

## **Title: Cognitive Enhancement and Social Mobility: Skepticism from India**

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### **Abstract**

Cognitive enhancement (CE) covers a broad spectrum of methods, including behavioral techniques, nootropic drugs, and neuromodulation interventions. However, research on their use in children has almost exclusively been carried out in high-income countries with limited understanding of how experts working with children view their use in low- and middle- income countries (LMICs). This study examines perceptions on cognitive enhancement, their techniques, neuroethical issues about their use from an LMICs perspective.

Seven Indian experts were purposively sampled for their expertise in bioethics, child development and child education. In-depth interviews were conducted using a semi-structured topic guide to examine 1) understanding of CE, 2) which approaches were viewed as cognitive enhancers, 3) attitudes towards different CE techniques and 4) neuroethical issues related to CE use within the Indian context. All interviews were audio recorded and transcribed before thematic analysis.

Findings indicate Indian experts view cognitive enhancement as a holistic positive impact on overall functioning and well-being, rather than improvement in specific cognitive abilities.

Exogenous agents, and neuromodulation were viewed with scepticism, whereas behavioral approaches were viewed more favorably. Neuroethical concerns included equitable access to CE, limited scientific evidence and over-reliance on technology to address societal problems. This highlights the need for more contextually relevant neuroethics research in LMICs.

## Introduction

Cognitive enhancement (CE) has attracted a large amount of attention in the last twenty years due to the increasingly competitive demands of society regarding educational performance (Colaneri, Sheldon, and Adesman 2018), and been highlighted as one of the most significant areas of neuroethical interest in the last twenty years (Harris 2011). Although CE research in the neuroscientific field is relatively new, the concept of cognitive enhancement has been around for a long time. For example, in some cultures, indigenous herbs, e.g. Ashwagandha and Ginkgo Biloba, have been used to promote memory and concentration for generations (Verster and Van Niekerk 2012). However, in recent years the discussion around cognitive enhancement has focused on pharmacological (Rommelfanger et al., 2018; Schelle et al., 2014) and technological interventions e.g. neuromodulation approaches (Lewis et al. 2016), with a large part of the literature coming from high-income countries (HICs). However, understanding what is meant by CE is a complex issue, and one which may differ across countries and cultures. Typically, “cognitive enhancement” has been understood as improvements made above or beyond the “normal”, or “improving cognitive functions” (Tomažič and Čelofiga 2019), but this may not represent a full understanding of CE, especially in regions outside HICs, where sociocultural contexts differ, and research is limited.

CE covers a broad spectrum of methodologies including exogenous agents such as pro-cognitive drugs, neuromodulation interventions and behavioral techniques (Keshavan et al., 2014; Tomažič & Čelofiga, 2019). Pro-cognitive drugs typically include psychostimulants like methylphenidate (Ritalin) which is used to treat attention- deficit/hyperactivity disorder (ADHD). Pro-cognitive drugs are commonly used for enhancement purposes, and their use in typically developing

individuals has been focused on in the literature partly because this type of enhancement affects individuals on a biological and psychological level (Colaneri, Sheldon, and Adelman 2018).

They are also relatively quick and low-cost to deliver, Comparatively, behavioural techniques may require specialized training which can be lengthy and costly to administer.

Neuromodulation includes interventions such as deep-brain stimulation (DBS) and transcranial magnetic stimulation (TMS), which are relatively new enhancers and require specialized technology. These factors limit CE accessibility, especially in resource limited settings. Pro-cognitive drugs on the other hand have more potential to be scaled up and widely distributed (Butcher 2003).

One area of academic debate has been the potential of CE to support people of disadvantaged backgrounds to attain their 'true' cognitive potential (Ray, 2016; Jotterand, 2018; Farah, 2015).

Recent estimates suggest that one in every three pre-school children in low and middle-income countries (LMICs) is failing to meet expected developmental milestones (McCoy et al. 2016), and over 200 million children in LMICs are at risk of sub-optimal development, with the majority of these children living in India (Farah 2015; Lu, Black, and Richter 2016).

Improvement of cognitive function in these children could have a significant impact on their functionality, wellbeing, and developmental potential, which in turn could lead to an improvement in quality of life for the individual and their family. It has therefore been argued that CE (specifically pro-cognitive drugs) could be used to equalize social inequalities amongst children who are at the most disadvantaged (Tomažič & Čelofiga, 2019; Jotterand, 2018).

Moreover, it has been debated whether it is a moral requirement to explore the use of pharmacological CE to help remedy the disadvantages experienced by children due to social inequalities (Ray 2016). Whilst this is a heavily debated topic (Farah et al. 2004), the research on

CE has been based almost exclusively in HICs, and with little exploration of the concept and acceptability of CE approaches in settings where it has been argued that CE could be the most impactful, such as in LMICs. Furthermore, little research on the ethical implications of advancing neuroscientific research in CE has been conducted in LMICs, where socio-cultural contexts differ; little is known about how the concept of CE is currently viewed in LMIC contexts. This is important because we know that the process of adoption of a new idea, innovation or technology, such as CE, into a community is impacted by socio-cultural values, previous ideas, and/or perceived needs, that can accelerate or hinder this process, as described by the diffusion of innovation theory (Kaminski 2011). We also know that societal culture influences an individual's expectations, values, health beliefs and decisions, which further impact how scientific advances are viewed and adopted by communities (Rommelfanger et al. 2018). Therefore, neuroethics research in this area is critical for greater understanding and insight into the far-reaching social impact of scientific advances across different settings (Rommelfanger et al. 2018). In addition, as science advances, CE technologies may become more accessible globally. It is therefore important to understand acceptability of these approaches, whether these technologies will be adopted, and to determine the safeguards which need to be in place.

