

Multilingualism and Its Cognitive Dynamics in India: A Neuro-Humanities Approach

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Abstract

The paper highlights the nascent field of neurohumanities, as it seeks to bridge the gap between the sciences and the humanities by elucidating novel perspectives of the nexus between cerebral function and human phenomena, such as language and culture. Through an examination of the concepts of neuroplasticity and multilingualism, the paper showcases the profound impact of linguistic diversity on cognitive mechanisms and neural structure. Furthermore, it underscores the importance of embracing Indian multilingualism as a fertile ground for interdisciplinary exploration, facilitating deeper insights into the intricacies of human cognition.

Keywords: Neurohumanities, multilingualism, cognitive development, neuroplasticity, cultural neuroscience

Introduction

With the emergence of neurobiological exploration in the nineteenth century and its explosive growth in the last 50 years, the diverse range of methodologies available to neuroscience has expanded. Research in humanities and neuroscience have proceeded in parallel, with certain significant points of convergence that have yielded major insights. Edwards (2008) contends that there is no difference between the two domains. Though they are distinct intellectual traditions and operate in isolation, yet the yearning persists in uncovering how neural processes underpin fundamental aspects of human experience. The paper by Carew and Ramaswami (2020) introduces the interdisciplinary field of

neurohumanities that amalgamates perspectives from both neuroscience and humanities and delves into the facets of human cognition, language, art, and culture. It seeks to connect biological processes in individual brains to phenomena of interest in the humanities and to examine how diverse, empathetic responses may arise from art, prose or discourse. The field of neurohumanities integrates hypothesis-based laboratory studies with human experiences, thus facilitating a deeper comprehension of social behaviour.

The former US President, George Bush officially declared the 1990s as the “Decade of the Brain” (Library of Congress, 2018) marking a significant milestone in the recognition of neuroscience research. The pace of progress has accelerated greatly in recent times marked by several pivotal developments. Neuroscientists are now forming productive interdisciplinary collaborations in the fields of psychology, linguistics, artificial intelligence and cultural studies. (Kemmerer, 2022). Within the realm of language, studying neurohumanities involves an examination of how language functions are represented, computed, and processed in the brain, alongside the interaction of language with cognitive and cultural phenomena. If we take the (relatively narrow and delineated) view that language, music, and emotion ‘belong’ to the domain of humanities, that can also be studied from the vantage points of psychology, computation and neuroscience, then, neurohumanities is simply the research that facilitates a deeper understanding of the concepts traditionally associated with humanities, using the perspectives and methods of scientific disciplines. For instance, a formal analysis of the meter in a poem, or to capture the ‘prose rhythm’ can closely be related to the domains of linguistics or psychology. Likewise, in the case of emotion, research programmes drawing from studies of animal behaviour and physiology lead to a study of different variables of emotion that can be connected to the subjective experience of emotion within the domain of humanities. Therefore, researchers engaged in the study of neurohumanities, explore intricate models of language and brain function that incorporates a nuanced understanding of neurological processes within cultural contexts (Massey, 2009).

In the realm of neurohumanities, a fascinating challenge arises in understanding the intricate correlation between neural activity and subjective human experiences. Observing neural activity patterns while individuals engage with films or recount episodes from their lives poses the question: How can we accurately interpret these neural flows without

direct insight into their thoughts and emotions? Although imaging techniques like fMRI or EEG allow us to discern patterns of neural activity, deciphering them to glean insights into cognition is complicated. Integrating cultural and neural perspectives is crucial for advancing our comprehension of human consciousness. This interdisciplinary pursuit of neurohumanities aims to bridge the study of human experiential structures, as explored by phenomenologists, Merleau-Ponty (1964), with investigations into brain dynamics. It provides a framework for understanding how our perceptions, emotions and cognition manifest in neural activity, thereby shedding light on the nature of consciousness itself.

Multilingualism, Neural Schemas and the Brain

Neural schemas are organized patterns of neural connections or networks within the brain that encode knowledge, concepts or skills. These schemas are constructed through repeated experiences and learning processes. During language acquisition, the brain develops schemas to encode the sounds, meanings and structures of words or sentences. As individuals encounter new linguistic elements, their brains establish novel neural connections or adjust existing ones to assimilate this information. With continued exposure and practice, these schemas strengthen and streamline, facilitating fluent and proficient language usage over time.

