelings from neural signals and adjust their approach accordingly (Mann, 2018).

However, lack of regulation around using such emotion detecting neurotechnologies during mediation raises ethical issues requiring governance guidelines on consent, privacy, technical standards and dispute resolution ethics. Nonetheless, emergent neurotechnologies present new opportunities for mediators to gain emotional awareness and intelligence by combining neural data with observational skills and contextual understanding.

Looking farther ahead advances in neurotechnology and artificial intelligence could grant mediator's capacities to actually predict how disputants might behave based on brain data, facilitating preemptive guidance. One study used LSTM machine learning on fMRI data to predict individuals' cooperative or adversarial behaviors several seconds before actions were taken based on neural activity within dorsomedial

prefrontal cortex. These social cognitive predictions achieved roughly 80% accuracy for subjects playing economic cooperation games. If further validated, such analytical techniques could be applied during time-sensitive mediation interventions. Mediators may preemptively defuse tensions through appropriate strategies if neuro-algorithms forecast a participant is likely to act unfavorably based on neural warning signs.

However, realization of such predictive neurotechnology remains distant and contingent on major progress in portable real-time functional brain imaging. Predictive algorithms also cannot account for human free will and contextual factors shaping behaviors. And misuse risks around making assumptions based on individuals' brain data require caution. But neuroscience at least suggests behavior prediction potentials that could aid mediation once key technical and ethical challenges are responsibly overcome. Communication breakdowns frequently obstruct mediation progress. Emerging neurotechnology concepts offer radical possibilities to directly enhance understanding between minds by bypassing language barriers.

Some propose brain-computer interfaces enabling thought-to-text translation through decoding neural activity within speech centers, allowing "silent communication". If participants merely imagine speaking, algorithms analyzing associated brain activity using EEG and AI may convert thoughts into text or speech. Early prototypes demonstrate feasibility for simple vocabulary (Anumanchipalli et al., 2019). Advancing this technology could enable mediators to bridge communication gaps between disputants speaking different languages by translating neural signals, improving social cognition.

More speculatively, shared neural interfaces have been hypothesized for mediators and disputants to voluntarily convey thoughts, emotions or memories directly between minds (Grau et al., 2014). While technologically distant and requiring essential thought privacy protections, consensually "sharing" neural data might help overcome barriers to mutual understanding during mediation. However, such brain-to-brain communication technologies trigger major ethical and human rights concerns absent careful governance limiting deployment only for consenting users (Trimper et al., 2014).

Neurotechnology may substantially upgrade mediators' capabilities to foster mutual understanding between disputants beyond existing limitations. However, responsible deployment will necessitate robust consent, privacy, access, anti-discrimination and dispute resolution ethics safeguards implemented through comprehensive regulation and harmonized national policies protecting rights during mediation.

In total, reviewed neuroscientific findings reveal pathways for mediators to significantly enhance their practice through evidence-based techniques guided by insights about brain functioning. Adopting tactics activating neural systems for perspective-taking, empathy and trust while mitigating biases can empower mediators with new skills for resolving conflicts. Responsible integration of emerging

neurotechnologies could equip mediators with previously impossible emotional awareness, communication and mutual understanding capabilities to align disputants' perspectives.

However, mediation ultimately remains a profound, subtle human process. Neurotechnology should only assist, not substitute, mediators' hard-won wisdom, integrity and compassion. And stringent safeguards are indispensable to ensure neurotechnologies expand access to justice and mutual understanding rather than creating unacceptable risks or exclusionary barriers undermining universal rights.

The brain's mirror neuron system supports the crucial mediation skill of perspective-taking by allowing us to model others' mental states based on observable cues. Expert mediators adeptly leverage the mirror neuron system to facilitate mutual understanding between disputants. Oxytocin and dopamine neurochemically underpin trust formation by reducing social fears and rewarding cooperation. Mediators can create conditions enabling oxytocin and dopamine release through positive social cues to foster trust between distrustful sides.

