

BIONIC EARS: COCHLEAR IMPLANTS AND THE FUTURE OF ASSISTIVE TECHNOLOGY

ENGR110/210, Perspectives in Assistive Technology

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A Story....



The cochlear implant can disrupt our notions of what functions or purposes assistive technology should serve.



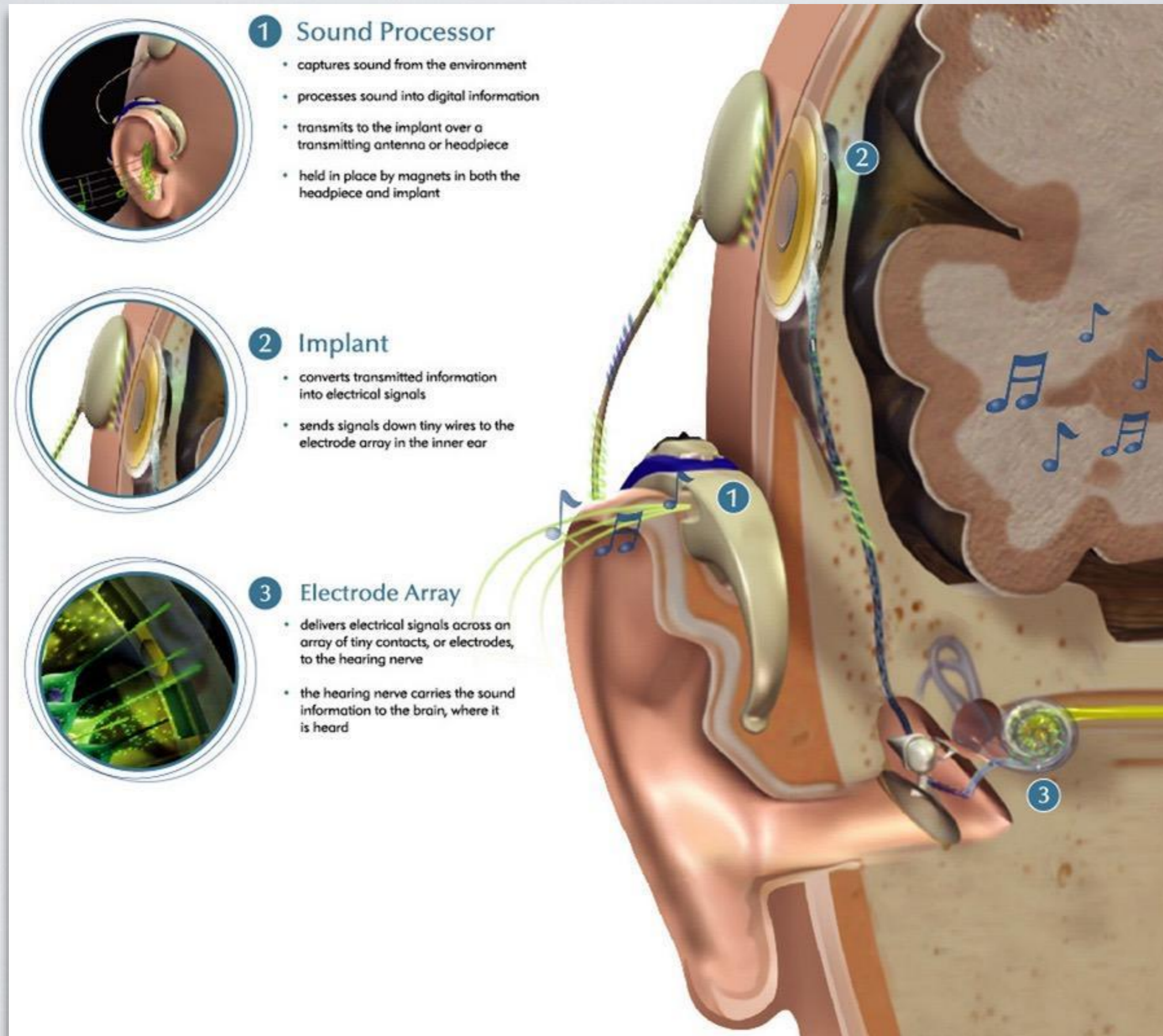
OVERVIEW

1. Brief History of Cochlear Implants
2. “Bionic Rhetoric”
 - Normalization vs. Enhancement
3. Bionic Rhetoric in Cultural Discourse
4. Conclusions and Discussion



