



CHANGING
BRAINS

Conversation Lab: Brain Enhancement



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GENERAL DESCRIPTION

Type of program

Forum

Overview

This discussion-based activity encourages participants to consider the ethics of brain enhancement, for example by using electrical devices to boost our brain function. Participants will learn about current brain enhancement technologies from a local subject matter expert and then work in small groups to reflect on how their values might influence both their individual decisions as well as future implications for our society.

Audience

This program works best for participants ages 13 and up. Inviting participation by scientists can help promote dialogue and mutual learning among scientists and community members.

Big ideas

- People's values determine which technologies are developed and used.
- New technologies change society, sometimes in unexpected ways.
- Scientists, engineers, and designers use their creativity to invent things and imagine the future—just like you do.
- Brain research benefits from many perspectives—including yours.

Learning objectives

Through participating in this program, learners will:

- Increase their awareness about ethical issues or research related to brain enhancement.
- Practice skills in collaboration and communication through working with others and sharing their perspectives.
- Practice creativity through imagining possible futures of brain enhancement technologies.
- Practice reflexivity and strengthen their self-efficacy in discussing topics and values related to the ethics of brain enhancement.

BACKGROUND INFORMATION

Neuroethics Engagement

As neuroscience research advances, the need for public dialogue about the social, ethical, and regulatory issues is increasingly recognized. New discoveries about the brain and nervous system yield insights with cultural and philosophical implications for our perceptions of identity, consciousness, and decision making. Emerging neurotechnologies, meanwhile, open doors to modulation and modification of the brain, raising moral and legal questions of agency, responsibility, and equity. To promote greater representation and collaborative exchange of perspectives in neuroscience, the concept of *neuroethics engagement* has been proposed to combine the systematic approaches of ethical inquiry with best practices of public engagement to strengthen multi-directional, cross-disciplinary dialogue and mutual learning ([Das et al., 2022](#)). Neuroethics engagement activities such as this program are designed to consider not only science content and ethical questions but also to cultivate personal attributes (reflexivity, creativity, and cultural curiosity) and interpersonal skills (communication, collaboration, and empathy).

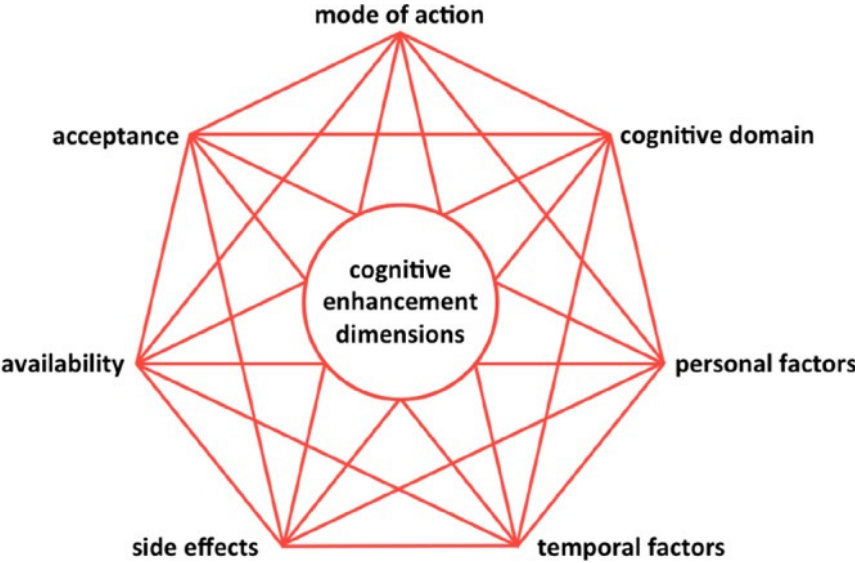
Cognitive Enhancement

Cognitive enhancement refers to the use of interventions or techniques to improve cognitive function, such as memory, attention, perception, problem-solving, and decision-making. Cognitive enhancement can take many forms of intervention (Figure 1; [Dresler et al., 2019](#)): *biochemical* (including nutrition as well as stimulants, nootropics, or other pharmaceuticals), *behavioral* (e.g., cognitive training programs, physical exercise, meditation, and other techniques), and *physical* (technologies that directly modulate brain function). These different types of intervention vary widely not only in their modes of action but also in their functionality, timescale of efficacy, availability and social acceptance.

While many of these interventions have been tested for clinical applications, the goal of cognitive enhancement is to improve cognitive abilities in healthy people, leading to better performance in daily activities, academic or professional work, and other areas of life. For example, cognitive enhancement may be used by individuals looking to improve their memory for studying, by athletes to enhance their focus and reaction time, or by professionals looking to boost their productivity and creativity.