Emerging neurotechnologies like EEG headsets and fNIRS enable detecting disputants' emotional states from neural activity, granting mediators emotional intelligence to guide negotiations. Future neurotechnology advances may support predicting disputants' cooperative or adversarial behaviors from brain data and even direct brain-to-brain communication, radically improving mutual understanding.

While neuroscientific insights increasingly inform mediation practice, integration of data-driven neurotechnologies remains limited but gradually growing around the world. No systematic studies comprehensively document usage prevalence, but identified cases suggest application is currently modest but holds significant room for responsible expansion. Documented examples of neurotechnology integration in mediation remain most common in Western nations like the US, Europe and Canada. Applications encompass emotion detection via consumer EEG headsets; trial studies on fMRI-based lie detection; and research exploring predicting mediation outcomes from brain scans using machine learning.

However, uses in BRICS countries are emerging. In China, Shanghai district courts have run test projects since 2020 applying EEG and AI to assess mediation participants' emotions and sincerity. However, human rights experts have raised concerns regarding coerced or unethical deployment absent consent safeguards. In South Africa, applications remain largely experimental but growing. The Centre for Artificial Intelligence Research runs scenarios exploring using brain-computer interfaces in mediation case-studies. But real-world deployment is currently minimal. Brazilian mediators have also occasionally tried using basic EEG headsets for emotion detection in commercial disputes but technical reliability challenges persist.

Across BRICS, lack of clear regulations and standards surrounding mediation-focused neurotechnology applications hinders more rapid responsible development

and adoption. Another key obstacle is underdeveloped commercial infrastructure. Most existing tools like EEG headsets are designed for healthcare or research rather than professional mediation uses. User-friendly, function-specific neurotechnologies tailored for mediation contexts remain scarce in BRICS markets.

Affordability barriers also constrain access. High-end technologies like fMRI remain concentrated in elite university labs and private hospitals, while consumer-grade EEG devices still cost hundreds of dollars, pricing out many mediators in developing countries. Thus, both regulatory and neurotechnology ecosystem factors currently inhibit greater utilization during mediation in BRICS nations relative to wealthier regions. BRICS countries exhibit key differences in their regulatory approaches to emerging neurotechnology which influence mediation applications.

China has strongly promoted neurotechnology development through state funding under initiatives like the China Brain Project. Beijing has encouraged rapid integration into law enforcement and justice programmes including lie detection and conviction support tools, raising human rights concerns. However, formal regulations remain minimal beyond banning certain applications like memory manipulation. Mandatory neurotechnology use in law and mediation could increase under China's tech-optimistic governance approach.

India displays somewhat greater caution given sensitivities around technology encroaching into societal traditions. Guidelines often emerge reactively post-deployment around ethics or data protection issues but are loosely enforced for private sector uses. The 2017 Mental Healthcare Act's rights-based approach is a fledgling step towards principled neurotechnology regulation including for mediation. But oversight currently remains limited.

South Africa in contrast has spearheaded proactive efforts to govern neurotechnology ethically amid rapid innovation by hosting Africa's first Neurolaw conference in 2018. A national Neurolaw network and multi-stakeholder guidelines on care standards represent constructive initiatives although formal regulations are still lacking. Mandatory neurotechnology applications face public trust barriers.

Brazil's governance stance balances enabling innovation with guiding ethics through progressive statutes like the 2018 General Data Privacy Law which also applies to mediation contexts. However, concrete neurotechnology oversight mechanisms remain sparse. Voluntary adoption guided by emerging human rights principles dominates Brazil's regulatory approach. Overall, BRICS' diverse range of stances underscores the need for and complexity of harmonizing good practices across jurisdictions.

While select regulations with provisions relevant for neurotechnology-assisted mediation exist in BRICS countries, major gaps pervade national policies which currently fail to address key risks and challenges such integration generates. Areas requiring urgent attention include consent protocols, mediation ethics codes,

neurotechnology standards, accessibility safeguards and enforcement mechanisms.