Multilingualism, in simple words, can be defined as an individual's capacity to read, write and comprehend in two or more languages. In a multilingual individual, their various language systems tend to be active, and even compete with one another. Being multilingual brings about alterations in the neural pattern and changes in anatomical structure. These changes may involve increase grey matter and in cortical thickness in specific regions like the temporo-parietal cortex, along with changes in white matter integrity. (Pliatsikas, 2019)

The study conducted by Liedke and Nelson (1968) compared monolingual and multilingual samples based on age, socio-economic status, gender and IQ. It revealed that multilinguals possessed superior conceptual skills and also ranked higher in scholastic aptitude tests compared to their monolingual counterparts. Additionally, the multilinguals also excelled in tests measuring cognitive flexibility, encompassing both verbal and perceptual plasticity. Southworth's study (1980) conducted in India examined 1300 school children (grade

1-10) which included monolingual Malayalam speakers and other mother-tongue (MT) multilinguals such as Tamil or Konkani. The participants were organized into 5 different socio-economic levels. The findings revealed that multilingual children achieved better classroom performance.

Over the past decade, research on the multilingual brain and its mechanisms have garnered great attention, particularly concerning language representation, grey matter density, and the speed of lexical retrieval (Baker, 2011). Additionally, studies have explored various aspects such as working memory (Morales et al., 2013), inhibition and metacognitive skills, including cognitive flexibility (Bialystok et al., 2004, 2006, 2012), creativity (Kharkhurin, 2012 for adults; Leikin, 2013 for children), inferential skills in oral narrative comprehension (Tsimpli et al., 2016), and analytic thought process (Cummins, 2000).

Multilingualism in India

Linguistic diversity is a 'Hallmark of India', and Indian multilingualism goes beyond mere numerical diversity and is quite overwhelming. There are 1652 mother tongues identified by the 1961 census, and these are further categorized into 300 to 400 distinct linguistic classifications across five language families, along with a much larger number of dialects. Moreover, there are 22 constitutionally recognized official languages (Constitution of India, VIIIth schedule, after the 100th constitutional amendment, December 2003) along with English (the associate official language). Of these, the Indo-Aryan and Dravidian families include the languages spoken by 95 per cent of the population. According to the 'People's Linguistic Survey of India' (<http://www.peopleslinguisticsurvey.org/>) launched by Ganesh Devy in 2010, there are 780 different languages in India, many of which are endangered. Most recently, *Ethnologue* (2018) suggests the number of different languages is lower, and stands at 462. This linguistic diversity and its endangerment has been a major concern to state and central governments in relation to education and national policies.

Languages are resources, not burdens, in multilingual societies. Multilingualism in India (and in other countries with similar social landscape), cannot be merely viewed as a transition from monolingualism to bilingualism or as a linear extension to bilingualism by the addition of a third or fourth or nth language. The co-presence of multiple languages creates intricate independencies and networking between the languages

and their speakers. This makes it difficult to isolate languages or their speakers as autonomous entities. Children raised in multilingual societies are exposed to a layered structure of linguistic diversity from an early age, which Mohanty (2006) calls “concentric layers of societal multilingualism”. As children navigate various social settings, from familial neighbourhoods to broader local and regional communities, and even more complex environments like the marketplaces, they encounter overlapping linguistic domains. This multilayered landscape challenges the notion of rigid language boundaries. “Multilinguality implies that the boundaries we construct between different languages are artificial and often socio-politically motivated, but in practice, language boundaries are porous and languages flow effortlessly into each other” (Agnihotri, 2014).

Schools that exclusively teach in dominant languages can be seen as a hindrance to ensuring equal educational opportunities. Such an approach undermines the natural multilingualism of children, with negative repercussions for the preservation of their mother tongues (Mohanty & Skutnabb-Kangas, 2022). Multilingual Education (MLE) based on mother tongue education is widely acknowledged as an effective educational approach. MLE entails providing quality education using two or more languages (including sign language) as mediums of instruction with the aim of fostering high levels of multilingualism in Indian classrooms, and ideally, multiliteracy by the end of formal schooling (Mohanty et al., 2009). MLE programmes when implemented globally are based on the principles and theoretical foundations of psycho-linguistic principles of Bilingual Education (BE), with adaptations to suit diverse cultural and contextual settings. (Cummins, 2000). In 2004, Andhra Pradesh initiated MT-based MLE for primary grades across 1000 schools in eight tribal languages. The programme was successful in improving classroom participation when compared to schools using the dominant language (Telugu) as the medium of instruction (Mohanty et al., 2009).