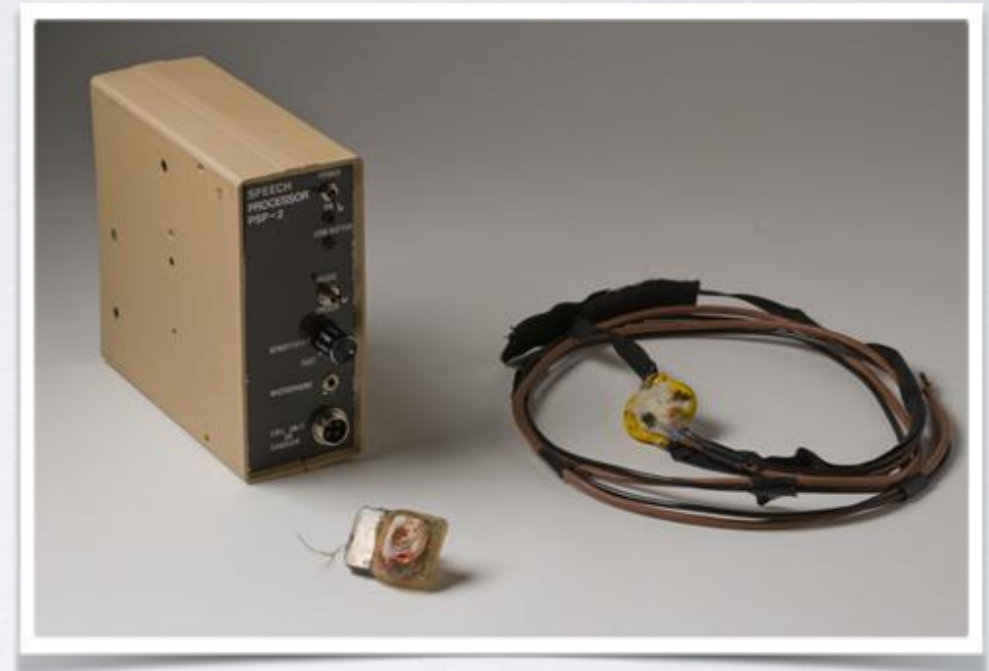
Visualization of a cochlear implant with an electrode array

HOW DOES A COCHLEAR IMPLANT WORK?



COCHLEAR IMPLANTS: A BRIEF HISTORY

- 1925: The “modern” period of electrical hearing begins
- 1952: First electronic hearing aids developed (amplification device)
- 1957: “Monsieur G.” is implanted with an electronic coil in Paris
- 1972: Charles Graser receives first single-channel take home implant from Dr. William House
- 1982: First modern cochlear implants go on the market in Australia (2 years later, G. Clark introduces the multi-channel Nucleus 22 implant)
- 1984: FDA approves the 3M single channel cochlear implant for American adults
- 2004: 82,000 worldwide are implanted with the device
- 2007: Bilateral cochlear implantation begins to gain acceptance (approx. 8,000 BCI users)
- 2012: Approximately 324,200 people worldwide have received CIs; in the U.S., roughly 58,000 adults and 38,000 children have been implanted



The original prototype multi-channel cochlear implant



Nucleus 22 multi-channel device

COCHLEAR IMPLANTS: A BRIEF HISTORY

- **From single channel to multiple channels:**
 - The first cochlear implant supplied a single channel, i.e. frequency (1972).
 - Today, cochlear implants typically supply up to 24 channels.
 - By comparison, hair cells in the cochlea provide thousands of channels.
- Demo:
<https://www.youtube.com/watch?v=SpKKYBkJ9Hw>



Nucleus 6 System (2014-present)

Nucleus 7 (2017?-present)

BIONIC RHETORIC

- Historian of Science Mara Mills traces two etymologies for “Bionic”:

(1) The Maico Company advertised the “Bi-Onic” electrical hearing aid system in 1946.