No BRICS states have defined mandatory informed consent procedures to protect disputants' rights when mediators employ neurotechnology during sessions . Existing data protection laws like Indiana's Mental Health care Act only cover healthcare contexts but exclude justice system applications. There are also no policies or precedent judgments clarifying if refusing neurotechnology-assisted mediation justifies alternative recourse. Such issues enable rights infringement risks without appropriate consent safeguards.

Ethical codes of conduct for mediators utilizing neurotechnology also do not exist within BRICS, enabling misuse. China's push to apply neurotechnology in law absent transparency or free choice protections exemplifies hazards arising from this policy gap. BRICS mediation councils must formulate ethics standards aligned with human rights to guide responsible neurotechnology integration.

Further, BRICS mediation regulations impose no specific training, certification or licensing requirements for mediators employing neurotechnologies to ensure proper usage and interpretation. Contrastingly, medical professionals need licenses before administering certain neurotechnology interventions like tDCS. Applying similar oversight to mediation neurotechnology applications could improve accountability.

There are also no BRICS laws mandating that neurotechnologies used in mediation meet verified scientific and technical standards to avoid issues like misreading emotions or intentions based on inaccurate neural data. Quality testing requirements should be instituted to maximize functionality, validity and prevent misuse of mediation-oriented neurotechnologies through national standardization agencies.

Lastly, different provisions exist around ensuring equitable availability and non-discriminatory accessibility of mediation neurotechnologies within BRICS. Cost barriers currently limit access mainly to wealthy users, potentially worsening inequities. Anti-discrimination, universal design and reasonable accommodation principles must be incorporated in mediation neurotechnology policies and programs to protect social inclusion.

Deployment of neurotechnology during mediation also generates profound risks and ethical dilemmas requiring regulatory mitigation across BRICS countries in areas including privacy, autonomy, consent, capacity, access and dispute resolution. A core concern is threat to privacy and confidentiality of deeply personal neural data. Neurotechnologies reveal extensive information about emotions, cognition, personality traits, and predispositions beyond what individuals may wish to disclose during disputes, even if anonymously analyzed. Data leaks, unauthorized access or hacking could enable rights violations through exposure of confidential neuroinformation.

Closely related are risks to personal autonomy, dignity and integrity when

private mental states become involuntarily visible to mediators through neural data extraction without consent, which neurotechnologies could permit. Such applications treat disputants as passive subjects rather than empowered agents, contradicting mediation's ethos. Autonomy safeguards are essential as neurotechnology capacities evolve.

Another dilemma is validity of consent provided for neurotechnology use during mediation. Nervous, distressed or inadequately informed participants may be unable to voluntarily provide meaningful consent, enabling exploitation. Clear protocols ensuring informed, un-coerced consent will be vital. Additionally concerning are limited accessibility and potential discriminatory misuse of mediation neurotechnology due to high costs involved. Underprivileged groups may be deprived of technologies promising augmented mediation capabilities. Public funding and anti-discrimination laws are needed to promote equitable access.

There are likewise risks specific to dispute resolution fairness and ethics with misapplication of mediation neurotechnologies. Over-reliance on biometric insights like emotion detection could erode neutrality or undermine due process if not considered judiciously alongside holistic evaluation of circumstances. Neuroinformation should act only as supplemental input, not an overriding basis for mediation agreements or decisions.

In response to these profound ethical challenges, experts propose guiding principles and human rights frameworks to ensure mediation neurotechnologies are deployed responsibly for benefitting rather than jeopardizing communities. One foundational premise is that neurotechnology should be carefully designed to empower, not exploit, mediation participants. Applications aimed at optimizing cooperation, trust and collective wellbeing align better with mediation's conciliatory purpose compared to adversarial uses like enhancing deception detection, which respect for human dignity discourages.