Multilingual socialization research indicates that 3-4 year-old children in India exhibit a remarkable pattern of abstract language awareness. They can discern similarities and differences among multiple languages, accompanied by awareness of linguistic accommodation, mutual acceptance attitudes and a genuine multilingual perspective, all of which are characteristic features of Indian multilingualism. Moreover, in multilingual environments, the phenomenon of cross-linguistic transfer can manifest even in the absence of formal schooling experiences; studies

in neurolinguistics have observed such transfer in illiterate adults. This exchange of knowledge occurs spontaneously and naturally as languages are not isolated entities, but interconnected elements (Mohanty et al., 2009).

English continues to hold an unparalleled position as the predominant language for teaching and research. In the midst of this linguistic dominance, students hailing from non-metropolitan areas often find themselves at a disadvantage. With less than 15 per cent of the eligible age group being able to access higher education, and only a fraction proceeding to attain postgraduate qualifications. This linguistic disparity bears profound implications on the prospects of occupational, economic and social advancement (Niranjana, 2013). Social class, particularly, socio-economic status (SES), stands out as a significant determinant of learning outcomes. Children hailing from low SES backgrounds tend to face more challenges in cognitive performance compared to their affluent middle-class counterparts. Various elements contribute to SES, including parental education, income, occupation, household and neighbourhood amenities, sanitation, lack of cognitive stimulation at home as well as nutritional and psychological well-being. These factors affect these children in school-related skills, language acquisition and cognitive development. Research has revealed that children aged 8-11 from high or middle SES backgrounds exhibit superior performance in language comprehension, memory retention and executive functions, like working memory and cognitive flexibility when compared to their peers from low SES backgrounds (Alcott & Rose, 2017).

The multilingual context in India presents a promising avenue for potentially enhancing the learning outcomes of children from low SES backgrounds. Numerous studies have analysed the potential advantages it would lead to in terms of cognitive performance. The Kond Studies (Mohanty, 1982) involved a comparison between Kui-Odia bilinguals and Odia monolinguals in terms of metalinguistic and cognitive development. The participants included individuals aged 10-12 in grade 6, 12-14 in grade 8, and 14-16 in grade 10. Cognitive assessments were based on an early iteration of the PASS theory of intelligence developed by (Das et al., 1975). Results from the study revealed that Kui-Odia bilingual children outperformed the monolingual children across all measures of simultaneous and successive processing.

In the ongoing trajectory post-1960, the foundational perspective regarding multilingualism as an asset has flourished, and further studies have enriched our understanding of this domain. For instance, in an fMRI study (Kumar et al., 2010) focusing on phrase reading in Hindi-English speakers, a distinct pattern of cortical activation was observed when reading texts in Hindi. Additionally, research indicates that multilingual children exhibit positive transfer across languages, concerning their proficiency in literacy-related discourse, such as storytelling. This cross-linguistic transfer manifests across a broad spectrum of literacy skills, particularly evident in tasks involving abstract and decontextualized contexts (Cummins, 2009). Studies have shown that multilingual children demonstrate comparable performance levels in tasks like picture description and providing definitions (Snow et al., 1991).

To bridge the disparity between learning and accessing multilingual education, it is imperative to strengthen Indian language resources rather than marginalizing local languages in favour of English. Addressing the challenge of resource material inadequacy and ensuring its widespread availability necessitates the generation of new materials in regional languages. This can be achieved through the development of model curricula, field testing them, and integrating digital resources with experimental initiatives in Indian regional languages. Aligned with the objectives outlined in the New Education Policy (NEP) 2020, the Union Education Ministry has mandated all educational institutions, including universities, colleges and schools to furnish textbooks and study materials in regional languages within three years. This directive encompasses regulatory bodies such as the University Grants Commission (UGC), the NCERT, as well as esteemed educational institutions like IIT and Central Universities. The Ministry remarked that “studying in one’s own language can provide a student the natural space to think innovatively without any language barrier.” The government has also introduced the Anuvadini AI-based App for translating a wide array of engineering, medical, law, undergraduate, postgraduate and skill-based books. These translated resources are made available through the e-Kumbh portal. Additionally, the Ministry has highlighted that competitive exams such as NEET, JEE and CUET are already being administered in 13 Indian languages. Thus, this generation of new materials into mainstream education is creating a new generation of interdisciplinary readers (The Hindu, 2024).