A number of ethical questions have been raised regarding cognitive enhancement and its potential unintended consequences. First, many techniques are still experimental and their long-term effects on the brain and body are not fully understood. Some products are unregulated but commercially available, leading to marketing claims without sufficient evidence of their effectiveness. Second, there are social questions of fairness, access, and coercion. Cognitive enhancement may create an unfair advantage for individuals who have access to and can afford these interventions, leading to increased inequality. At the same time there is a concern that cognitive enhancement may become a social norm, leading to pressure for individuals to use these interventions to keep up with peers or meet societal expectations. Finally, there are questions as to whether cognitive enhancement can undermine the value of natural human abilities, skills, and accomplishments. How might these interventions influence ideas of authenticity and identity? Advocates for the responsible use of cognitive enhancement propose that

individually-tailored, evidence-based approaches have the potential to decrease inequities by leveling the playing field, compensate for normal cognitive decline with aging, and lead to potential social benefits at a population scale (Colzato, 2018).



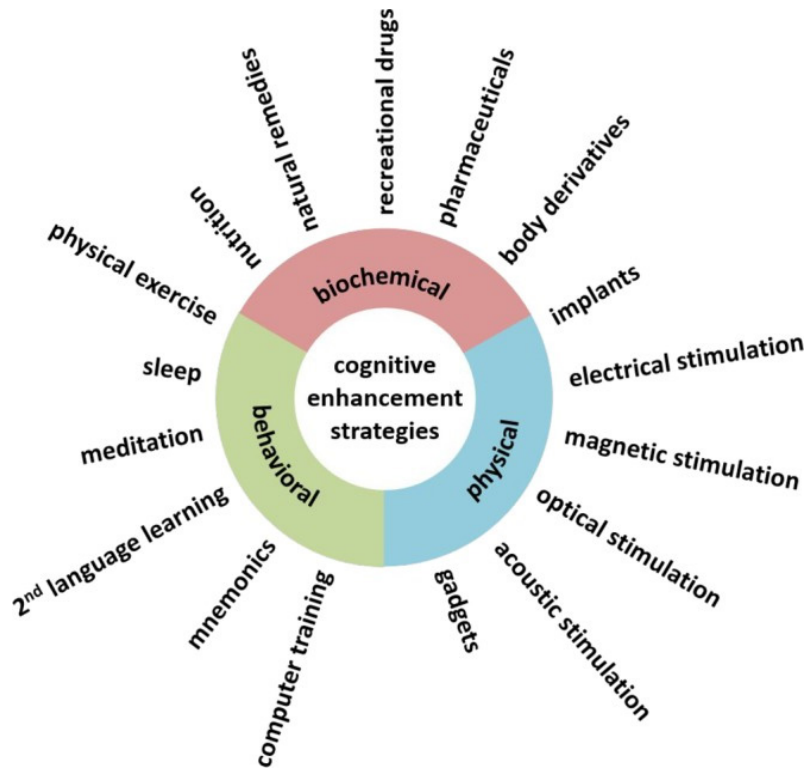


Figure 1. Cognitive enhancement encompasses multiple dimensions of functional, temporal and social effects (top) that can be influenced through multiple interventional strategies (bottom). Adapted from [Dresler et al., 2019](#).

Brain Stimulation Technologies

Brain stimulation technologies are a class of neurotechnologies that use electrical or magnetic fields to modulate the electrical activity of neurons in specific areas of the brain. There are several types of brain stimulation technologies, including:

1. Transcranial magnetic stimulation (TMS): TMS uses a magnetic coil placed on the scalp to generate a magnetic field that induces electrical currents in specific areas of the brain. TMS can either excite or inhibit neural activity depending on the frequency and intensity of the magnetic field.
2. Transcranial direct current stimulation (tDCS): tDCS uses two electrodes placed on the scalp to deliver a low electrical current to specific areas of the brain. tDCS can either increase or decrease neural activity depending on the polarity of the electrodes.
3. Deep brain stimulation (DBS): DBS involves surgically implanting electrodes into specific areas of the brain to deliver electrical stimulation. DBS is typically used to treat neurological conditions such as Parkinson's disease, epilepsy, and obsessive-compulsive disorder.

Of these, tDCS has the most potential for use for cognitive enhancement, as it is generally medically safe, portable, commercially available and relatively inexpensive, and easy to use. Studies suggest that tDCS may be able to stimulate creativity ([Weinberger et al., 2017](#)), moderate aggressive thoughts ([Choy et al., 2018](#)), and improve language processing ([Hussey et al., 2015](#)), among other cognitive functions.