To understand how to frame the neuroethical issues of CE use among disadvantaged children in LMICs, we conducted a small study to understand 1) how cognitive enhancement is understood within an LMIC context; 2) attitudes of Indian experts towards the use of CE techniques; 3) neuroethical issues arising from using CE techniques in the Indian context.

## **Materials and Methods**

## ***Interviews***

Seven semi-structured interviews were conducted with experts from India. Experts were purposively sampled for stakeholders with a professional interest in child development, and specifically for expertise in: bioethics, cognitive development, child education and practice relevant to cognitive enhancement in children. All participants were Indian and had built their expertise working within India. Details of participants and their areas of specialization can be found in Table 1. A topic guide for the semi-structured interviews was developed through a facilitated virtual discussion with an ethics study group at Duke University and included members from the NeuroGene consortium (including authors: JD, GLE, JS). Interviews were conducted in a combination of English and Hindi.

## ***Procedure***

This protocol was approved by the IRB at Sangath, India. Participants were emailed and asked if they would like to participate in the study. If interest was expressed, details of the study were provided in the form of an information sheet. Written and/or audio consent was obtained prior to the interview. All interviews were audio recorded.

A topic guide to facilitate the discussion was developed in collaboration with Indian and non-Indian experts, and through an initial review of the current state of the literature and a discussion with the ethics study group (as detailed above). It focused on the following areas: 1) understanding of cognitive enhancement; 2) attitudes of experts towards the use of CE techniques and 3) neuroethical issues arising from using CE techniques in the Indian context and 4) whether experts considered a range of potential techniques as cognitive enhancers.

## ***Data analysis***

All interviews were transcribed from the audio recording. Following familiarization of the data (transcribed interviews), thematic analysis was carried out (Braun and Clarke 2006). An initial coding framework was established between two researchers (GLE, JD) based on the review of the literature. Emergent themes were identified by both researchers independently following immersion in the data of the first four transcripts. These emergent themes were then discussed and defined to develop the final coding framework. These initial transcripts were then reviewed using the final framework. The remaining transcripts were then coded according to the final coding framework. These codes and emerging themes were compared, and any discrepancies were discussed until consensus was reached.

## **Results**

The results section is categorised into two sections. Section 1 outlines results relating to expert perceptions of cognitive enhancement and CE techniques. Section 2 focuses on the neuroethical and social issues of using CEs with children in India. Four key themes emerged from thematic analysis in section 2: 1) communication about CE in the local context; 2) influence of societal inequalities on access to CE; 3) access to, and implementation, of CE; 4) neuroethical concerns relating to use of CE.

### ***Section 1: Perception of Cognitive Enhancement***

#### *Cognitive Enhancement – a holistic improvement*

Indian experts considered enhancement as improving the ability of a child. Child development experts specifically considered their role to be helping a child understand their own abilities and provide building blocks to assist in their “improvement”. Indian experts generally viewed cognitive enhancement as a *holistic* positive impact on a child’s overall functioning, targeting

multiple factors of child's development, rather than specific cognitive abilities such as the "speed of processing" or "attention/concentration."

*"Cognitive enhancement would-be all-round development of the child essentially"*

*(Interview 4)*

Key to this holistic viewpoint, experts felt that cognition is complex, emphasizing that the attainment of potential, is influenced by their sociocultural environment and not a biologically predetermined capacity.

*"I believe that the person's cognitive development depends upon both your biology as well as environment. It's a complex interaction between the two. And I don't believe it is only the biology that determines it."*

*(Interview 1)*

This breadth of functioning was thought to encompass communication and understanding. A person's self-awareness and state of mind were also implicated as critical elements of enhancing cognition, for example a person's ability *"to calmly think in the moment... might contribute overall as a cognitive enhancer"* ... *"I think enhancement for me would be becoming aware of one's thought process and you use that thought process to improve the overall functioning in some way."* *(Interview 2).*

#### *Approaches considered Cognitive Enhancers by Experts*

Table 2 outlines expert perceptions on which methodology was considered to be a cognitive enhancer. Experts did not consider behavioral interventions including physical exercise, exogenous agents including nutritional supplements and pro-cognitive drugs, caffeine, or neuromodulation techniques including deep brain stimulation (DBS) and transcranial magnetic



stimulation (TMS), as cognitive enhancers. Any technique that focuses on only one aspect of cognition, e.g., attention and speed of processing was not considered to be an enhancer, but instead considered to be a mediator to facilitate cognitive enhancement.

*“We are not trying to bring about a sudden improvement in the child’s intelligence but rather we are trying to provide the facilitating factors that can help the child to improve.”*

*(Interview 4)*

**Behavioural Interventions:** Behavioural interventions, i.e. physical exercise were viewed as mediators for facilitating CE, and considered important for cognitive performance and overall integration of information. However, they were not considered to be enhancers in their own right (Table 2).