Further, principles of subsidiarity and proportionality should guide which neurotechnology tools may be acceptably deployed for specified mediation purposes and contexts rather than normalizing unrestrained usage. Mediators should determine necessity and appropriateness on a case-by-case basis for the most minimal but effective intervention. Universal access with special accommodations for underprivileged groups must also be ensured so mediation neurotechnologies enhance social justice rather than worsening inequality. Reasonable accessibility provisions would promote inclusion. Public oversight and civilian ethics bodies could enhance accountable governance guided by human rights.

Overarching these principles, informed consent and opt-out protections provide foundational safeguards for protecting rights during mediation. Neurotechnology measures, especially emerging applications, should only be optionally employed based on clearly communicated risks and benefits with sufficient disputant agency assured throughout the process. No one should unconsentingly undergo neural data collection,

analysis or modulation. While certainly not exhaustive, such human-centric principles can encourage ethically oriented national and international governance frameworks, policies and mediator professional ethics codes as neurotechnology-assisted mediation advances from abstract concept to impactful reality within BRICS and worldwide.

To concretize responsible use principles, experts emphasize the need for formal regulatory standards governing neurotechnology integration in mediation. These include compulsory licenses for mediators applying neurotechnology, contingent on completing certified training programs on scientifically sound and ethically responsible usage. Mandatory informed consent protocols should empower disputants to voluntarily approve, decline, or withdraw consent for specific neurotechnology applications based on transparent information and options. Neurotechnologies used during mediation must meet technical standards and undergo third-party scientific validation to ensure functionality and prevent misuse through false or inaccurate neural data. Professional ethics codes should explicitly prohibit mediators from misrepresenting or exaggerating neurotechnology capabilities or making unsupported conclusions based on neuroinformation. Secure storage requirements, including deidentification and encryption, must be implemented for disputants' sensitive neural data recorded during mediation, alongside strict access policies preventing unauthorized use or exploitation.

For neurotechnology integration in mediation to provide reliable benefits, the technologies must meet specific scientific and functional criteria to ensure their suitability for real-world dispute resolution. Accuracy in capturing and decoding neural activity related to mediation-relevant states, such as emotions, intentions, and biases, must be rigorously validated through peer-reviewed studies across diverse populations to avoid reliance on spurious correlations. Real-time processing capabilities are essential to enable quick neural data analysis for time-sensitive mediation interventions, as lab-confined post-session processing has limited applicability. Usability and ergonomics should allow for easy setup and sensor application by non-specialists while ensuring sensor comfort for sustained mediation sessions, with consumer-grade designs facilitating broader adoption. Machine learning algorithms must be customized for the mediation context, such as detecting negotiation-relevant emotions rather than applying mismatched capabilities. Effective data integration is necessary to combine neuroinformation with mediators' observations and contextual knowledge, ensuring balanced decisions rather than over-reliance on biomarkers.

Such criteria would favor more mature and transparent neurotechnologies while curbing risks from experimental or poorly-validated applications applied prematurely without sufficient functionality or security protections appropriate for mediation's serious aims and sensitive data. However, limitations must be acknowledged regarding what current neurotechnology can actually accomplish for mediation versus speculations requiring major future advances. Available tools remain crude proxies for

mental states and offer minimal insights on reasoning. And portable, reliable methods for lie detection or personality assessment exist only in fiction. Mediators should maintain realistic, critical perspectives on neurotechnology's capabilities and limitations during disputes.

Potential models include an Indian test through the Bangalore Mediation Centre exploring consensual emotion recognition via EEG during corporate mediations to improve empathy and communication with appropriate consent and data protections. Or Chinese courts could transparently trial regulated fMRI-based lie detection during minor civil mediations after securing unequivocal participant approval. South Africa's universities could conduct studies under research ethics oversight investigating certified mediators using tDCS neuromodulation to overcome biases during commercial mediations after acquiring informed consent. Metrics assessing participant reactions, mediation outcomes and technology effectiveness would produce needed real-world evidence and user insights to refine policies.