References

Choy O, Raine A, Hamilton RH. (2018) Stimulation of the Prefrontal Cortex Reduces Intentions to Commit Aggression: A Randomized, Double-Blind, Placebo-Controlled, Stratified, Parallel-Group Trial. *J Neurosci.* 38(29):6505-6512. <https://doi.org/10.1523/JNEUROSCI.3317-17.2018>

Colzato LS. (2018) Responsible Cognitive Enhancement: Neuroethical Considerations. *J Cogn Enhanc* 2, 331–334. <https://doi.org/10.1007/s41465-018-0090-3>

Das J, Forlini C, Porcello DM, Rommelfanger KS, Salles A., and Global Neuroethics Summit Delegates. (2022) Neuroscience is ready for neuroethics engagement. *Front. Commun.*, vol. 7. <https://doi.org/10.3389/fcomm.2022.909964>

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Hussey EK, Ward N, Christianson K, Kramer AF (2015) Language and Memory Improvements following tDCS of Left Lateral Prefrontal Cortex. *PLoS ONE* 10(11): e0141417. <https://doi.org/10.1371/journal.pone.0141417>

Weinberger AB, Green AE, Chrysikou EG. (2017) Using Transcranial Direct Current Stimulation to Enhance Creative Cognition: Interactions between Task, Polarity, and Stimulation Site. *Front. Hum. Neurosci.*, vol. 11. <https://doi.org/10.3389/fnhum.2017.00246>

OVERVIEW

During this program, participants work in small groups to engage with ideas that inform future uses of neurotechnologies for cognitive enhancement. They will consider how personal values and social contexts influence our decisions about neurotechnologies and the larger systems within which they work. This program guide provides instructions for an in-person discussion, but the program could feasibly be adapted to an online format.

This activity has three different components that are carried out over the course of 60-90 minutes:

- Program introduction: Participants complete an initial survey about a cognitive enhancement scenario and introduce themselves to others at their table. (10 minutes, can take place before the official start of the program)
- Brain stimulation and cognitive enhancement: The whole group listens to an introduction to the science, technology, and ethical considerations of cognitive enhancement technologies by a guest speaker or program facilitator. (15 minutes)
- Personal values and decision making: Participants reflect on their personal values about cognitive enhancement through an individual drawing activity. Then, they discuss with others at

their table to identify shared or different values and lived experiences that shape their decision making. (20-25 minutes)

- **Implementation in society:** The program facilitator leads a short whole-group activity to assess participants' agreement with potential real-world applications of brain enhancement technologies. Then, each table chooses one scenario and discusses its potential ethical considerations. (20-25 minutes)
- **Q&A:** Time permitting, the program concludes with a whole-group discussion. With multiple scientist participants, this component can encourage open dialogue beyond each table among experts and community members with a wider range of experiences and expertise. (10 minutes)

ADVANCE PREPARATION & MATERIALS

Advance preparation

Background research

Before facilitating the program, familiarize yourself with the biochemical and physical strategies for neuroscientific cognitive enhancement. Look into whether any local scientists in your community are conducting research on these technologies. Connecting your program to local research adds significance to the conversation for community participants and increases the likelihood of involving scientist participants who value the opportunity for public engagement about their work.

You can also reach out to local community representatives who may be invested in the development and future implementation of cognitive enhancement technologies. These may include people with relevant lived experience or those working in government, education, security and defense, law, public health, labor rights, and other fields. Understanding the local relevance of the program can help you tailor the context of the discussion to your community or bring together different perspectives that may influence future policy decisions.

Finding a guest speaker

As you do your background research, you may come across someone that you can invite to be a guest speaker at your program. The NISE Network's [Guide to Working with STEM Experts](#) includes resources to help you find local experts in neuroscience. You're looking for someone who can do a short introduction to the topic of cognitive enhancement and its ethical implications. Even if their work is more directed towards therapeutic applications than enhancement, experts may be interested in engaging with the community in thinking about future implications that go beyond their immediate clinical or basic research priorities. Their introduction could address issues such as: What are different strategies for cognitive enhancement? How do they modulate brain function? What types of cognitive capabilities do they enhance? What might be some potential tradeoffs and unintended consequences? What moral or ethical questions should be considered?