Expert views on meditation and yoga as cognitive enhancers differed somewhat. Three out of the seven experts interviewed felt meditation and yoga were not cognitive enhancement approaches in themselves, but rather approaches which could help a child with readiness for cognitive enhancement. Comparatively, four experts (Interview 2, 3, 6, 7) considered mindfulness and yoga to be a cognitive enhancer. Interestingly, the two teachers who were interviewed perceived yoga and meditation to be important enhancement techniques because when incorporated in the education system, they were seen as being useful to reduce stress amongst children, which is essential for progress and general wellbeing.

Experts considered mental training, (including improving problem solving, decision making skills and social skills) a cognitive enhancer, as it *“enhances cognitive functioning”* (Interview 2). Education in general, whilst sometimes not having previously been thought of in these terms, was also emphatically agreed to be a cognitive enhancer. This was stated partly due to the

holistic approaches that are encompassed in education, and “*allowing the child to understand the world around*” (Interview 4).

***Exogenous Agents:*** Although all experts considered adequate nutrition to be of utmost importance, they highlighted the difference between adequate nutrition and use of nutritional supplements, which was more contentious. For example, one teacher (Interview 6) describes that whilst nutrition is extremely important, it is not a cognitive enhancer, rather one of many factors contributing to child’s academic performance. Experts expressed reservations about whether nutritional supplements could be used with all children as a CE technique, emphasizing the importance of a balanced diet instead. Healthy food was perceived as much more important for children from disadvantaged backgrounds, than use of nutritional supplements.

All Indian experts strongly agreed that caffeine (viewed by all experts as tea or coffee, rather than caffeine pills) was not a cognitive enhancer. Experts considered it to be a stimulant, and voiced some concern about side effects and dependency on caffeine.

It was evident that all experts were skeptical about the use of pro-cognitive drugs. Firstly, experts questioned their effectiveness, but also tended to declare that they felt they didn’t know enough on the topic. Importantly, experts expressed concern that pro-cognitive drugs could be viewed as a “quick fix” solution.

*“when these kind of drugs are prescribed, the parents and the child will absolve of any responsibility of taking any other further efforts for improving the cognitive skills in the child. It is more of a passive kind of effort that they will be taking. Like, take medicine, my cognitive skills will improve!”*

*(Interview 5)*

There were additional worries on the adverse effects of using pro-cognitive drugs, as well as concerns over misuse.

*“Chances are all these drugs, these stimulants they can be abused if these are OTC [over the counter]”*

*(Interview 3)*

Finally, Indian experts highlighted the temporary nature of the effect of pro-cognitive drugs as a cognitive enhancer, and if they need to be used, to ensure that their use be combined with other approaches (Table 2).

**Neuromodulation:** The overriding argument from experts regarding use of neuromodulation, such as DBS, TMS and genetic modification for cognitive enhancement, was their concern about the lack of research evidence available for these techniques.

Experts expressed concerns about use of technology without thinking about its consequences, and the potential for it to be used to try and overcome larger social problems.

*“You may have a technology but that does not mean you need to use it. Unless you are able to have a capacity to undo it?”*

*(Interview 1)*

There were also concerns raised about their scalability and applicability for universal coverage, partly due to high costs associated with their use.

## ***Section 2: Neuroethical and Social Issues***

Four key themes emerged from the thematic analysis relating to neuroethical and social issues of using cognitive enhancers in India: 1) communication about CE in the local context; 2) influence

of societal inequalities on access to CE; 3) access to, and implementation, of CE; 4) neuroethical concerns relating to use of CE.

#### *Theme 1: Communication about CE*

Given the low awareness about CE in the community, experts from India considered communication on CE and its techniques as being very important and suggested that creating awareness about CE is central for improving access.

Interestingly, all Indian experts mentioned there is no local language equivalent for the term ‘cognitive enhancement’ and when asked about common colloquial terms which would be useful to describe the concept, they mentioned phrases referring to ‘smartness’, ‘becoming clever’, or ‘efficient’ and ‘quick in thinking’ that are commonly used in Hindi, the most widely spoken language in India.

*“So ‘Tez ban jaana’ [becoming fast] or ‘Hoshiyaar ban jaana’ [becoming smart] are common phrases associated with cognitive enhancement. Also, people look in terms of being street smart.”*

*(Interview 4)*

#### *Theme 2: Influence of societal inequalities on access to CE*

Indian experts described differences between HIC and LMIC contexts relating to access including community level awareness. It was felt that in HIC, CE is given more importance as part of regular education systems. On the other hand, in LMICs, the focus is on how to provide basic education for all children.

*“The opportunity given to the children and the exposure will be different in children in HIC as compared to children in LMICs. So, obviously the HIC children will be much more exposed and those kind of aspects will be focused as part of their regular*

*education. They will take more effort to pick up children who require these kinds of techniques. Unless anyone takes extra effort towards them maybe children from LIC may not be exposed to those kinds of [techniques].”*

*(Interview 5)*

Indian experts felt that foremost social class differences in India are likely to play a role in accessibility. Several of the experts described that in families where parents are educated and have available resources, cognitive enhancement for their children may be given priority. However, in families from lower socioeconomic strata, particularly those living in challenging environments where basic survival takes on priority, it is unlikely that cognitive enhancement would be given importance.

*“If a parent doesn't have enough for the basics such as food, then how can he/she think beyond that.”*

*(Interview 7)*

However, it was also felt that if cognitive enhancement could specifically target lower socioeconomic strata through frontline workers, this would be hugely beneficial in terms of overall well-being and upward social mobility.