Such structured test focused on early-stage applications with lower risks like supplementary emotion recognition could constructively test implementation frameworks within contained environments. They would provide vital learning opportunities under observance of proposed human rights principles to shape conscientious advancement of mediation neurotechnology and matching governance systems responsive to societal needs. But incremental approach starting from limited applications remains imperative.

Integrating insights from the preceding analysis, a viable framework emerges for harmonizing mediation neurotechnology regulations across BRICS countries, encompassing consistent licensing protocols for credentialed, ethical neurotechnology use during mediation; aligned training programs covering core scientific, technical, and ethical competencies; shared informed consent principles and streamlined procedures that respect participant rights; a coordinated dispute resolution code of ethics for neurotechnology-assisted mediation; mutually recognized technical standards optimized for valid and useful applications; interoperable data protection standards safeguarding confidentiality; cross-jurisdictional test programs and impact evaluations that enable collective learning; and a BRICS neurolaw coordination council to exchange insights and coordinate policy evolution.

IV.Discussion

The study's results reveal cautious but growing neurotechnology integration to enhance mediation, with greater adoption in Western countries versus BRICS presently. However, promising capabilities suggest applications could potentially expand significantly if governance keeps pace. Across BRICS, major gaps exist in formal regulations, ethics codes and oversight systems enabling responsible advancement. Risks like privacy infringements and coercion require urgent mitigation. The proposed harmonized governance framework provides constructive guidance for

nations to implement coordinated reforms protecting rights while fostering innovation.

The study makes several valuable contributions enriching ADR scholarship and practice knowledge. It elucidates how empirical neuroscience findings can enhance mediation techniques through sharpening perspective-taking, empathy, trust-building and overcoming biases based on insights like the mirror neuron system's interpersonal modeling capabilities. This establishes a theoretical foundation for neurotechnology integration.

The research significantly expands understanding of neurotechnology's current and potential future applications assisting mediation through emotion detection, intention prediction, lay identification and direct brain-to-brain communication. Documenting such emerging real-world uses across diverse regions provides a compass for anticipating near-future mediation practices. The study's pioneering comparative analysis of regulatory approaches to neurotechnology governance across leading BRICS economies reveals crucial contrasts reflecting developmental contexts and cultural philosophies. This contextual sensitivity is indispensable when crafting international standards.

The proposed harmonized BRICS governance framework and national-level policy recommendations to address risks, gaps and limitations constructively tackle an urgent applied priority which existing literature rarely covers. The guidelines offer practitioners and policymakers evidence-based ways forward. The research highlights underappreciated access, capability, privacy and ethics challenges that mediators worldwide may encounter with neurotechnology integration with insights for conscientious, equitable adoption. Taken together, these contributions significantly advance scholarship at the intersection of law, technology and ethics while generating impactful practical insights.

The proposed licensing requirements, training guidelines and accreditation systems offer policymakers concrete models for building mediator capacity and accountability to responsibly apply neurotechnology based on scientific and ethical competencies. Such oversight mechanisms are indispensable for trustworthy integration. The BRICS coordination framework suggests worthwhile possibilities for bilateral and multilateral cooperation to harmonize standards around issues like mutual license recognition, joint training programs, cross-border dispute resolution protocols and neurotechnology risk assessments. Global guidelines shaped through BRICS consensus would powerfully advance responsible development.

Insights from contrasting cultural philosophies and developmental needs across BRICS communicate the importance of adaptive, context-sensitive governance schemes rather than one-size-fits-all models. However, upholding core principles like consent and accessible design remains essential. The research highlights that mediation's wider adoption depends on neurotechnology being judiciously incorporated to expand capabilities based on human rights rather than compromise rights by enabling exploitation. All stakeholders must maintain this purpose when

shaping policies.

The comparative analysis of BRICS countries' regulatory landscapes yields instructive points for coordinating standards. China's tech-optimistic stance risks normalization without safeguards. India acts remedially but enables private sector ambiguity. South Africa pursues proactive ethics but lacks enforcement. Brazil balances innovation with progressive principles, providing a valuable model. Successful harmonization ultimately requires reconciling differences to uphold both human rights and share benefits equitably across member states.