You'll want to meet with your potential speaker to introduce yourself and to explain the program format and audience before inviting them to speak. If possible, it's also a good idea to look for videos of their previous presentations or make time to hear them speak to determine their comfort level and ability to address the public. Once you've located your guest presenter, you will want to work together on the opening section of the program. For example, you might discuss:

- Do you want a broad overview of cognitive enhancement strategies or focus on a particular technology?
- Do you want your guest speaker to focus just on their work or include other information from their field?
- How can they best address the ethical and societal implications of cognitive enhancement?
- Are there specific questions relevant to their research they would like to ask the community?
- How much time do you want them to speak? (Around 10-15 minutes works well.)

You should offer assistance as they put together their presentation. Make sure they know that this is not a traditional lecture with Q&A, and that the purpose of the presentation is to set up participatory dialogue among audience members. Don't hesitate to ask to review their presentation ahead of time and offer suggestions. If you don't have a guest speaker to work with, that's okay! You can provide the program introduction.

Inviting additional expert participants

In addition to your guest speaker, consider inviting additional scientists or other experts working in related fields to join your event and contribute to the conversation. For example, you could involve graduate students or other colleagues in your guest speaker's lab or department (and ask your speaker to help recruit!). If feasible, aim for one scientist or expert per table of 6-8 people. These targeted invitations can allow representation of different areas of expertise beyond your guest speaker. More importantly, they facilitate small group dialogue between experts and community members in a format where everyone is on more equal footing, and can demonstrate that even experts bring a diversity of personal values, priorities, and identities. Make sure that you clearly communicate expectations for these scientists' participation in your invitation; suggested language is included in the sample invitation template below. At the event itself, direct any invited experts to specific seats to ensure they are spread out among different groups.

SAMPLE INVITATION FOR ADDITIONAL SCIENTIST PARTICIPANTS

Dear _____

I would like to invite you to join us for [event title] at [museum] on [date/time]. This event is a casual, dialogue-based opportunity for experts and public audiences to talk and learn about the societal impacts of emerging research together. We're reaching out to invite you and a guest to attend, based on your expertise in [research field].

What does the program involve? [Event title] is focused on the topic of brain stimulation for cognitive enhancement. We'll kick off the program at [start time] with a short talk, followed by a mix of interactive activities and small group discussions about the values and priorities that shape our views about brain stimulation technology and its applications.

What's my role? Your participation will enrich the experience for other attendees as an opportunity to interact with scientists who are actively working in this field. But we hope you'll find it equally enjoyable and valuable! No advance preparation is required, nor do we expect you to act as moderators or experts throughout the program. Your role is to simply participate in the activities and discussions like other guests, listening and sharing ideas and experiences while adding your scientific perspective as appropriate. We'll have an opportunity for Q&A at the end of the program and one-on-one mingling afterwards, and we will introduce you to answer any questions and talk to attendees about your research as you like.

How do I RSVP? [Add details here]

Thanks for your consideration and I hope you can join us!

Marketing

Attendance will vary depending on how extensively the program is publicized. Be sure to use language or marketing materials that your institution has found to work best with older audiences (ages 13 and up). If possible, use descriptive language or photos to help communicate that the program is a participatory discussion. Here are some ways you can get word out about your event:

- Museum website, newsletter, and member email list
- Social media (Facebook, Twitter, Instagram)
- On-site marketing, including announcements at other programs, as well as posted flyers or slides
- Local media outlets (newspapers, television, community papers)
- Craigslist (www.craigslist.org)
- Meetup groups (<http://www.meetup.com/>)
- Community calendars and email lists
- Museum partner organizations and area schools
- University partners
- Posters and flyers around the community
- Local businesses and organizations
- Local festivals or community events

Pre-registration and communication with participants

Having participants pre-register using an online survey resource will allow you to gather information such as their email address and any accommodations for people with disabilities. It is highly recommended that you send out an event reminder a few days prior to the program. There are several websites that allow you to manage a registration list. Some options are SurveyMonkey, Eventbrite, and Google Forms.

Materials

- Tables and chairs, arranged to seat 6-8 people at each table
- Table discussion ground rules (one per table) (sample available to [download](#) from nisenet.org)
- Drawing worksheets (print one per participant) (sample available to [download](#) from nisenet.org)
- Pack of markers or colored pencils for each table
- Modifiable slide presentation template (available to [download](#) from nisenet.org)
- Laptop, projector, and screen (for slides)
- About 15 minutes of calm instrumental music to play in the background during the individual drawing activity (optional)
- Mic and speakers (for presentation) (optional)
- Light refreshments (such as beverages and cookies) (optional)

Set Up

- Use the questions in the first slide of the slide presentation template to collect initial responses on brain stimulation at the start of the program. You can project the questions and have participants vote on scraps of paper, or simply let everyone respond through a show of hands. You may also choose to create a quick online intro survey and corresponding QR code using the tool of your choice.
- Organize the room so each table has a clear view of the slides.
- Place a copy of the table discussion ground rules and a set of markers or colored pencils at each table.
- Have copies of the drawing worksheets ready to hand out later.
- Make sure your audiovisual system is working - quickly run through your slideshow and queue up any music files if using.