*“If we can actually target the lower socio-economic strata and enhance their thinking not just in terms of them seeking any kind of an intervention, but even generally for their own well-being, I think you have really achieved something significant there.”*

*(Interview 2)*

*Theme 3: Access to, and implementation of, CE*

Three sub-themes were identified: i) challenges to widespread implementation of CE; ii) challenges of identifying children with potential need for cognitive enhancement; and iii) improving accessibility to CE.

***i. Challenges to widespread implementation of CE:*** Indian experts expressed that professionals are cognizant of the fact that sub-optimal learning environments for large sections of society limit opportunities to attain potential and are aware of the specific challenges and problems. However, they felt implementation of CE techniques in LMIC contexts would be a challenge since there is no integration of CE with public policies on education.

*“The challenge of this decade is to gain an understanding into how to integrate these [CE] methods in the existing system and policies.”*

*(Interview 4)*

***ii. Challenge of identifying children with potential need for CE:*** In the absence of any education policies around CE, Indian experts felt a primary concern was understanding how to identify children who may benefit from CE and use of measures to ensure inclusion of children from disadvantaged backgrounds and/or those with disabilities.

*“Essentially in terms of cognitive enhancement, early identification, early detection and early intervention is important... The biggest challenge right now ... is inclusion. Children with learning challenges or those who are slow learners, those who come from disadvantaged backgrounds. How do they fit into the system?”*

*(Interview 4)*

Another implementation challenge highlighted was the affordability of interventions along with high costs that are associated with delivery by professionals and experts who are aware of CE techniques.

*“Parents from lower backgrounds don’t have the money and the awareness of the interventions available. So, affordability is a key issue.”*

*(Interview 6)*

**iii. Improving accessibility to CE:** Indian experts also laid emphasis on the need for large scale solutions to target children who face difficulty with academic performance. They viewed contextualization of solutions to incorporate the diversity of local languages whilst being sensitive to unique challenges faced by different societal strata as critical when considering CE.

*“I think the education plan for cognitive enhancement is to target a wider population. We have different things for different socio-economic strata. How you bring this information to each one of them [is important].”*

*(Interview 2)*

In order to improve accessibility and affordability in India, it was felt that CE techniques should ideally be home-based and use technologies which are easy to administer and monitor e.g., using smart phones for training or exercises which could be done at home thereby saving on logistic costs.

#### *Theme 4: Neuroethical Concerns on use of CE in LMICs*

Three sub-themes emerged regarding neuroethical concerns on the use of CE in India: i) lack of scientific evidence; ii) over-reliance on technology, and iii) consent.

**i. Lack of scientific evidence:** Overall, Indian experts expressed skepticism about the widespread use of CE techniques and felt a major neuroethical concern was premature advocacy and use of CE without adequate scientific evidence, particularly from within the local context to support their use. They therefore highlighted the need for research into CE techniques and establishing which methods are most beneficial.

*“So, the ethical issue is the scientific grounding of this knowledge.... Well-grounded scientific methodologies need to be practiced rather than those that aren’t.”*

*(Interview 4)*

Another related neuroethical concern specifically around the use of CE with children was the limited understanding and scientific evidence from use with children. Child development experts shared their concerns about how there is not much understanding in the field about long term effects on the brain when cognitive enhancers are used, or any potentially harmful long-term changes in the brain, even if there is some current scientific evidence to indicate that CE has short term benefits.

**ii. *Over-reliance on technology:*** Importantly, experts raised ethical concerns about reliance on using technological advancements to overcome social problems rather than addressing root causes of societal challenges. For example, a bioethicist described how manifestations of mental health problems may be secondary to larger societal issues and expectations that an intervention would change behaviour without addressing the underlying societal challenges would be a very deterministic perspective.

*“Instead of improving social aspects, you think the social problem can be fixed by the medical technology?” (Interview 1)*

Child development experts also suggested that parents may view CE as a quick fix solution to a child’s academic difficulties, particularly if they have unrealistic expectations from CE. They raised ethical concerns about parents becoming overly reliant on use of CE such as pro-cognitive drugs, which require low parental involvement, and the possible influence that CE may have on parenting practices like responsibility for providing continued engagement and support to a child. Another concern they raised was that if parents expect immediate results, are very busy, or



have logistic challenges with continuing CE techniques that require continuity such as training, they may view these particular techniques as cumbersome which may limit their uptake.

*“But many people would want a quick fix that is why medicines still have the edge. Because it is a quick fix and less responsibility. So, some people are ok with taking medicines for cognitive enhancement. But, when you talk about other techniques, they say we cannot take them to those places [travel to access cognitive enhancers], nobody has time.”*

(Interview 5)

**iii. Consent:** Ethical considerations were raised about child rights and consent. Typically, for any interventions with children, parental or guardian’s consent is usually considered sufficient.

However, all experts questioned whether parental consent alone would suffice in the case of CE and expressed that it would be important to make typically developing children and adolescents aware of their rights and take assent before considering CE. This concern arose from a larger standpoint of whether it is ethical of parents to expect their child to perform beyond their natural capacity. They described how in the Indian context, parents of children with developmental disabilities, often accepted their circumstances as ‘naseeb’ or fate; however, parents of typically developing children who may not be doing very well in school, had very high expectations of their children, which could act as a motivation for CE. Unlike with adults, who are aware of their choices, children are reliant on parents to make a decision for them, and this may put undue pressure on the child. They queried that if the motivation behind CE and a child excelling in life were based in a parent’s own insecurity or circumstances, would it be ethically justified to place such expectations to excel or pressure on a child.