Multilingualism and Neuroplasticity

The term 'neuroplasticity' was initially introduced by Polish neuroscientist Jerzy Konorski during the mid-twentieth century. Since its inception, the concept has been widely explored in the fields of neuroscience, psychology and their related disciplines. Neuroplasticity, also referred to as neural plasticity or brain plasticity, denotes the remarkable capacity of neural networks within the brain to undergo changes in structure and function. This dynamic phenomenon enables the brain to adapt and reorganize in response to various experiences and environmental stimuli. It serves as a fundamental mechanism underpinning various cognitive processes and contributes to the recovery of the brain after an injury or neurological disorders. The study (Mechelli et al., 2004) that catalyzed research in this field employed a technique known as Voxel-Based Morphometry to examine the brain structure of individuals proficient in multiple languages as compared to a monolingual individual. The study revealed heightened gray matter density in distinct brain regions associated with verbal fluency in the left posterior supramarginal gyrus (SMG) of the multilingual counterparts. This pioneering investigation provided initial evidence suggesting that multilingualism could induce physical alterations in the brain, subsequently inspiring various other studies on multilingualism and brain morphology.

The need to manage multiple language systems and to select the appropriate lexicon during language production confers greater cognitive control and mental flexibility upon multilingual individuals (Kroll et al., 2012). Moreover, multilingualism is said to protect against cognitive decline and attention control deficits associated with aging, while also promoting the maintenance of white matter structures in the brain (Bialystok et al., 2012). Bialystok views the multilingual experience as "one of the environmental factors that contribute to cognitive reserve or brain reserve." Navigating the complexities of multiple language systems engages mental activities that mitigate age-related cognitive decline, and delay the onset of dementia. Bialystok examined the age of onset of Alzheimer's disease in 91 monolingual and 93 bilingual patients and found a four-year delay for the bilingual patients despite their lower level of education than that of the monolinguals.

A study by Menon et al., (2023) investigated the correlation between multilingualism and cognitive performance among elderly individuals residing in rural southern India. This study used cross-sectional

(baseline) data from Srinivasapura Aging, Neuro Senescence and COGNition study, which is an ongoing community-based, longitudinal aging cohort study conducted in a rural setting in southern India, the study encompassed a total of 3725 participants. The participants were categorized into two groups based on their linguistic proficiency—monolinguals and multilinguals. The cognitive performance of the participants was assessed using the Clinical Dementia Rating (CDR) Scale. The analysis of Clinical Dementia Rating (CDR) scores concerning language categories revealed that among monolingual participants, 86.5 per cent exhibited healthy cognitive functioning, while 13.5 per cent showed signs of mild cognitive impairment (MCI). Conversely, among multilingual participants, 94.3 per cent displayed healthy cognitive status, with only 5.7 per cent demonstrating MCI. Logistic regression yielded an odds ratio value of 0.69 (95 per cent CI: 0.5-0.9), indicating that monolingual individuals were more likely to develop cognitive impairment compared to their multilingual counterparts.

Neuroplasticity plays a crucial role in allowing culture to leave an imprint on the brain, thereby sustaining cross-cultural differences in neural specialization as these neural bases also influence second language learning. While language processing engages the entire brain, the specific regions involved vary depending on the task, with certain areas being more critical than others. Damage to focal language areas, such as Broca's and Wernicke's areas due to brain injury can lead to aphasia—a language disorder affecting communication abilities, including speaking, understanding speech, reading and writing, depending on the severity of the injury (Ziegler & Goswami, 2005).

Conclusion

To embark on a journey of transformative education as well as the emergence of cognitive perspectives, it is important to develop a praxis that opens the spaces necessary for the creation of new thought. For this to happen, there must be a new commitment to intelligence, a new fidelity in communication, and a deeper appreciation for imagination. Humans transcend mere biological existence. Though the brain does offer necessary biophysical reality for individual cognition and action, it alone does not suffice to shape the mind or behaviour. On the mind-brain continuum, the individual mind is the expression emerging from the personalized brain (Greenfield, 2000). This process of personalization occurs throughout life within environmental and socio-cultural milieus,

characterized by intricate interactions between ‘nature’ and ‘nurture’ (Massey, 2009).

In the realm of neurohumanities, diverse disciplines have begun to converge, albeit slowly. Cognitive scientists, linguists, and neurologists have laid the groundwork for understanding how storytelling and visual arts intersect with human experiences. However, as this is a nascent field, there’s vast potential in exploring the rich complexity and creativity inherent in historical, philosophical, and artistic texts. These texts, integral to the training of historians, philosophers, cultural studies and art critics, offer unique insights that are ripe for exploration within the neuroscientific framework. In this journey of interdisciplinary exploration, Indian multilingualism stands as a testament to the complex interplay of language, culture, and cognition. With its myriad languages and dialects, India offers a rich ground for further analysis into the tapestries of neural plasticity and linguistic diversity. As we delve deeper into the neurohumanities, embracing the diverse linguistic landscape of India promises to illuminate new pathways toward a deeper understanding of the human experience.

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