- “onic” replaced “otic,” to signify “of the ear.” The device was advertised as an auditory prosthesis that mimicked natural hearing.

- **Normalization**

(2) coined by Air Force flight surgeon Jack Steel in 1958 to describe the engineering of biological systems based on mechanical principles. Bionics were deployed as a means of designing artificial systems that improve upon biological systems.

- **Enhancement**

As this etymology of bionic suggests, the word inscribes the tension between *enhancement* and *normalization*.

THE BIONIC RHETORICS OF COCHLEAR IMPLANTS

- **Deaf culture:**
 - Cochlear implants as promoting “Deaficide”—correlated to “language death” of ASL and cultural genocide since 1990s.
 - The documentary film *Sound and Fury* (2000) captures this counterrhetoric, highlighting Deaf culture’s discomfort with CIs as it (1) treats deafness as a disability, and (2) undercuts the centrality and value of silence in Deaf culture
- **Bioethicists:**
 - Raise questions about the value of neuroenhancement and artificial prostheses more broadly.
 - Bioethicists consider how the CI—as a biomedical/assistive technology—might perpetuate “eugenicist” attempts to promote oralism through the medical eradication of deafness

THE BIONIC RHETORICS OF COCHLEAR IMPLANTS

Deaf Futurists:

- deafened individuals (distinct from the Deaf) harness technology to solve communication problems at large.
- prototype for brain implants, “downloadable intelligence,” and most recently, direct computer-to-brain interfaces
- Deaf futurists claim that electroacoustic aids bring new sounds and kinds of listening into the world that transcend human ability/biology (Michael Chorost).



CHOROST'S "BIONIC QUEST"

Sound Technologies

- Bolero: Orchestral sound recording on LP & CD
 - “[Bolero] became my touchstone. Every time I tried out a new hearing aid, I’d check to see if Bolero sounded OK. If it didn’t, the hearing aid went back.”
- Cochlear Implant
 - “In many ways, my hearing was better than it had ever been. Except when I listened to music. I could hear the drums of Bolero just fine. But the other instruments were flat and dull. The flutes and soprano saxophones sounded as though someone had clapped pillows over them. The oboes and violins had become groans. It was like walking color-blind through a Paul Klee exhibit. I played Bolero again and again, hoping that practice would bring it, too, back to life. It didn’t.”

CHOROST'S “BIONIC QUEST”

“Hacking” the Cochlear Implant: Improving User Experience

- Advanced Bionics: virtual channels (software that makes CI hardware act like there are actually 121 electrodes)
- “My god, the oboes d’amore do sound richer and warmer. I let out a long slow breath, coasting down a river of sound, waiting for the soprano saxophones and the piccolos. They’ll come in around six minutes into the piece—and it’s only then that I’ll know if I’ve truly got it back. As it turns out, I couldn’t have chosen a better piece of music for testing new implant software....over and over the theme repeats, allowing me to listen for specific details in each cycle.”
- What is the trade-off?

My hearing is no longer limited by the physical circumstances of my body. While my friends' ears will inevitably decline with age, mine will only get better.”

—Michael Chorost

DECONSTRUCTING THE ROLE OF ASSISTIVE TECHNOLOGY

Cochlear implant as speech processing machine (Mills)

- Early investigators of the cochlear implant focused on speech processing.
- “Engineers don’t program below 250 hertz because it picks up low-pitched sounds (air conditioners, engines) and interferes with speech perception.”
- “CI signal processors embody a range of cultural and economic values, some of which are deliberately “scripted” into design, others of which accrete inadvertently. **These scripts include the privileging of speech over music, direct speech over telecommunication, non tonal languages over tonal ones, quiet ‘listening situations’ over noisy environments, and black-boxed over user-customizable technology”** (Mills 323).

Cochlear implant as music machine (Chorost)

- “After I get over the initial awe of hearing music again, I discover that it’s harder for me to understand ordinary speech than it was before I went to virtual channels.”