*“is [it] actually ethical to pressure the child to do something beyond their capacity?”*

*(Interview 5)*

*“Maybe it’s their [parent’s] expectations and that they are not able to accept their own ordinariness in the process.”*

*(Interview 2)*

## **Discussion**

To the best of our knowledge, this is the first study which has explored perspectives on CE amongst experts within an LMIC setting. Interestingly, experts highlight that there is no local language equivalent for the term CE, and common colloquial terms describing the concept refer to increasing “smartness” or “efficiency”. However, results suggest that experts in India consider cognitive enhancement as much more than increasing one element of cognition (e.g. speed of thinking). Instead, a key concept that was identified from our analysis was that CE was perceived from a holistic viewpoint, and perceptions of which methodologies were considered cognitive enhancers was strongly influenced by this. Exogenous agents and neuromodulation techniques were not considered cognitive enhancers, but education and mental training were viewed more favourably as cognitive enhancement approaches for use in LMIC contexts. Our thematic analysis identified core themes relating to the neuroethical and social issues around the use of cognitive enhancement. We synthesise these below and highlight the overriding concerns from an LMIC expert perspective about access to CE and their potential use for upward social mobility.

### ***Perceptions of CE from an LMIC perspective***

A key finding of this paper is that Indian experts view CE very broadly to mean holistic upward modulation of function, which includes not only cognitive growth, but social adjustment and overall wellbeing. This is in contrast to the literature, which typically views CE as “*the use of drugs, biotechnological strategies or other means by healthy individuals aiming at the improvement of cognitive functions such as vigilance, concentration or memory without any medical need*” (Bostrom and Sandberg 2009; Hildt 2013; Singh and Kelleher 2010). In addition to improvements in cognitive abilities and overall functioning, Indian experts lay emphasis on comprehension, self-awareness about one’s own abilities, communication and social adjustment. Differences in the conceptualization of cognition are well known to be impacted by deeper cultural influences for example between LMICs and HICs (Mishra, 2001; Sinha & Kao, 1988). This broader view towards CE may be rooted in the cultural understanding of cognitive development which emphasizes improving one's life and ‘*eventually discovering the “true reality” by acquiring extraordinary forms of cognition—that is, to “see” the world (including oneself) as it really is*’ (Sedlmeier and Srinivas 2016).

The broad understanding that LMIC experts had of the concept of CE was related to the way different CE techniques were viewed. The traditional categorization of CE techniques includes pharmacological, behavioral and neuromodulation techniques (Keshavan et al. 2014); however, in the context of CE, research from HICs have largely focused on pharmacological and neuromodulation CE (Schelle et al. 2014). This may be due to the way the concept has been understood in the western literature as related to improvements in specific cognitive abilities, and also due to access to advanced technologies. Our results however point to a greater interest in less invasive techniques in the LMIC context as compared to HIC. This is highlighted by our results demonstrating the emphasis given to self-awareness and overall wellbeing being a core

aspect of cognitive enhancement in this LMIC setting. Interestingly, although the impact of exercise and yoga/meditation on cognitive processes such as attention and memory have been demonstrated (Austin and Loprinzi 2019), this has not been as widely explored as a CE technique compared to pro-cognitive drugs in HIC. This may be because of rapid growth of technological advancements, perhaps combined with a greater awareness of pharmacological CE use, especially in higher education settings in HICs (Schelle et al. 2014), leading to research priorities being dominated in this field. The contrasting significance with which experts interviewed in India gave to these techniques highlights the importance of not only understanding how CE is understood within a cultural context, but how this might influence research priorities and uptake of neuroscientific discovery.

### ***Neuroethical and Social Issues of the use of Cognitive Enhancement***

#### *Use of CE for upward Social Mobility*

Although all Indian experts viewed CE as being important for upward social mobility, skepticism was expressed about the use of pro-cognitive drugs and neuromodulation for this purpose. Similar reservations have also been noted in HIC, where concerns have primarily focused on the lack of scientific evidence about CE efficacy and underpowered studies (Sahakian et al. 2015), the long-term effects on child development (Graf et al., 2013; Gaucher et al., 2013) and in the case of pro-cognitive drugs, risks associated with potential misuse and abuse (Schelle et al., 2014; Wilens & Kaminski, 2019; Bossaer et al., 2013; Garasic & Lavazza, 2016). Further to this, it has been suggested that a child who has been given access to CE might have difficulty understanding their identity as they develop (Gligorov 2016), and may become dependent on CE originating from a self-doubt as to whether they can function without the CE (Colaneri, Sheldon, and Adesman 2018).

It has been argued that there could be a moral responsibility to use CEs to level the playing field for children from socially disadvantaged backgrounds (Colaneri, Sheldon, and Adesman 2018; Graf et al. 2013). However, concerns were expressed from an LMIC perspective about the idea of using of CE techniques to target social inequalities, something, they argued, that should instead be addressed more systemically. If certain CE techniques, specifically pro-cognitive drugs and neuromodulation, were made widely accessible, then there would be a risk of this acting as a “quick-fix” solution to address disparities, specifically within educational settings, thereby ignoring the complexity of issues that underlie social inequalities which require long-term multisectoral support. In summary, they argued that cognitive enhancement should be approached in a holistic manner, taking into account social determinants of cognitive development, rather than neuroscientific discovery alone, e.g., providing a solution in the form of a pro-cognitive drug.