Sample table setup with discussion ground rules, QR code to intro survey, and colored pencils. Photo: The Franklin Institute

PROGRAM DELIVERY

Time

75 minutes

Talking points and procedure

Program introduction (10 minutes)

Introduce the program and set the stage. Offer participants a final prompt to respond to the intro survey if they have not yet done so. Review the program goals and flow. Discuss emergent trends from the results of the survey to introduce the concept of brain stimulation technology and people's attitudes towards using it for enhancement. Finally, if you have a guest speaker, introduce them.

Brain stimulation and cognitive enhancement technologies (15 minutes)

Present an overview of brain stimulation and its potential use for cognitive enhancement. Refer to Slides 6-16 in the slide presentation template as a guide to a potential narrative. The sample presentation (adapted from a presentation by Dr. Roy Hamilton, director of the [Laboratory for Cognition & Neural Stimulation](#) and the [Penn Brain Science, Translation, Innovation and Modulation Center](#) at the University of Pennsylvania) covers: 1) different technologies used for brain stimulation, 2) examples of cognitive functions that have been shown to be enhanced, and 3) social and ethical questions for consideration. Invite questions from the audience if time allows.

Personal values and decision making (20 minutes)

Explain that this activity is an opportunity to consider our individual perspectives on some of the questions raised in the presentation. Pass out the drawing worksheets. Instructions are also included on Slide 17 of the slide presentation template. Ask participants to reflect on whether they would personally choose to use a brain stimulation device, what would influence their decision, and draw for 10 minutes (optional: play calm background music). Then give them 10 minutes to discuss their drawings at their tables.



Examples of individual values drawings.

Photo: The Franklin Institute

Discussion questions may include:

- What common values emerged from all group members?
- How did group members interpret other values differently?
- What experiences influenced the way different group members think about this decision?

Implementation in Society (20 minutes)

Explain that the next activity is a way to assess our *shared* views on potential applications of brain stimulation for cognitive enhancement. Introduce a hypothetical new brain stimulation headset that gives a small boost to attention. As you read aloud five different scenarios in which this headset might be used (Slides 18-22 of the slide presentation template), ask participants to stand up or raise their hand for the uses they agree with. Encourage participants to look around and note the level of agreement or disagreement in the audience for each scenario.

Then, allow each group 15 minutes to choose one of the five scenarios and consider the suggested discussion questions (Slide 23). If you have more time, allow each group to report out a summary of their discussion.

- Who would benefit from widespread implementation?
- What might be some unexpected consequences?
- What information would you want to know to decide?
- Who should be involved in the decision?

Q&A (10 minutes)

Close the program with an open invitation to participants to ask questions and share their thoughts. Re-introduce your guest speaker to guide the discussion and encourage other invited expert participants to answer questions; asking them to briefly describe their current directions of research is a good way to wrap up the event by encouraging conversation about future possibilities of brain stimulation technology.

CLEAN UP

Time

15 minutes

Steps

Collect all paper materials from the tables and recycle them. You may choose to recycle the drawings, share them with others, or display them (if a bulletin board is available, participants may enjoy perusing the display to see the range of drawings created). Collect markers or colored pencils and table signs and return to storage.

MODIFICATIONS

You can offer a shorter activity for younger guests that explores similar themes using a subset of the [Neuro Futures](#) technology cards. Pull out specific cards representing cognitive enhancement technologies, such as Smart Pills, Super Prosthetic Limbs, Brain Implant, and Bionic Eye. Give each participant a few tokens to place on the cards to indicate which technologies they would most like to

see developed. Invite them to share their thinking, asking simple questions that address issues of safety, functionality, self-identity, relationships with others, and fairness.

UNIVERSAL DESIGN

This program has been designed to be inclusive of visitors, including visitors of different ages, backgrounds, and different physical and cognitive abilities. The following features of the program’s design make it accessible:

- Repeat and reinforce main ideas and concepts
- Provide multiple entry points and multiple ways of engagement

LICENSE AND CREDITS

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The Personal Values drawing activity was adapted from “[Drawing Together](#),” one of the Liberating Structures developed by Henri Lipmanowicz and Keith McCandless for fostering trust, collaboration, and innovation.