DECONSTRUCTING THE ROLE OF ASSISTIVE TECHNOLOGY

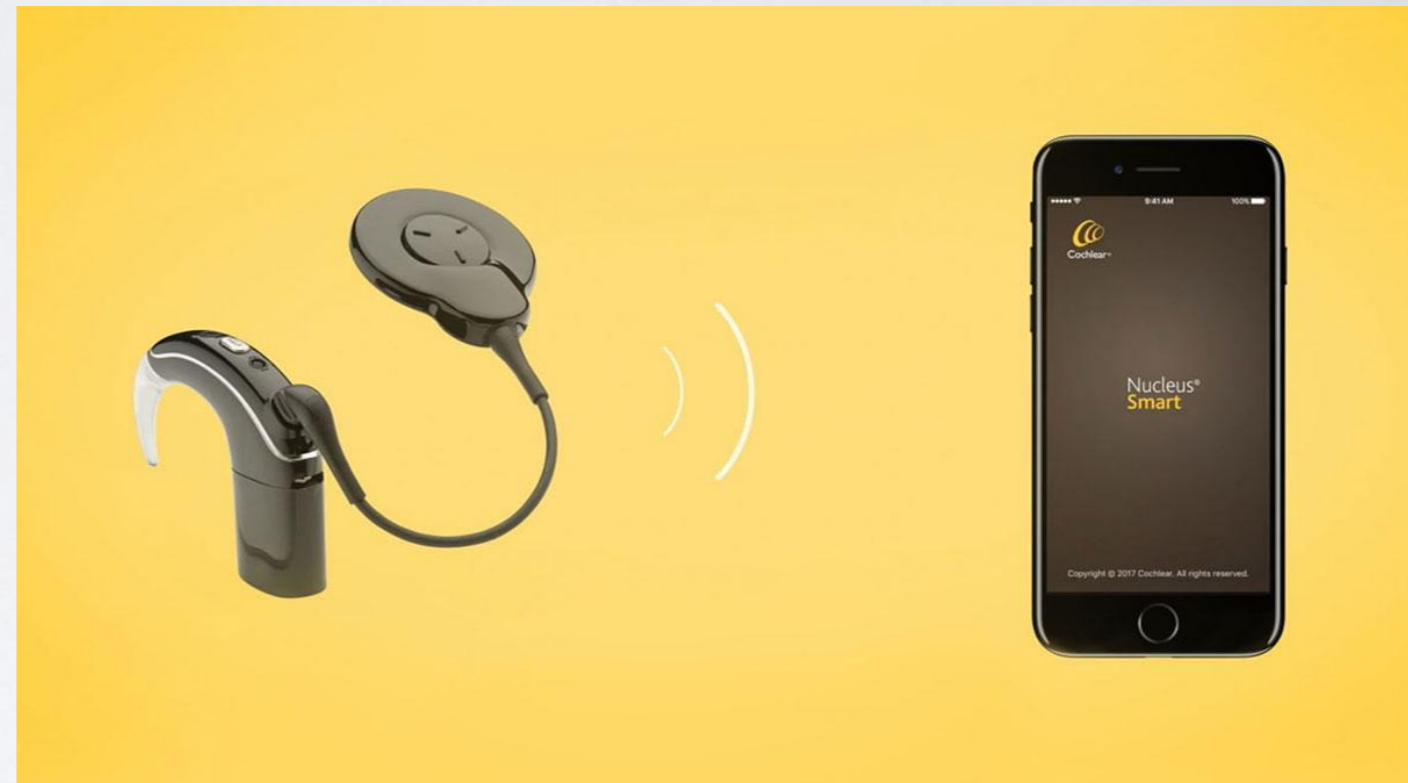
Cochlear implant as media device

- Today, there is virtually no trade-off between music and speech.

Most cochlear implants can support up to 3-4 programs, which means that users can have a designated program for music, and a designated program for speech (and in different environments: noisy, quiet, and dynamic listening situations with the ability to control microphone sensitivity).

- Customizable (within certain parameters): most systems come with a *remote control* or smartphone control.

- Can link to other media devices (TV, mobile phones, iPods, etc.); bluetooth capability.



HACKING ASSISTIVE TECHNOLOGY

- **Cochlear implants introduce a new mode of auditory perception:**

Portable music players or smartphones can be directly linked to the cochlear implant via bluetooth, which means that users listen to music that never takes the shape of a sound wave; music never actually *exists as sound*.

Thank you!

Questions?