#### *Equal access to CE*

A strong association between SES and a child’s cognitive abilities has previously been demonstrated (e.g. Farah et al., 2006; Noble et al., 2007; Noble et al., 2006). Therefore, an important question is, if CE were to be considered an option, how could society effectively identify which children would benefit most from CE (Hackman and Farah 2009) and provide access if implemented widely. Access to CE may be influenced by social barriers, access to information and cost which could compound the disadvantages faced by people already living in disadvantaged circumstances (Farah et al., 2004). The concept of fair use of CE has also emerged in literature from HIC, and this concept focuses on both the importance of equal distribution of CE, but also the idea that CE can reduce the individual effort that is required from students to educationally perform well (Schelle et al. 2014). Although the first of these concepts was also

expressed by our LMIC experts, the second did not emerge. It is possible that the different emphasis on the impact of CE is reflective of the cultural differences between contexts. An important construct, widely discussed in the literature, of differentiating between cultures has been the distinction between “individualistic” compared to “collectivist” societies (e.g. Schimmack, Oishi, and Diener 2005), which focuses on how individuals define themselves and their relationships with others, specifically with the groups to which they belong (Brewer and Chen 2007). For example, in most Western cultures, self-definition can be described as based on individual autonomy, compared to many Eastern cultures, where self-definition can be viewed primarily as social interdependence. This concept has been suggested to be useful when differentiating cultural attitudes to healthcare (Garasic and Lavazza 2016; Rommelfanger et al. 2018). It has been suggested that “collectivist” societies stress collective identity, emotional dependence and group solidarity (Brewer and Chen 2007), and it is possible that this may play a part in Indian experts perceiving CE from a holistic viewpoint, with a stress on the social and emotional development of children, compared to most Western literature. This idea is further illuminated by the LMIC experts’ skepticism of individualistic CE techniques (specifically pro-cognitive drugs and neuromodulation), which have been more commonly researched in HICs. On the other hand, the distinction between ‘individualistic’ and ‘collectivist’ societies has received much criticism, for example related to the concept, especially of “collectivism”, being defined overly broadly (e.g. Brewer & Chen, 2007; Schwartz, 1990); this therefore, in the context of a rapidly developing economy such as India, likely warrants a more nuanced analysis.

### ***Limitations***

Whilst providing important perspectives on CE, and for the first time from an expert LMIC perspective, this study is limited due to the small number of interviews conducted, and its focus

on India, rather than from different LMIC settings. However, this is a first step to collect empirical evidence of perspectives from an LMIC context and will form the basis for guiding further enquiry into perspectives from other stakeholders. This will be important to understand which type of neurotechnologies for cognitive enhancement may be adopted going forwards and therefore inform future research in this area.

### ***Conclusion and Next Steps***

In conclusion, experts in LMICs perceive cognitive enhancement differently to the majority of literature from HIC, to mean a ***holistic*** upward modulation of function, which goes beyond cognitive improvement alone to include social adjustment and wellbeing. These findings highlight that what needs to be implemented and adopted for attainment of cognitive potential and upward social mobility differs across contexts. We must not lose focus on the ultimate priority of social upward mobility, which is more likely to be achieved through a systems approach, rather than individualistic approaches to CE i.e. via quality education and behavioral approaches. Indian experts viewed these systemic approaches more favorably than neuromodulation or exogenous agents for cognitive enhancement in children. Since infrastructural differences and access to quality education differ across countries, we therefore highlight that research priorities may also differ. From a neuroethical standpoint, we raise the question of whether we should be investing more resources on research and implementation of cognitive enhancement approaches that are more acceptable to ultimate end-users in LMIC populations where the number of potential beneficiaries may be large. Although limited in its scope, our research provides novel empirical evidence in this area, and highlights the importance of conducting further research in LMIC settings to guide research priorities. A next integral step would be to investigate perceptions of CE with end-users, such as parents, from a neuroethical

lens to provide further insights into acceptable approaches towards cognitive enhancement with an ultimate aim of providing support to children for upward social mobility in resource limited settings.