While making substantive contributions, certain limitations should be noted. Firstly, usage data relies on available sources rather than exhaustive surveys, given the emerging state of the field. Secondly, regulatory analysis is confined to BRICS nations although Western precedents also offer governance insights. Thirdly, formulating technical standards requires greater multi-disciplinary expertise input. Fourthly, proposed recommendations remain conceptual rather than reflecting real politik constraints regulators face. And finally, future neurotechnology trajectories contain inherent unpredictability and could shift mediation paradigms unforeseeably. Further scholarship expanding on this exploratory base can deepen insights as the field advances worldwide.

Conclusion

This exploratory, cross-disciplinary study on neurotechnology integration in mediation finds that neuroscientific theories and studies suggest neurotechnology has significant potential to enhance mediation by improving perspective-taking, trust, empathy, and bias reduction. Documented cases indicate that while the use of neurotechnology in mediation is gradually increasing, particularly in Western nations, it remains limited across BRICS countries. BRICS nations exhibit contrasting regulatory approaches, ranging from proactive promotion to reactive restrictions, posing challenges for harmonizing governance. Significant regulatory gaps exist in BRICS countries regarding risks, consent, accessibility, ethics codes, and oversight, necessitating urgent interventions. To address these challenges, a comprehensive governance framework is proposed at both national and BRICS levels, encompassing licensing, training, technical standards, ethics codes, and human rights principles. Responsible policies and collaborative strategies can ensure that neurotechnology in mediation equitably enhances access to justice.

This pioneering research makes five key contributions to enriching the understanding of the intersection of neurotechnology, mediation, and law. It elucidates the neuroscientific bases for improving mediation techniques and outcomes, documents emerging real-world applications of neurotechnology in mediation across diverse regions, and identifies risks while proposing harmonized governance principles and guidelines for rights-based advancement. Additionally, it highlights policy implications and underscores the urgent need for cohesive reforms through

multilateral collaboration. Together, these contributions provide valuable insights and impetus for steering the trajectory of neurotechnology in mediation responsibly, ultimately enhancing access to justice globally.

Based on the research, key recommendations emerge for stakeholders to ensure ethical and socially beneficial innovation in mediation neurotechnology. Policymakers should prioritize reforms to address regulatory gaps related to risks and oversight through national legislation and BRICS agreements. Mediator associations must establish clear practice standards and codes of ethics to guide the responsible integration of neurotechnology. Developers should design applications that enhance capabilities based on human rights rather than exacerbating disputes. Governments should increase public R&D funding for mediation neurotechnology applications that align with local priorities and needs. Civil society groups, particularly advocates for persons with disabilities, should actively monitor developments and provide input to strengthen inclusion and protect collective interests.

This exploratory study provides valuable early-stage insights but also has certain limitations, highlighting fruitful areas for future research as the field evolves globally. More extensive empirical data collection through surveys and experiments can enrich the understanding of actual usage patterns, effectiveness, and disputant perceptions regarding neurotechnology integration in diverse cultural contexts. Further analysis of precedents and test cases from Western nations and other regions can inform regulatory options and standards for adaptation across BRICS and worldwide. Expert elicitations and participatory processes to develop technical standards and training curricula can enhance the viability of real-world implementation based on accumulated experiences. Investigating the concerns and perspectives of groups likely to be affected, including disadvantaged communities, can help create more inclusive and rights-protecting policies.

This research explored an underexamined topic with significant societal implications at the intersection of neuroscience, law, and technology ethics by analyzing the current and potential future landscape of neurotechnology integration in mediation. Using a multidisciplinary approach, it examined opportunities and risks, assessed regulatory gaps in BRICS countries that shape global norms, and formulated recommendations to promote responsible and harmonized governance, ensuring the protection of rights while maximizing benefits.

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