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### **References**

- Austin, Malina, and Paul D. Loprinzi. 2019. 'Acute Exercise and Mindfulness Meditation on Learning and Memory: Randomized Controlled Intervention'. *Health Promotion Perspectives* 9 (4): 314–18. <https://doi.org/10.15171/hpp.2019.43>.
- Bossaer, John B., Jeffrey A. Gray, Stacy E. Miller, Gavin Enck, Vamsi C. Gaddipati, and Robert E. Enck. 2013. 'The Use and Misuse of Prescription Stimulants as "Cognitive Enhancers" by Students at One Academic Health Sciences Center:' *Academic Medicine* 88 (7): 967–71. <https://doi.org/10.1097/ACM.0b013e318294fc7b>.
- Bostrom, Nick, and Anders Sandberg. 2009. 'Cognitive Enhancement: Methods, Ethics, Regulatory Challenges'. *Science and Engineering Ethics* 15 (3).
- Braun, Virginia, and Victoria Clarke. 2006. 'Using Thematic Analysis in Psychology'. *Qualitative Research in Psychology* 3 (2): 77–101. <https://doi.org/10.1191/1478088706qp063oa>.
- Brewer, M.B., and Y.R. Chen. 2007. 'Where (Who) Are Collectives in Collectivism? Toward Conceptual Clarification of Individualism and Collectivism.' *Psychological Review* 1 (114): 133.
- Butcher, James. 2003. 'Cognitive Enhancement Raises Ethical Concerns'. *The Lancet* 362 (9378): 132–33. [https://doi.org/10.1016/S0140-6736\(03\)13897-4](https://doi.org/10.1016/S0140-6736(03)13897-4).
- Colaneri, Natalie, Mark Sheldon, and Andrew Adesman. 2018. 'Pharmacological Cognitive Enhancement in Pediatrics': *Current Opinion in Pediatrics* 30 (3): 430–37. <https://doi.org/10.1097/MOP.0000000000000615>.
- Farah, M. J. 2015. 'The Unknowns of Cognitive Enhancement'. *Science* 350 (6259): 379–80. <https://doi.org/10.1126/science.aad5893>.
- Farah, Martha J., Judy Illes, Robert Cook-Deegan, Howard Gardner, Eric Kandel, Patricia King, Eric Parens, Barbara Sahakian, and Paul Root Wolpe. 2004. 'Neurocognitive



- Enhancement: What Can We Do and What Should We Do?' *Nature Reviews Neuroscience* 5 (5): 421–25. <https://doi.org/10.1038/nrn1390>.
- Farah, Martha J., David M. Shera, Jessica H. Savage, Laura Betancourt, Joan M. Giannetta, Nancy L. Brodsky, Elsa K. Malmud, and Hallam Hurt. 2006. 'Childhood Poverty: Specific Associations with Neurocognitive Development'. *Brain Research* 1110 (1): 166–74. <https://doi.org/10.1016/j.brainres.2006.06.072>.
- Garasic, Mirko D., and Andrea Lavazza. 2016. 'Moral and Social Reasons to Acknowledge the Use of Cognitive Enhancers in Competitive-Selective Contexts'. *BMC Medical Ethics* 17 (1): 18. <https://doi.org/10.1186/s12910-016-0102-8>.
- Gaucher, N, A Payot, and E Racine. 2013. 'Cognitive Enhancement in Children and Adolescents: Is It in Their Best Interests?' *Acta Paediatrica* 102 (12): 1118–24. <https://doi.org/10.1111/apa.12409>.
- Gligorov, Nada. 2016. 'Cognitive Enhancement and Personal Identity'. In *Neuroethics and the Scientific Revision of Common Sense*, by Nada Gligorov, 11:53–74. Studies in Brain and Mind. Dordrecht: Springer Netherlands. [https://doi.org/10.1007/978-94-024-0965-9\\_4](https://doi.org/10.1007/978-94-024-0965-9_4).
- Graf, W. D., S. K. Nagel, L. G. Epstein, G. Miller, R. Nass, and D. Larriviere. 2013. 'Pediatric Neuroenhancement: Ethical, Legal, Social, and Neurodevelopmental Implications'. *Neurology* 80 (13): 1251–60. <https://doi.org/10.1212/WNL.0b013e318289703b>.
- Hackman, Daniel A., and Martha J. Farah. 2009. 'Socioeconomic Status and the Developing Brain'. *Trends in Cognitive Sciences* 13 (2): 65–73. <https://doi.org/10.1016/j.tics.2008.11.003>.
- Harris, John. 2011. 'MORAL ENHANCEMENT AND FREEDOM'. *Bioethics* 25 (2): 102–11. <https://doi.org/10.1111/j.1467-8519.2010.01854.x>.
- Hildt, Elisabeth. 2013. 'Cognitive Enhancement – A Critical Look at the Recent Debate'. In *Cognitive Enhancement*, edited by Elisabeth Hildt and Andreas G. Franke, 1:1–14. Trends in Augmentation of Human Performance. Dordrecht: Springer Netherlands. [https://doi.org/10.1007/978-94-007-6253-4\\_1](https://doi.org/10.1007/978-94-007-6253-4_1).
- Jotterand, Fabrice. 2018. 'Childhood Brain Development, the Educational Achievement Gap, and Cognitive Enhancement'. *Frontiers in Pharmacology* 9 (October): 1142. <https://doi.org/10.3389/fphar.2018.01142>.
- Kaminski, June. 2011. 'Diffusion of Innovation Theory'. *Canadian Journal of Nursing Informatics* 6 (2).
- Keshavan, Matcheri S., Sophia Vinogradov, Judith Rumsey, Joel Sherrill, and Ann Wagner. 2014. 'Cognitive Training in Mental Disorders: Update and Future Directions'. *American Journal of Psychiatry* 171 (5): 510–22. <https://doi.org/10.1176/appi.ajp.2013.13081075>.
- Lewis, Philip M., Richard H. Thomson, Jeffrey V. Rosenfeld, and Paul B. Fitzgerald. 2016. 'Brain Neuromodulation Techniques: A Review'. *The Neuroscientist* 22 (4): 406–21. <https://doi.org/10.1177/1073858416646707>.
- Lu, Chunling, Maureen M Black, and Linda M Richter. 2016. 'Risk of Poor Development in Young Children in Low-Income and Middle-Income Countries: An Estimation and Analysis at the Global, Regional, and Country Level'. *The Lancet Global Health* 4 (12): e916–22. [https://doi.org/10.1016/S2214-109X\(16\)30266-2](https://doi.org/10.1016/S2214-109X(16)30266-2).
- McCoy, Dana Charles, Evan D. Peet, Majid Ezzati, Goodarz Danaei, Maureen M. Black, Christopher R. Sudfeld, Wafaie Fawzi, and Günther Fink. 2016. 'Early Childhood Developmental Status in Low- and Middle-Income Countries: National, Regional, and

- Global Prevalence Estimates Using Predictive Modeling'. Edited by James K. Tumwine. *PLOS Medicine* 13 (6): e1002034. <https://doi.org/10.1371/journal.pmed.1002034>.
- Mishra, R.C. 2001. 'Cognition across Cultures'. In *The Handbook of Culture and Psychology*, 119–35. New York: Oxford University Press.
- Noble, Kimberly G., Bruce D. McCandliss, and Martha J. Farah. 2007. 'Socioeconomic Gradients Predict Individual Differences in Neurocognitive Abilities'. *Developmental Science* 10 (4): 464–80. <https://doi.org/10.1111/j.1467-7687.2007.00600.x>.
- Noble, Kimberly G., Michael E. Wolmetz, Lisa G. Ochs, Martha J. Farah, and Bruce D. McCandliss. 2006. 'Brain?Behavior Relationships in Reading Acquisition Are Modulated by Socioeconomic Factors'. *Developmental Science* 9 (6). <https://doi.org/10.1111/j.1467-7687.2006.00542.x>.
- Ray, Keisha Shantel. 2016. 'Not Just "Study Drugs" for the Rich: Stimulants as Moral Tools for Creating Opportunities for Socially Disadvantaged Students'. *The American Journal of Bioethics* 16 (6): 29–38. <https://doi.org/10.1080/15265161.2016.1170231>.
- Rommelfanger, Karen S., Sung-Jin Jeong, Arisa Ema, Tamami Fukushi, Kiyoto Kasai, Khara M. Ramos, Arleen Salles, et al. 2018. 'Neuroethics Questions to Guide Ethical Research in the International Brain Initiatives'. *Neuron* 100 (1): 19–36. <https://doi.org/10.1016/j.neuron.2018.09.021>.
- Sahakian, Barbara J., Annette B. Bruhl, Jennifer Cook, Clare Killikelly, George Savulich, Thomas Piercy, Sepehr Hafizi, et al. 2015. 'The Impact of Neuroscience on Society: Cognitive Enhancement in Neuropsychiatric Disorders and in Healthy People'. *Philosophical Transactions of the Royal Society B: Biological Sciences* 370 (1677): 20140214. <https://doi.org/10.1098/rstb.2014.0214>.
- Schelle, Kimberly J., Nadira FaulmÄ¼ller, Lucius Caviola, and Miles Hewstone. 2014. 'Attitudes toward Pharmacological Cognitive Enhancementâ€”a Review'. *Frontiers in Systems Neuroscience* 8 (April). <https://doi.org/10.3389/fnsys.2014.00053>.
- Schimmack, Ulrich, Shigehiro Oishi, and Ed Diener. 2005. 'Individualism: A Valid and Important Dimension of Cultural Differences Between Nations'. *Personality and Social Psychology Review* 9 (1): 17–31. [https://doi.org/10.1207/s15327957pspr0901\\_2](https://doi.org/10.1207/s15327957pspr0901_2).
- Schwartz, Shalom H. 1990. 'Individualism-Collectivism: Critique and Proposed Refinements'. *Journal of Cross-Cultural Psychology* 21 (2): 139–57. <https://doi.org/10.1177/0022022190212001>.
- Sedlmeier, Peter, and Kunchapudi Srinivas. 2016. 'How Do Theories of Cognition and Consciousness in Ancient Indian Thought Systems Relate to Current Western Theorizing and Research?' *Frontiers in Psychology* 7 (March). <https://doi.org/10.3389/fpsyg.2016.00343>.
- Singh, Ilina, and Kelly J. Kelleher. 2010. 'Neuroenhancement in Young People: Proposal for Research, Policy, and Clinical Management'. *AJOB Neuroscience* 1 (1): 3–16. <https://doi.org/10.1080/21507740903508591>.
- Sinha, Durganand, and Henry Kao. 1988. *Social Values and Development: Asian Perspectives*. Sage Publications, Inc.
- Tomažič, Tina, and Anita Kovačič Čelofiga. 2019. 'Ethical Aspects of the Abuse of Pharmaceutical Enhancements by Healthy People in the Context of Improving Cognitive Functions'. *Philosophy, Ethics, and Humanities in Medicine* 14 (1): 7. <https://doi.org/10.1186/s13010-019-0076-5>.

Verster, Gerrit Christiaan, and Anton Albert Van Niekerk. 2012. 'Moral Perspectives on Stimulant Use by Healthy Students'. *South African Medical Journal* 102 (12): 909. <https://doi.org/10.7196/SAMJ.6090>.

Wilens, Timothy E., and Tamar Arit Kaminski. 2019. 'Prescription Stimulants'. *Pediatric Clinics of North America* 66 (6): 1109–20. <https://doi.org/10.1016/j.pcl.2019.08.006>.